

**An investigation of learning and emerging knowledge in the Mpophomeni
Sanitation Education Project, Howick, KwaZulu-Natal**

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Abstract

This study took place within the broader context of water resources management in South Africa. With the democratisation of water stewardship through an enabling international and South African water policy landscape, an opportunity opened up for citizens to participate in the effective management of their own water resources. In this context, a community-engaged citizen science project known as the Mpophomeni Sanitation Education Project emerged to demonstrate how a diverse range of knowledge agents can work and learn together to better manage their water resources and address problems of sewage pollution threatening their provincial water source.

The following study aimed to shed light on the learning and emerging knowledge in the MSEP. The study was conducted in three phases. Wenger's Communities of Practice (CoP) theory provided a lens to look at Phase One, which aimed to answer the following sub-question: Is the MSEP a CoP? Wenger's CoP theory also assisted with the investigation during Phase Two, which looked at the following question: What is the nature of learning in the MSEP? Social realist theories of knowledge and education, and Tàbara and Chabay with their Ideal Type (IT) worldviews, provided suitable lenses for Phase Three's investigation of the following question: What is the nature of emerging knowledge in the MSEP?

The main finding for Phase One is that the MSEP does function as a CoP. With its strong focus on relationships, it's clearly defined joint enterprise of solving the problem of sewage pollution, individual and joint commitment to engage with the problem and the sharing of a repertoire of tools, ideas and practices it is cultivating a culture conducive to purposeful learning. Regarding the exploration of the nature of learning in Phase Two, findings confirming the engagement of identity with learning and the importance of context for meaning-making emerged. Finally, study findings about the nature of knowledge in the MSEP found that the knowledge practices in the MSEP that are both social and epistemic in nature are produced by a diverse range of knowledge agents in an open knowledge space.

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Contents

An investigation of learning and emerging knowledge in the Mpophomeni Sanitation Education Project, Howick, KwaZulu-Natal	i
Abstract.....	ii
Acknowledgements	iii
LIST OF TABLES AND FIGURES	viii
LIST OF APPENDICES.....	x
LIST OF ACRONYMS	xii
Chapter 1 The Study Context	1
1.1 Introduction	1
1.2 The Mpophomeni Sanitation Education Project.....	2
1.3 History of Mpophomeni Township: The seeds for an active citizenry are sown	3
1.4 Contextual background	4
1.5 The response to the social-ecological problem.....	6
1.5.1 A description of the components of the MSEP.....	7
1.5.1.1 Enviro Champs.....	7
1.5.1.2 Mpophomeni Youth Productions	8
1.5.1.3 WESSA EcoSchools Environmental Clubs	8
1.6 Research opportunity	10
1.7 Overview of the study.....	11
Chapter 2 Contextual and Conceptual Aspects	12
2.1 Introduction.....	12
2.2 Water resources in the South African context	12
2.3 Water Resource Management in South Africa	14
2.3.1 Global initiatives for integration and participation in the domain of water.....	14
2.3.2 The South African water policy landscape.....	15
2.3.3 Major players.....	16
2.4 Social learning as an important tool for water resources management	17
2.5 Citizen science and social learning.....	20
2.5.1 Characteristics of social learning congruent with citizen science.....	20
2.5.2 Alignment between citizen science and social learning	22
2.6 Conclusion	23
Chapter 3 A Review of Theories about Learning and Knowledge	24
3.1 Introduction.....	24

3.2 Communities of Practice	25
3.2.1 Elements of a CoP.....	25
3.2.2 Learning in a CoP	27
3.2.2.1 Community: Learning as Belonging	27
3.2.2.2 Identity: Learning as Becoming	28
3.2.2.3 Practice: Learning as Doing.....	28
3.2.2.4 Meaning: Learning as Experience.....	28
3.3 Contributions towards an understanding of learning	29
3.4 Honing in on knowledge	32
3.4.1 Upsetting Des[apple]cartes.....	32
3.4.2 Reforming the epistemic default	35
3.5 Knowledge for Sustainability	36
3.5.1 Human Information and Knowledge Systems coupled with social-ecological systems.	37
3.6 Conclusion	42
Chapter 4 Research Methodology	43
4.1 Introduction.....	43
4.2 Research Methodology	43
4.2.1 Ontological foundation and guiding research paradigm	43
4.2.2 Research design in the critical realist metatheoretical context	45
4.2.3 Case study	46
4.3 Data Generation.....	47
4.3.1 Interviews	48
4.3.2 Document analysis	49
4.3.3 Participant observation.....	49
4.3.4 Focus Group	50
4.4 Data Management.....	50
4.5 Data Analysis	53
4.5.1 Phase 1: Analysis of MSEP as a CoP.....	55
4.5.2 Phase 2: Analysis of learning in the MSEP.....	56
4.5.3 Phase 3: Analysis of knowledge in the MSEP.....	57
4.6 Realist criteria for validity and reliability	59
4.6.1 Ontological appropriateness	60
4.6.2 Contingent validity.....	60
4.6.3 Multiple perceptions of a single reality	60

4.6.4 Methodological trustworthiness.....	60
4.6.5 Analytic generalisation.....	61
4.6.6 Construct validity.....	61
4.7 Ethical aspects of the study	61
4.8 Being an insider-researcher	63
4.9 Conclusion	64
Chapter 5 A presentation of the data.....	65
5.1 Introduction.....	65
5.2 An overview of MSEP activities	65
5.2.1 Enviro Champs	65
5.2.2 Mpophomeni Youth Productions.....	67
5.2.3 WESSA EcoSchools Environmental Clubs.....	68
5.2.3.1 Documentary film about water pollution in Mpophomeni	69
5.2.3.2 Iceberg Conversations	70
5.2.3.3 Youth Environmental Science Conference.....	72
5.3 Findings about the MSEP as a CoP	73
5.3.1 The joint enterprise of teaching in the MSEP.....	74
5.3.2 Mutual recognition within the MSEP between participants of the value of their contributions.	75
5.3.3 Valuing people, community and cooperation	76
5.3.4 Perceptions of positive impact.....	77
5.4 Findings about learning in the MSEP CoP.....	78
5.4.1 Validation in the community	79
5.4.2 Becoming a teacher in the process of learning	79
5.4.3 Self-esteem is positively impacted through involvement in the MSEP	80
5.4.4 MSEP participants are making meaningful connections through learning.....	81
5.4.5 Learning in the MSEP results in people being willing to ‘go the extra mile’	84
5.5 Findings about the nature of emerging knowledge in the MSEP	85
5.5.1 Representation, Knowledge arena and knowledge agents.....	85
5.5.2 Context	93
5.5.2.1 “INGUBO YAMASELE”	93
5.5.2.2.1 MiniSASS as context-specific scientific knowledge.....	95
5.5.2.2.2 Manhole ‘names’	95
5.5.3 Complexity	96

5.5.4 Knowledge associated with values and ethics	98
5.7 Conclusion	99
Chapter 6 Findings and Recommendations	101
6.1 Introduction.....	101
6.2 Findings about the MSEP as a CoP	101
6.2.1 Analytical statement 1: The MSEP reflects the relational focus associated with CoP and effective social learning processes	102
6.3 Findings about learning in the MSEP	102
6.3.1 Analytical statement 2: MSEP participants demonstrate an engagement of their identity in the learning process.....	102
6.3.2 Analytical statement 3: The MSEP CoP demonstrates purposeful learning processes	103
6.4 Findings about emerging knowledge in the MSEP	103
6.4.1 Analytical statement 4: The knowledge practices in the MSEP generate embodied knowledge	103
6.4.2 Analytical statement 5: In the MSEP multiple knowledge configurations are produced by a diverse range of agents in an open knowledge system	105
6.4.3 Analytical statement 6: The citizen science tool miniSASS used in the MSEP is an example of a tool that produces concrete universal knowledge	106
6.4.4 The MSEP demonstrates the value of intuitive knowledge.....	106
6.5 Recommendations	107
6.6 A review of the research	108
6.7 Conclusion	109
References	110

LIST OF TABLES AND FIGURES

TABLE NO	DESCRIPTION	PAGE
Table 1	Inventory of data sources	54
Table 2	The research phases and analytical categories	60
Table 3	Examples of named manholes with GPS coordinates	66

FIGURE NO	DESCRIPTION	PAGE
Figure 1	Aerial photo of Mpophomeni Township	2
Figure 2	The components of the MSEP	3
Figure 3	A photo collage of the problem of sewage pollution in Mpophomeni	5
Figure 4	Map of pollution levels in the Upper-uMngeni catchment	6
Figure 5	MiniSASS facilitator and learner examining a sample of aquatic invertebrates from the <i>uMngeni</i> river	10
Figure 6	Meaning as an emergent property of the interaction of two learning sub-systems	18
Figure 7	The dimensions of practice as the property of a community	27
Figure 8	The four elements of learning	27
Figure 9	A critical realist concept diagram	32
Figure 10	A diagram of dichotomies that make up our “subcutaneous epistemic layer”	34
Figure 11	The two IT knowledge systems	41
Figure 12	An example of the analytical memorandum for Phase 1	56
Figure 13	An example of the analytical memorandum for Phase 2	57
Figure 14	An example of the analytical tool for Phase 3	59
Figure 15	A diagram of the study design	64

FIGURE NO	DESCRIPTION	PAGE
Figure 16	Collated results of monitoring over 3 years	67
Figure 17	An actor from the MYP acting out “The Toilet Play”	68
Figure 18	Screenshots from the documentary film about sewage pollution	70
Figure 19	Diagram of the Iceberg Conversation as a way of explaining reality	71
Figure 20	A scientist from UKZN providing feedback about the poster submissions at the Youth Environmental Science Conference	73
Figure 21	Poster about water quality in the uMthinzima stream	90
Figure 22	Poster about illegal dumping and pollution in Mpophomeni	91
Figure 23	Snapshot of the map of monitored manholes	92
Figure 24	Example of contextualised, reconfigured knowledge	95

LIST OF APPENDICES

Appendix	Description	Page
Appendix 1	Enviro Champs monitoring form	119
Appendix 2	MiniSASS water quality monitoring tool	121
Appendix 3	Examples of transcribed interviews from Round 1 and Round 2	123
Appendix 4	Example of a transcribed miniSASS fieldwork observation	135
Appendix 5	Focus group itinerary	141
Appendix 6	Focus group summary and transcript	143
Appendix 7	Introduction letter from Rhodes University	154
Appendix 8	Consent form and email document with permission to use photograph	155
Appendix 9	Map of manholes designated to one Enviro Champ	159
Appendix 10	Written transcript of documentary film made by <i>The Earth Guardians</i> Enviro Club	160
Appendix 11	<i>The Pop Cyd Enviro Friendly Group</i> enviro club drama script	161
Appendix 12	Analytical memorandum for Phase 1, sub-question 1 – AM1	169
Appendix 13	Analytical memorandum for Phase 2, sub-question 2 – AM2	178

Appendix	Description	Page
Appendix 14	Analytical memorandum for Phase 3, sub-question 3 – AM3	199

LIST OF ACRONYMS

CMA	Catchment Management Agencies
CoP	Communities of Practice
CR	Critical Realism
CS	Citizen Science
DBSA	Development Bank of South Africa
DUCT	Duzi Umngeni Conservation Trust
EC	Enviro Champ
HIKS	Human Information and Knowledge Systems
IT	Ideal Type
IWRM	Integrated Water Resources Management
MSEP	Mpophomeni Sanitation Education Project
MWP	Mondi Wetlands Project
MYP	Mpophomeni Youth Productions
NRM	Natural Resource Management
NWA	National Water Act
SES	Social Ecological Systems
SR	Social Realism
UMDM	uMgungundlovu District Municipality
UNCED	United Nations Conference on Environment and Development
WESSA	Wildlife and Environment Society of South Africa
WMA	Water Management Areas
WRM	Water Resources Management
WUA	Water User Associations
WWF	World Wildlife Fund for Nature

Chapter 1 The Study Context

1.1 Introduction

The following research case study is situated in the Mpophomeni Township in the KwaZulu-Natal Midlands of South Africa. The study focuses on the Mpophomeni Sanitation Education Project (MSEP), a community-engaged citizen science (CS) project initiated by the Duzi uMngeni Conservation Trust (DUCT), a non-governmental organisation based in Pietermaritzburg and the nearby town of Howick, in the KwaZulu-Natal province of South Africa. As the name indicates, DUCT is concerned with the conservation of the uMsunduze river, with a catchment size of 875 km² and a tributary length of 115 km, and the uMngeni river, with a catchment size of 441 km² and a tributary length of 225 km (Health Programme, n.d.). With a mean annual rainfall of between 410 and 1450 mm, the uMngeni catchment is the main supplier of drinking water for the KwaZulu-Natal Midlands, including the cities of Pietermaritzburg and Durban, and is heavily dammed with five major dams – Midmar, Albert Falls, Nagle, Henley and Inanda together storing 753 million cubic metres of water (River Health Programme, n.d.).

In 2006, the rapid deterioration of the health of both rivers and concern about the resulting contamination of the main water supply for the region prompted the establishment of DUCT. In order to accomplish their vision of “an ecologically healthy and biologically diverse uMngeni-uMsunduzi river system that provides sustained ecological goods and services for the communities that depend on them for their survival” (DUCT, homepage, n.d.). DUCT developed their multi-faceted educational response that has evolved over the years to address complex social-ecological issues and the associated risks for people and the environment.

The Mpophomeni Township is situated south of Midmar Dam. Two minor tributaries, the uMthinzima and the uMhlangeni streams, meander through extensive wetlands in the township and flow into the nearby Midmar Dam. The aerial photograph in Figure 1 indicates the proximity of Mpophomeni Township to Midmar Dam and the uMthinzima stream that runs alongside the township and flows into Midmar Dam.

Organisations partnering with DUCT in the MSEP are: The Wildlife and Environment Society of South Africa (WESSA); GroundTruth – Water, Wetlands and Environmental Engineering Consultants; the World Wildlife Fund for Nature (WWF); and the Umgungundlovu District Municipality (UMDM).



Figure 1: Aerial photo of Mpophomeni Township with Midmar Dam in the background (Photo: www.airserv.co.za)

1.2 The Mpophomeni Sanitation Education Project

In 2012, DUCT established the MSEP. The MSEP is a community-engaged CS project that aims to address the problem of sewage pollution in the township through citizen involvement in monitoring and reporting sewage pollution events. In addition, the MSEP is involved with public awareness raising, environmental education activities, and the monitoring of water quality in streams. The main aspect of the work of the MSEP, called the Enviro Champs, is the monitoring of spilling events and the reporting of events to local authorities in order to enable a timely and effective response. The Enviro Champs work closely with the plumbers who are employed by the uMgungundlovu District Municipality (UMDM). Data generated through the monitoring activities are recorded and analysed to determine the major causes of the problem. Enhancing the work of the Enviro Champs and addressing the need for education about the problem, there are two other aspects to the MSEP: the Mpophomeni Youth Productions, a drama group who produce and perform educational street theatre, and WESSA EcoSchools Environmental Clubs for high school learners. These three aspects are managed by a coordinating team composed of the Enviro Champs coordinator, who also works as an Enviro Champ, the WESSA EcoSchools Enviro Club coordinator, and the

project manager who oversees all three aspects, as well as supporting the Mpophomeni Youth Productions (MYP) street theatre component. Figure 2 below summarises the different components of the MSEP. A detailed description of the different project components follows in Section 1.5.1.

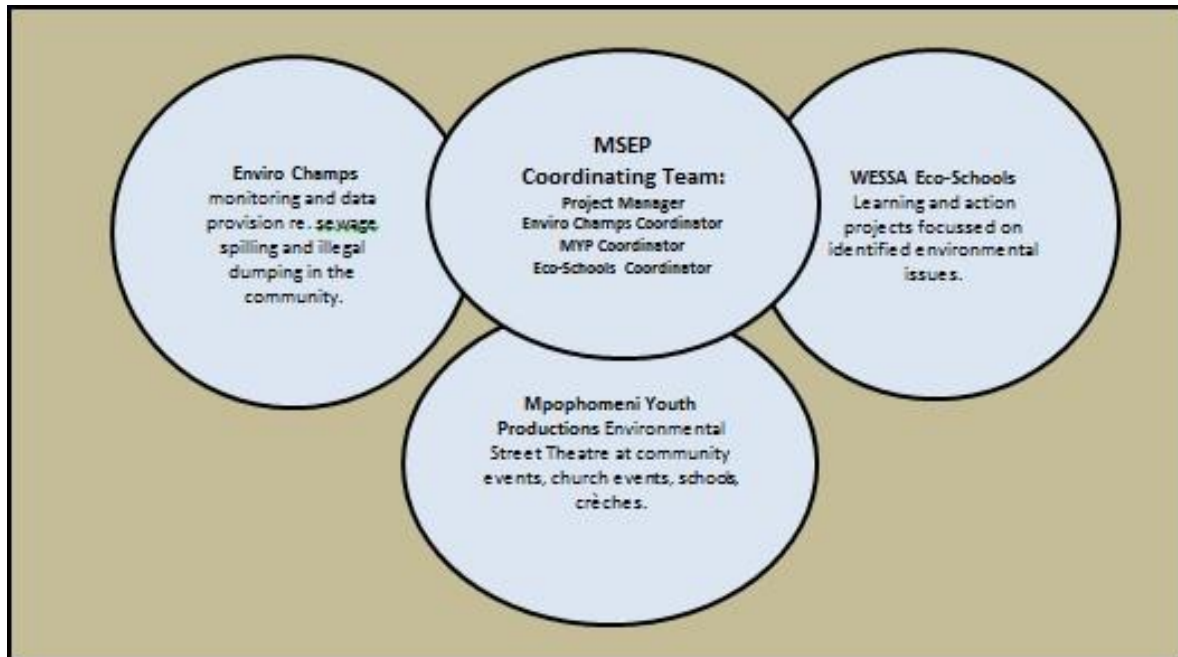


Figure 2: Components of the Mpophomeni Sanitation Education Project (L.Boothway, 2014).

1.3 History of Mpophomeni Township: The seeds for an active citizenry are sown

Mpophomeni Township was established in 1964 mainly for workers of the South African Rubber Manufacturing Company (SARMCOL) who, due to Apartheid laws of racial residential separation, were forcibly removed from Howick-West and the location where Midmar Dam is today (Mkhize, 1995; Zulu-Mpophomeni Tourism Experience homepage, 2010). In April 1985, 1 000 SARMCOL workers were dismissed when they organised a strike in protest against SARMCOL’s unfair labour practices and refusal to acknowledge and legitimise the workers’ unions. Mpophomeni Township became an organising hub for the strike, with daily meetings and marches supported by other residents. The SARMCOL strike is widely recognised as a key event in the political struggle against Apartheid (Mkhize, 1995). These are the historical roots of the proactive citizenry today addressing issues of water pollution that infringe on Mpophomeni residents’ constitutional right to a healthy environment. Fifty years later, Masimbumbane (cited in Makwangudze, 2013) states that the

“population [of Mpophomeni] was estimated at about 35 000 people, with more than 80% unemployment rate in 2007, with those in formal employment working in Howick, Pietermaritzburg and Durban” (Makwangudze, 2013, p. 2). Also notable are the high levels of poverty and the high incidence of HIV/AIDS (*ibid.*).

1.4 Contextual background

In the year 2000, Reconstruction and Development Plan (RDP) houses were built in Mpophomeni Township to address the ever-increasing need for housing in the area (T. Luvuno, personal communication, April 11, 2013). Thirteen years after the installation of the sewerage reticulation system, regular blockages and spilling of raw sewage in several locations in the township, that have been ongoing for a number of years, indicate that the system is faulty and needs to be replaced. The project manager of the MSEP confirms this, noting that:

Short-cuts were taken, the wrong pipes were used, the wrong gradient etc. so the waterborne sewerage in Mpophomeni, the actual system is not working properly. And then added to that is the fact that people of Mpophomeni maybe don't use the waterborne sewerage system properly. They throw the wrong things down the toilet, they throw things into the manholes, they lift the manhole covers and push bags of rubbish down there, they throw rocks down there, and they throw goat skins whatever, whatever, for various reasons (L. Taylor, personal communication, March 19, 2013).

The ongoing spilling of raw sewage from blocked sewerage manholes into water courses is a common sight in the township (see Figure 3). As a result of the inadequate and dysfunctional sewerage infrastructure and unsustainable social practices described above, raw sewage high in phosphorous and nitrogen is increasing the nutrient load in Midmar Dam, which can result in eutrophication within an estimated 15 years (*ibid.*).



Figure 3: A collage of photos of spilling sewerage manholes also featuring an illegal dumpsite. Raw sewage runs directly into the uMthinzima stream (Photos: L. Taylor, 2013).

Figure 4 indicates pollution levels in sections of the uMngeni river's main tributaries, using colour coding and width. The colour coding system has been aligned with the national minisass database of water quality in South African rivers. Blue indicates that the stream is unmodified and in a natural condition. Green represents a largely natural system indicating that the stream or river is in a good condition. Yellow indicates that the river is moderately modified and hence in a fair condition. Red indicates that the river is very modified and in a poor condition and purple refers to a seriously/critically modified river in a very poor condition. In order to achieve variation within these categories the width of the stream indicates levels of pollution with the widest purple rivers being the most polluted. The uMthinzima tributary indicated on Figure 4 is coded in thick red and purple in the section of the river running alongside the township and into Midmar Dam indicating the seriously degraded state of this tributary feeding into a provincial water source.

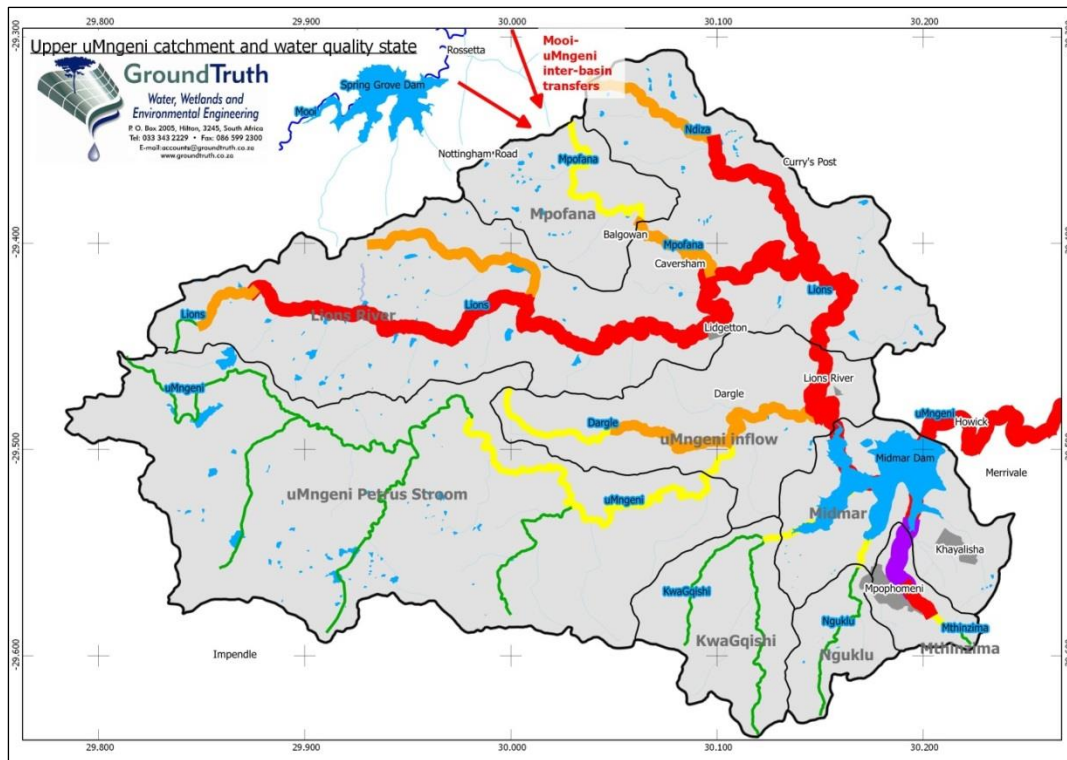


Figure 4: Map of pollution levels in the Upper-uMngeni Catchment (GroundTruth, 2014).

1.5 The response to the social-ecological problem.

As indicated previously, the MSEP with its three components – Enviro Champs, Mpophomeni Youth Productions and WESSA EcoSchools Enviro Clubs (Figure 2) – was established in November 2012 with funding from the uMgungundlovu District Municipality (L.Taylor, personal communication, March 19, 2013). The MSEP’s mandate was as follows: “... to establish an educational campaign aimed at training residents to protect and not abuse sewer systems and to report sewer leaks and blockages, and to monitor the municipal response to reports of leaks and blockages” (DUCT, n.d.). The establishment of the MSEP happened against the background of the South African National Water Act, Act No 36 of 1998, that was designed to address inequalities of a past discriminatory system. According to this act, the ownership of South Africa’s water was placed back into “a commons in which water belonged to all who lived in South Africa” (Munnik, et al., 2011, p. 35). With ownership comes the responsibility to ensure that the designated government water authorities, who are the custodians of the water, are effectively fulfilling their mandate. This approach assumes an active citizenry associated with a participatory democracy “superior to representative democracy in that it not only chooses who should govern, but how they should govern” (Tadesse et al., as quoted by Munnik, et al., 2011, p. 35). Therefore, in terms of the South African legal and policy environment regarding the quality and use of fresh water

resources, the stage was set for public participation in the effective management of water. It is within this legal and policy environment that a community-based social innovation project guided by CS, such as the MSEP, is of interest. In the MSEP in particular, CS is about participation towards new knowledge practices that will contribute to resolving specific health and environmental risks. Chapter 2 elaborates further on the policy context of the study and discusses the type of CS most suited to drawing on social learning processes in addressing natural resource management problems.

1.5.1 A description of the components of the MSEP

A detailed description of the different components of the project follows to position the MSEP, within the diverse field of CS, as a “possible mechanism of public deliberation” (Irwin, 2001). All the MSEP components were reviewed in the study to gain insight into their respective contributions to the process of learning and knowledge production. Descriptions and data about the project that features in this study pertain specifically to a three-year period from 2012 to 2014. The MSEP has since evolved and developed, as any responsive project would, and further studies would be necessary for a more current perspective of the project.

1.5.1.1 Enviro Champs

Ten volunteer residents of Mpophomeni, living in close proximity to illegal dumpsites and manholes which spill regularly, receive R200 airtime per month to report sewage spilling events and incidences of illegal dumping using their cell phones. The MSEP Enviro Champs monitoring system involves reporting a sewage spilling incident, identifying a possible cause, recording the time period between reporting and the fixing of the problem, and monitoring the impact of sewage pollution on nearby streams (L.Taylor, personal communication, March 19, 2013). Tools used for monitoring and data provision include a monitoring form that has to be completed during or immediately after the incident and submitted monthly (Appendix 1), a basic cell phone, and the miniSASS water quality monitoring tool (Appendix 2).

MiniSASS is a simplified version of the SASS bio-monitoring tool, originally based on the British Biological Monitoring Working Party (BMWP) that uses benthic aquatic macro-invertebrates as indicators of different levels of pollution, and adapted to suit South African conditions (Graham, Dickens & Taylor, 2004). Macro-invertebrates are collected using a standardised protocol. Each taxon is allocated a pollution-sensitivity score. Scores are used to calculate the Average Score Per Taxon (ASPT). Taxa that are more sensitive to pollution are allocated a higher score and therefore the higher the ASPT, the cleaner the water. While

SASS requires of the practitioner to identify 90 different macro-invertebrate families, the miniSASS reduced the number of ‘groupings’ to an accessible 13 groupings “without sacrificing scientific rigour or applicability to wide geographic ranges in South Africa” (Graham et al. cited in Graham, in press, p.5). MiniSASS is a biological tool that looks at groups of invertebrates as indicators of pollution. The primary focus is biological in the tradition of individual organisms being the unit of study, but linking the health of a stream to a well-functioning ecosystem and the impacts of people on the system naturally progresses during discussions of results. The Enviro Champs component is a local example of similar initiatives worldwide that aim to address information gaps in the Water, Sanitation and Hygiene (WASH) sector through transforming the generation, communication and sharing of data. This includes the use of mobile phones “as tools for data collection and dissemination across multiple sectors, such as health, socio-economic development, agriculture, natural resource management, and disaster relief” (Ross & Luu, 2012).

1.5.1.2 Mpophomeni Youth Productions

Durban’s eThekweni Municipality’s “Sustaining the Waste Water Education Programme” (1995–2002) used street theatre to educate communities about sustainable water and sanitation practices. In 2008, 600 performances reached an estimated 38 000 adults and 45 000 school children (Gounden, 2008). The eThekweni Municipality reported a significant reduction of sewage blockages during 2008, which they attributed to the Sustainable Sanitation Project, saving in excess of R5 million.

Inspired by the success of this project, the founders of the MSEP approached an existing drama production company in Mpophomeni, the Mpophomeni Youth Productions, to contribute to the community environmental education component utilising street theatre with an environmental theme. The plays, written and produced by members of the MYP, are performed for a wide range of community groups including schools, church groups, early childhood development centres and orphan care groups, and are designed to encourage public participation and discussion (L. Taylor, personal communication, March 19, 2013).

1.5.1.3 WESSA EcoSchools Environmental Clubs

The third component of the MSEP is the schools education programme which was aligned with the Federation for Environmental Education (FEE) International Eco-Schools programme implemented in South Africa by the Wildlife and Environment Society of South

Africa (WESSA) (Rosenberg, 2008, p. iv). The Eco-Schools programme “emphasise[s] *learning* in relation to *action*, and the need for *sustained* environmental education processes in schools” (*ibid.*, p. v). The Eco-Schools process is a holistic, inclusive process that involves whole school development with the support of a wide range of stakeholders within a local community context. Some of the benefits identified by teachers and education department officials, resulting from the programme identified during a programme evaluation conducted in 2008 were: the beneficial effects of experiential learning and knowledge enhancement that result from learners getting involved in remedial actions in their own environment; the beneficial spill-over effect on other social problems like poverty, over-consumption and health; and the potential for strengthening efforts to address social-ecological problems through the establishment of partnerships and the sharing of resources (Rosenberg, 2008).

Participation in the MSEP Schools Enviro Club is offered to high school learners in Mpophomeni as an extra-mural activity with the aim of building leadership, skills and knowledge that will have a positive impact on learners’ personal and academic performance. During fieldtrips conducted in Mpophomeni, learners use their cell phones to take photographs of environmental problems that they observe and record interviews with members of the community. Through using basic investigative environmental journalism, learners “frame” environmental issues in a personal way that is meaningful to them.

Learners also regularly conduct water quality studies, mainly in the two local streams, the uMthinzima and the uMhlangeni, using miniSASS (Appendix 2). Engagement with miniSASS teaches data-gathering skills, provides insight into the quality of the water in the local streams, and gives rise to discussions around the causes of water pollution.



Figure 5: MiniSASS facilitator and learner examining a sample of aquatic invertebrates taken in the uMngeni river (Photo: L.Boothway 2014).

1.6 Research opportunity

This study responds to an opportunity identified by Vallabh (2013), who highlights the lack of “documented research into the educational value of such [CS] projects” (p.8). Linked to this is Lindley’s (2014) discussion about the lack of conceptual clarity with regards to the social learning processes associated with social change (Rodela, Cundill & Wals, as cited in Lindley, *ibid.*). In the case of both Lindley’s (*ibid.*) study and this one, the focus is on social learning processes that enable social-ecological change in the natural resource management context. Operating from the premise that certain models of CS are more conducive to enabling learning for social-ecological change, the study aims to explore the nature of these social learning processes.

Another interest in this research is knowledge in CS projects. It is argued that CS operates in a contested interface where different knowledges can potentially meet on an equal footing (Irwin, 2001), and this is where the debate around the legitimacy of the knowledge produced by a diverse range of ‘knowledge actors’ surfaces strongly (Tàbara, 2013). Beyond the question of legitimacy is the question of efficacy. Legitimate knowledge may produce ‘sound science’ but effective, appropriate knowledge must produce the desired social-ecological change; thus the need for a study that describes this effective, appropriate knowledge and the learning processes associated with this type of action-enabling knowledge. Given this urgent

need for a better understanding of action-enabling learning processes and knowledge, the study investigates the knowledge-generation dynamics in the interface created by CS between what Muller and Subotzky (2001) describe as “seemingly incommensurate formal and informal knowledges” (p.175). In order to investigate the aspect of learning in the MSEP, using Wenger’s (1998) CoP theory, I needed to lay a foundation for this study by establishing an understanding of the characteristics of a CoP according to Wenger. This was necessary to prove that the MSEP was an appropriate organisation to study in terms of social learning processes and dimensions in a CoP. As a result, the study was organised in terms of three sub-questions that were answered during three phases which are described in more detail in Chapter 4.

The following research question and sub-questions guided the study:

What is the nature of learning and emerging knowledge in the Mpophomeni Sanitation Education Project?

Sub-question 1: Can the MSEP be viewed as a CoP?

Sub-question 2: What is the nature of learning in the MSEP?

Sub-question 3: What is the nature of emerging knowledge in the MSEP?

1.7 Overview of the study

The study starts out in Chapter 1 by outlining a profile of the geographical context of the study and a description of the MSEP. Chapter 2 contains a review of literature about contextual and conceptual aspects pertaining to water, supplemented in Chapter 3 by a review of literature about the specific focus of the study, namely, learning and knowledge. Chapter 4 includes a discussion of research methodology looking at the research design, the appropriateness of the case study method, the data-generation processes, and a description of the analysis, as well as a discussion of the issues around validity and ethics. In Chapter 5, the data about learning and emerging knowledge in the MSEP is presented and finally, in Chapter 6, a discussion of the most important research findings and recommendations concludes the thesis.

Chapter 2 Contextual and Conceptual Aspects

2.1 Introduction

Chapter 1 introduced the physical context of the study and the research question, and outlined a summary of the thesis chapters. Chapters 2 and 3 present a review of the literature that informed the study and relates to the theoretical context. In particular, Chapter 2 scopes literature pertaining to the contextual and conceptual aspects, whilst Chapter 3 highlights the theoretical work that supported the study. Chapter 2 starts out by looking at global water challenges, the water situation in South Africa, international initiatives that influenced the SA policy landscape and some of the policies that guide the management of water in South Africa. This is followed by a description of the role players involved in the implementation of these policies. In the second part of Chapter 2, the concept of social learning as a tool for water resource management is explored. Chapter 2 is concluded with a review of CS followed by a discussion of CS as a possible conduit for social learning processes in natural resource management and a review of models of CS likely to enable the kind of learning and knowledge required to achieve sustainability.

The issue of water pollution and citizens' actions to assert their constitutional right to a healthy environment is seated in the social-ecological interface. As such, the study scoped relevant literature mainly from the fields of Environmental Education, Natural Resource Management and Organisational Learning that offers some useful models for social learning. Tàbara and Chabay (2013, p.71) provided a rationale for this study when they suggest that “changing epistemological and ontological assumptions of the quality of robust social-ecological knowledge is a first step for the emergence of transformative pathways towards sustainability in research, education and policy”.

2.2 Water resources in the South African context

According to a WWF report, *Rich Countries, Poor Water* (Dickie, 2006), the seven key water-related challenges faced by first-world countries are the following: The under-valuation of watersheds supplying water; conflicting opinions regarding decisions about the conservation versus the abstraction of water; attitudes about natural system functioning, for example flooding; maintenance and modification of ageing and inappropriate water

infrastructure; the impact of agriculture on water quantity and quality; general large scale contamination of water; and, lastly, inadequate knowledge about the interconnectedness of human and natural systems.

Straddling the space between first- and third-world status, South Africa cannot be described as a 'rich' country, yet it faces similar challenges to first-world counterparts. In a report that investigates the potential of civil society to play a role in the monitoring and improvement of water quality, the challenges highlighted for the South African context all relate to deteriorating water quality (Munnik et al., 2011). It is generally known that South Africa is a water-scarce country. This is based on the annual rainfall statistics, water available per person, climate change predictions and the physical geography of the country (Perret, 2002). Only half the global average, South Africa's mean annual rainfall is 490mm, with a mere 9% of precipitation reaching the rivers because of the high rate of evaporation (Davis & Day as cited in Perret, *ibid.*).

According to the 'total actual renewable water resources' per person calculation, it was estimated that in 2005 there was 1 110 cubic metres of water available per person, making South Africa the twenty-ninth driest out of 193 countries, with only small islands and Middle-East oil states classified as "drier" (Muller et al., 2009). Furthermore, due to the physical geography of the country, only 8% of the land supplies 50% of the surface run-off water (Centre for Environmental Rights homepage, 2019). The label 'water scarce' may lead to a simplistic assumption that having more water will solve the problem. However, the problem is complex, and a report commissioned by the Development Bank of South Africa identifies nine problem areas associated with water security in SA, namely: diffuse pollution, point pollution, poor supply services, a lack of bulk infrastructure, an absolute shortage of water, user conflicts, climate change aridity, shared river issues, and lost development opportunities (Muller et al., *ibid.*). This serves to turn the focus on water management and the quality of the available water. Most pertinent to the specific geographic context of this study is the decline of water quality in streams and dams due to failing, inadequate and badly-engineered sewerage infrastructure and unsustainable sanitation practices.

According to the DBSA report, the issue that is highlighted for the geographic area in which this particular case study is located, the uMngeni Catchment in KwaZulu-Natal, is 'diffuse pollution'. Diffuse pollution can be defined as "pollution from widespread activities with no one discrete source" (European Environment Agency, n.d.).

The DBSA report's findings are further supported by recent data that reflect increased concentrations of phosphorus, nitrogen and *Escherichia coli* (*E.coli*) in the upper reaches of the uMngeni catchment, resulting in deteriorating water quality. The growth of informal settlements with inadequate sanitation infrastructure in the Mpophomeni Township, increased agricultural pollution, and effluent discharges from wastewater treatment plants are cited as some of the causes of the diffuse pollution (Namugize et al., 2017).

George, though speaking to a different geographic context, describes the same problem that residents are facing in Mpophomeni:

Despite the technology, the engineers and the ingenuity of modern sanitary systems, despite the shine of progress and flush toilets, even the richest, best-equipped humans still don't know what to do with sewage except move it somewhere else and hope no one notices when it's poured untreated into drinking water sources.
(George, quoted in Lara-Arredondo, 2010, p. 6)

2.3 Water Resource Management in South Africa

In the following section, I look at global initiatives for efficient water management which have influenced South African policies with regards to water. I elaborate on South African legislation, and finally describe the major role players in water stewardship, from a national to a local level, in the case-study area.

2.3.1 Global initiatives for integration and participation in the domain of water.

In January 1992, a preparatory meeting of the United Nations Conference on Environment and Development (UNCED) took place in Dublin. A set of recommendations known as the Dublin Statement on Water and Sustainability was presented to the UNCED in Rio de Janeiro in June 1992, and was adopted and became known as the Dublin–Rio Principles for the “equitable and efficient management and sustainable use of water” (Claassen, 2013, p. 325). The recommendations consisted of four principles which informed the subsequent development of the concept of integrated water resource management. The first of the principles referred to water as a finite resource with economic and social value. The second principle highlighted the importance of the involvement of local communities in the management of their own water resources. The third principle emphasised the importance of a comprehensive policy framework to support implementation. Lastly, the Dublin–Rio Principles foregrounded the need to acknowledge and enable rural communities with regard

to water management, recognising specifically the important role played by women. To this effect, Schreiner and Van Koppen (as quoted in Claassen, *ibid.*, p. 330) state that “empowerment of disempowered water users can be supported by pro-actively reaching out to poor communities...building capacity, ensuring mobility, structuring long term effective representation, and by mediating in conflicts”.

Subsequently, in a paper titled *Integrated Water Resources Management (IWRM)* advanced by the Global Water Partnership (GWP), the concept was launched and widely adopted in different countries, including South Africa. Although the concept of IWRM does not feature explicitly in the National Water Act (Act 36 of 1998), the act highlights the need for an integrated approach to water resource management and endorses a decentralised approach to management. The Global Water Partnership describes IWRM as “a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” (Claassen, *ibid.*, p. 325).

Though the integration approach is a generally agreed-upon ideal, several authors recognise the need for further conceptual clarification to strengthen the application potential of the IWRM approach (Muller et al., 2009; Jonker, as cited in Claassen, 2013, p. 326).

2.3.2 The South African water policy landscape

Without good policies, the efficient management of water resources is impossible. However, comprehensive policies alone do not guarantee the efficient management of water resources. The South African water context is supported by a set of policies that provide adequate support for the achievement of sustainable access to water for all. The Bill of Rights, Chapter 2 of the South African Constitution (Act 08 of 1996), sets the stage for a policy context that considers the rights of all South African citizens whilst recognising the importance of upholding the integrity of the ecological systems that provide and regulate the water supply (South Africa. South African Government [RSA], 1996). Other significant national policies that support and elaborate on the stipulations in the South African Constitution are: The Water Services Act (Act 108 of 1997), the National Environmental Management Act (Act 107 of 1998), the National Water Act (Act 36 of 1998) and the Water for Growth and Development Framework (DWAF, 2009).

However, policies by nature are theoretical guidelines only. A good policy still needs to be implemented in order to have any value (Muller, Burchi & Stein, 2018). Implementation is

effected by people, and our epistemic default is based on a mechanistic worldview that doesn't factor people in (Meek, 2011). Hence, we are not epistemologically equipped to tackle the challenges presented by the problem of water. Chapter 3 further elaborates on the question of what constitutes an epistemology for sustainability.

2.3.3 Major players

The National Water Act (Act 36 of 1998) provides for a balance of responsibilities, which includes the Minister and Director General at the national level, the Catchment Management Agencies (CMAs) at the basin level, and Water User Associations (WUAs) at a sub-basin level. Dividing South Africa into 19 Water Management Areas (WMAs) provides for water management to take place at catchment level (Muller et al., 2009). The decentralisation of water management also filters down to sub-catchment level. At this level the uMngeni Catchment is further divided into 13 sub-catchments known as Water Management Units (WMUs) (Perret, 2002; Warburton, cited in Namugize et al., 2017).

However, Claassen (2013) noted that in 2008, more than 10 years after the pronouncement of the NWA, only two CMAs out of the planned 19 had materialised. He added that “the decentralization of power has not reached the intended levels” (p. 329). Whether the decentralisation initiative has been rolled out more effectively since is a matter that falls outside the main focus of this project.

In the light of this, it is argued that, in spite of an enabling policy landscape supporting participation at all levels, the active participation of rural people in the management of natural resources is still not evident in practice on the ground, and a “lack of capacity, experience and innovation” are cited as some of the causes (Holmes-Watts & Watts quoted in Claassen, 2013, p. 329). Meek (2011), digging deeper for possible causes for a lack of positive change, suggests that it is the epistemologies that we hold which are responsible. Researchers such as Bawden (2009), Sterling (2010) and Milbrath (1994) also recognise the role of governing epistemologies. This is further discussed in Section 3.4.2.

In their discussion about what is needed for better water management, Muller et al. (2018) suggest effective implementation based on accurate data. They argue that officials need to know how much water is available in streams and be informed about sources of pollution. They also advocate that local communities be involved with decisions regarding water allocation to maintain habitat integrity, water for economic purposes and water for social

needs. They make an important point by stating that effective water management requires “organisations that can work with the resource and its users” (unpaged).

It is therefore suggested that successful water management requires combined scientific knowledge and relational knowledge, the latter of which involves trust. In other words, good water management starts with a person in a place. As Meek (2011, p. 32) puts it: “...knowing begins from the ... sense of our situatedness in the world. It starts with somebody home” and that person being acknowledged as a key role player in knowledge production. Chapter 3 will elaborate on the theoretical work around knowledge practices.

DUCT with the establishment of the MSEP stepped in to address a lack of capacity, experience and innovation in the uMngeni Catchment and, drawing on social learning ideas, are making headway in involving stakeholders at all levels to participate in the management of their water resources. Academics from the University of KZN, GroundTruth Consulting, the Royal Haskoning Engineering Company, the Umgundgundlovu District Municipality, WESSA, DUCT, and residents of Howick and Mpophomeni are working together to try and solve the problem of the rapid deterioration of the water quality of their main supply dams.

2.4 Social learning as an important tool for water resources management

Blackmore (2007) and Lindley (2014) suggest that social learning is an important tool for resource management. Wenger (1998) suggests that all learning is social, proposing therefore that learning is not a product but a process which is dependent on a social context. Learning is intricately linked to the social process of living; in other words, learning has a purpose. It is not only the process whereby a ‘knowledge product’ is produced for its own sake but rather a creative process whereby a new way of doing things seems possible and, as such, learning and meaning-making are closely linked.

Meaning as “a prerequisite for action”, according to Bawden (2009):

... emerges as a result of ‘interactions’ between the process of *experiential learning* on the one hand, and what we [School of Agriculture, Hawksbury Agricultural College, Australia] have termed *inspirational learning* on the other with these processes in turn involving the concrete world of experience, the spiritual world of insights, and the abstract world of concepts at the interface. (p.4)

The interplay between the experiential and inspirational learning subsystems is described as a process of ‘filtering’ by this sense-making framework or worldview with its cognitive and normative elements (see Figure 6). Bawden equating ‘worldview’, ‘paradigm’ and ‘sense making framework’, (2010, p. 95) describes this: “It is our worldviews that act as the ‘filters’ to our understandings, our frames of mind as the context for our judgments, our fundamental beliefs as the foundations for our morality” .

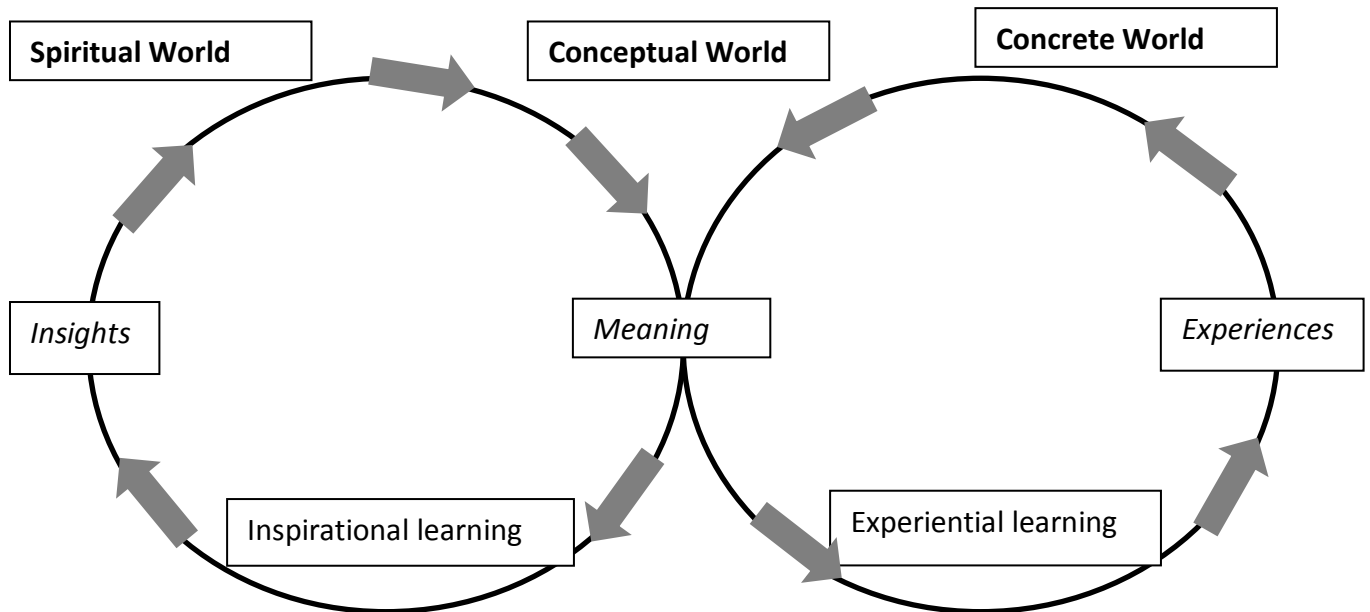


Figure 6: Meaning as an emergent property of the interaction of two learning sub-systems (Bawden, 2009)

Thus, if our actions are determined by our beliefs, it follows that learning processes for environmental sustainability should enable the evaluation and change of foundational beliefs or so-called ‘sense-making frameworks’/ paradigms (Bawden, 2010). The idea of transformative learning refers to the kind of learning processes that result in a deep paradigmatic change. Sterling (2010) proposes that this happens through paradigmatic reconstruction which is only possible when dominant paradigms are made explicit through the process of learning.

Building on the work of Bateson, Sterling (*ibid.*) describes the different levels of learning and related outcomes: he proposes three levels of learning which give insight into the relationship between change and learning. Learning on the first level involves cognition, which enables efficiency and has a conformative outcome. Second-level learning involves meta-cognition and enables an examination of assumptions with the potential for a reformative outcome. The third and deepest level of learning he calls “epistemic learning”, which involves a change

of paradigm and has the potential for a transformative outcome. Bawden (2010, p. 24) concurs, stating that “transformations in the way things are done depend on transformations in the way things are understood”.

Social learning is also a way of organising learning to achieve a specific outcome (Wals, 2007). The World Wildlife Fund for Nature’s (WWF) Mondri Wetlands Project (MWP) provides an example of how a diverse range of stakeholders worked together to bring about change, and from their experience they point out four key characteristics of the type of social learning relevant to the natural resource management (NRM) context. Firstly, learning is viewed as valuable, and the way people learn and what they want to learn is seen as important to the effectiveness of the learning. Secondly, this type of learning challenges people’s own views, beliefs and guiding paradigms. Thirdly, conflict of opinion is seen as a generative mechanism if managed wisely. Wals (2011, p. 184) refers to this as dissonance, and emphasises “the importance of conflict and dissonance in social learning”. The fourth characteristic of social learning highlighted by WWF–MWP is the importance of reflexivity to empower individuals and groups to come up with their own solutions instead of relying on expert input (Cockburn, Dubazane, Kotzé, Lindley, 2015). Wals (2011, p. 181) supports this view when he states:

...the creation of a more sustainable world requires *learning*; not just any learning, but learning that leads to a new kind of thinking, alternative values and co-created, creative solutions, co-owned by more reflexive citizens, living in a more reflexive and resilient society.

Scharmer’s (2009) social learning theory, Theory U, describes a deeply reflexive process which takes place when people learn together to achieve a common goal. An essential step in Theory U involves suspending individual ideas in order to see the issue from the perspective of the whole that is, the bigger picture, followed by an act of letting one’s own ideas go and, in doing so, enabling a transformation of individual will and self. The result is the emergence of a unique idea generated by the group which then assumes form and is institutionalised as an appropriate response for that specific context. The cycle is one that ever continues, thus ensuring that new appropriate responses result from constant assessment of institutionalised ideas in an ever-changing world. The following section will further discuss the compatibility of certain models of CS with social learning principles and outcomes.

2.5 Citizen science and social learning

This section explores how the concept of social learning relates to CS and whether CS can constitute a learning arena conducive to transformative learning. The context of resource dilemmas and sustainable development provides a backdrop for this exploration. As a result of natural resource dilemmas, citizens and scientists started looking for answers, and needed a different approach and a different way to learn, know and do things. In this context CS emerged.

Community-based environmental monitoring (Conrad & Hilchey, 2011) best describes the type of CS of which the MSEP is an example. Whitelaw et al. (as quoted in Conrad & Hilchey, *ibid.*, p. 274) define community-based monitoring as: “a process where concerned citizens, government agencies, industry, academia, community groups, and local institutions collaborate to monitor, track and respond to issues of common community [environmental] concern”. When monitoring a specific environmental problem with complex social and economic implications, citizens and scientists can uncover the ‘messy’ nature of the problem (Bawden, 2010). It is in these circumstances that the idea of social learning becomes not only relevant, but necessary, in order to address the problem. Reed et al. (as cited in Johnson et al., 2012) understand social learning to be a mutually-reinforcing reciprocal process between individual knowledge and group knowledge and actions. Johnson et al. (*ibid.*, p.1) argue that ecological and social challenges emerging from the complex nature of interdependent socio-ecological systems “often defy straightforward solutions, and efforts to address these problems will require not only scientific and technological capabilities but also learning and adaptation”. Appropriate learning processes have the potential to “transform a group of individuals into a community that shares a common interest or goal” (Webler et al., cited in Johnston et al., *ibid.*, unpagged) and strengthen the potential for collective remedial action (Wenger, 1998). Berkes (quoted in Johnson et al., *ibid.*, unpagged) makes an important point when stating that “social learning is both an outcome of, and an essential input to, effective cooperation within a group”.

2.5.1 Characteristics of social learning congruent with citizen science

The argument for the synergy between social learning and CS is based on the assumption that “the word ‘learning’ undoubtedly denotes change of some kind ...” (Bateson quoted in Blackmore, 2007, p. 514). If social learning’s outcome is changed thinking and practices, then problem-based citizen science projects stand to benefit from engaging in social learning

processes. In other words, embedded in the concept of social learning is a strong focus on change, and more specifically social-ecological change, which speaks directly to the goals of community based monitoring CS projects. Sterling (2010, p. 18) points out that, “given the very real threats to our global environment”, social learning increasingly resembles learning in the biological sense, as “the organism that is unable to adapt to external change perishes and all organisms ‘learn’ to some degree ... ”.

Providing a backdrop to this discussion is the ongoing pursuit by sustainability practitioners and sustainability scientists to bridge the divide between learning, knowledge and change; that is, finding the ‘missing link’ between merely knowing about something and doing something about it (Tàbara & Chabay, 2013; Cornell et. al., 2013; Wals, 2011).

Wals (2011, p. 180) describes the kind of learning that can potentially bridge this gap when he proposes that “learning in the context of sustainability requires ‘hybridity’ and synergy between multiple actors in society and the blurring of formal, non-formal and informal education”. The creation of this hybrid space for learning that could contribute to spanning the gap between knowledge and action requires a shift from dominant paradigms upholding the epistemic default, mentioned earlier in the chapter (Milbrath, 1994). Mezirow (quoted in Sterling, 2010, p. 20) uses the term ‘transformative learning’ to refer to a process “by which we transform our taken-for-granted frames of reference (meaning perspectives, habits of mind, mind-sets) to make them more inclusive”. Herein lies one of the key points of synergy with the Irwin (1995) branch of citizen science that claims to increase “environmental democracy, scientific literacy, social capital, citizen inclusion in local issues, [and] benefits to government” (Conrad & Hilchey, 2011, pp. 279–280).

There is an abundance of definitions of social learning that elaborate on the characteristics of the social learning process and guiding principles of diversity, complexity, uncertainty, social cohesion and dissonance. Reaching deeper, Milbrath (quoted in Tàbara & Chabay, 2013, p. 78) frames the process of social learning as “the move from one worldview to another”. Milbrath (1994, p. 117) describes the implications of such a worldview shift not taking place when he states that “persons whose thinking is embedded in a given paradigm cannot perceive reality that is seen by those whose thinking is embedded in another paradigm”. In the CS social learning space, the conversation between citizens and scientists is enabled through a mutual commitment to a better understanding of each other’s guiding worldviews. Benhabib (quoted in Edwards, 2011, p. 38) describes what is required of the stakeholders

participating in a social learning process that aims to achieve improved water resource management:

In a conversation, I must know how to listen, I must know how to understand your point of view, I must learn to represent myself to the world and the other as you see them. If I cannot listen, if I cannot understand, and if I cannot represent, the conversation stops, develops into an argument, or maybe never gets started.

Maintaining an effective conversation between science and citizens hinges on a mutual commitment to reflexivity, as mentioned in Section 2.4, widely viewed as a key enabler of adaptive thinking and learning (Blackmore, 2007; Cornell et al., 2013). Tàbara and Chabay (2013, p. 73) define the process of reflexivity as “learning to learn, to modify what we’ve learned and to promote adaptive thinking”.

2.5.2 Alignment between citizen science and social learning

Having discussed some key characteristics of social learning that provide potential linkages to CS, it is necessary to elaborate on the distinctive features of the type of CS that could generate conditions for the development of a ‘hybrid social learning space’ for sustainability (Wals, 2011). As mentioned above, maintaining a reflexive approach is not the sole responsibility of citizens; a reciprocated commitment to reflexivity on the part of the science community is also vital to cultivate a culture conducive to collaborative knowledge production. In other words:

... science can gain democratic public legitimacy only if it recognizes its own need to understand itself in relation to (these) other cultures [other knowledges], and to learn respectfully to negotiate with and accommodate to them, rather than dismiss them as vacuous, untrustworthy and emotive (Leach, Scoones & Wynne, 2005, p. 9).

The model of citizen science that is most closely aligned with the idea of reflexivity was first described by Irwin (1995) in his pursuit to democratise knowledge production. It hailed in a new era in which

... there is now recognition that publics have salient knowledges and critical perspectives that should be taken seriously as substantive inputs into the planning, design and implementation of scientific interventions and development initiatives previously assumed to be the sovereign domain of expert scientific bodies (Leach et al., 2005, p. 8).

This new type of sustainability science is contextually-bound and purpose-orientated, aiming not just to produce more knowledge but to achieve “socially-robust” knowledge (Gibbons as cited in Cornell et. al., 2013, p. 63). In other words, some science is no longer practised solely for its own sake, but with a social rationale. Jenkins (2010, p. 704) refers to “science for specific social purposes” and “science which relates in reflexive ways to the concerns, interests and activities of citizens as they go about their everyday business”.

This form of reflexive science for social purposes is best described by the “co-created projects” category in the Models for Public Participation in Scientific Research typology described by Bonney et al., (2009). Dickinson et al. (citing Becker et al., 2012) point out that communities who construct their own questions and develop projects to address their social-environmental concerns tend to develop stable constructive relationships within the project community. These types of community-based projects also tend to promote inclusiveness in local governance as well as build scientific skills and generate social capital (Whitelaw et al., cited in Dickinson et al., 2012).

Thus, in conclusion, social learning processes that elevate the importance of a diversity of role players, context and reflexivity will find the particular model of CS that aims to address social-ecological problems and that foregrounds the importance of multiple knowledge producers, context and reflexivity a conducive space in which to thrive.

2.6 Conclusion

Chapter 2 drew on existing literature to highlight contextual aspects around water, looking at policies both international and local which influenced the development of the idea of IWRM and its roll-out in the form of local catchment management agencies. Major role players at national and local level were also introduced. Having established the necessary water stewardship infrastructure in South Africa enabled organisations such as DUCT to implement at a local level initiatives such as the MSEP – a water-focused, community-based monitoring CS project. The last section of Chapter 2 briefly discussed the concept of social learning, which will be further elaborated on in Chapter 3, describing how social learning processes and certain models of CS have similar goals for bringing about social-ecological transformation.

Chapter 3 A Review of Theories about Learning and Knowledge

3.1 Introduction

The following chapter reviews the concepts and theories which provided a lens for exploring the nature of learning and the nature of knowledge in the MSEP CS project. The study mainly drew on literature from the fields of Education, Psychology and Sociology, specifically looking at social-cultural and situated learning theories to assist with the investigation into the nature of learning in the MSEP. Communities of Practice (CoP) theory (Wenger, 1998) proved helpful for understanding the kind of learning that happens when people work together to address a matter that concerns them all. However, CoP theory did not provide an adequate lens with which to explore the nature of knowledge used, produced and shared by MSEP participants, and for this purpose the study drew on social realist theories of education underpinned by critical realism.

In the first section of this chapter, Section 3.2.1, I will elaborate on the characteristics of a CoP. The different dimensions of learning in a CoP will then be discussed in Section 3.2.2 as this heuristic device was used both to understand and analyse learning in a CoP. A scoping of a selection of other literature sources that informed the investigation of the nature of learning in Section 3.3 concludes the first part of this chapter.

Section 3.4.1 describes the dominant views of knowledge that shaped the so-called “subcutaneous epistemological layer” (Meek, 2011, p.5), which some authors argue is proving to be inadequate and detrimental to the cause of sustainability (Tàbara & Chabay, 2013; Sterling, 2010; Bawden, 2009). This is followed in Section 3.4.2 by a discussion of epistemology, looking at the defective epistemic default. Section 3.4.3 introduces some ideas around learning and knowledge practices from the social realist school of thought that guided this study. Finally, Section 3.4 focuses on ideas put forth by Tàbara & Chabay (2013), who provided the analytical lens for the analysis of data on knowledge.

3.2 Communities of Practice

According to Wenger (1998, p. 85), a CoP can be described “as a locus of engagement in action, interpersonal relations, shared knowledge, and negotiation of enterprises”. He further states that “such communities hold the key to real transformation – the kind that has real effects on people’s lives” (*ibid*). Wenger’s (*ibid*) social theory of learning is a theory of situated learning that focuses on community and participation as major elements of learning and, importantly, learning with the purpose of bringing about transformation. A CoP is defined by Wenger-Trayner and Wenger-Trayner (2015, p.1) as: “Groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly”. In order to build an argument around learning and knowledge in the MSEP CoP, it had to be established whether the group of people engaged in the MSEP is, according to Wenger’s (1998) criteria, indeed a CoP. Following is an outline of the elements that constitute a CoP which were used to determine whether the MSEP is an example of a CoP.

3.2.1 Elements of a CoP

A CoP can be identified by the presence of three elements, namely: mutual engagement, joint enterprise and shared repertoire (Wenger, 1998) (see Figure 7 below). Mutual engagement refers to the actions we take to accomplish our goals. Coherence within the group is vital to the process, as mutual engagement in itself does not necessarily lead to the formation of a CoP. Wenger (*ibid*, p. 76) states that:

... mutual engagement ... connects participants in ways that can become deeper than more abstract similarities in terms of personal features or social categories. In this sense, a community of practice can become a very tight node of interpersonal relationships.

Whilst engaging in a jointly negotiated and agreed-upon venture, members of the CoP not only bring their unique contributions to the process but they also further integrate, define and develop their own identity within the group in the course of the engagement. How identity is shaped through mutual engagement as a dimension of learning will be further elaborated on in Section 3.2.2.2. Mutual engagement is about reciprocal competence, in that the members of the CoP are open to both giving and receiving help and in doing so acknowledging other

members with skills and knowledge beyond their own. This process of validation of all members' contributions strengthens social cohesion in the group (*ibid*).

The second characteristic element of a CoP is joint enterprise. It is the commonly agreed-upon goal that provides a shared vision and a unifying framework for the range of activities that make up the enterprise. The joint enterprise is defined, shaped and owned by the members of the group. Taking ownership of their enterprise is an important driver of success and, even if the enterprise first came into being as the result of an outside mandate, “the practice evolves into the community’s own response to that mandate” (Wenger, *ibid*, p.80).

The last characteristic element of the community of practice is shared repertoire. This refers to the tangible, objectified artefacts used in the project. It can be in the form of organising documents or reporting documents, or a special set of vocabulary or a lexicon unique to a particular CoP, that feature prominently in meetings, shared anecdotes, or knowledge products like information pamphlets and street theatre scripts that the community has produced or adopted in the course of its existence and which have become part of its practice. Over time, the joint pursuit of an enterprise creates resources for negotiating meaning. This shared repertoire of resources creates concretised abstractions that result from processes of negotiating meaning involving participating and reification – which Wenger (1998) states are in a complementary relationship. Wenger’s (*ibid*, p. 58) constructivist view is evident in his discussion of reification when he states that: “... we project our meanings into the world and then perceive them as existing in the world, as having a reality of their own”. The shared repertoire resources developed in the process of participation in the joint enterprise, and the meanings that result, are really abstractions in a “thing” form that reflect the participants’ understandings. In this regard, Wenger (1998, p. 58) states that: “[we] produce objects that congeal ... experience into ‘thingness’”. Pitkin (1987, p. 268) defines reification as “the realisation in the physical world of a human intention”. Wenger refers to the concept of reification in a way similar to Berger and Luckmann (quoted in Pitkin, 1987, p. 273) “as a feature of social psychology in general”. Understood in this way, reification results from human beings fulfilling their role as artificers, and from human intention fabricating tools and artefacts that ‘thingifies’ their mental concepts and in doing so makes their abstractions accessible to fellow human beings. In this literal sense, reification means “fabrication, the work of homo faber” (Arendt as quoted in Pitkin, 1987, p. 268).

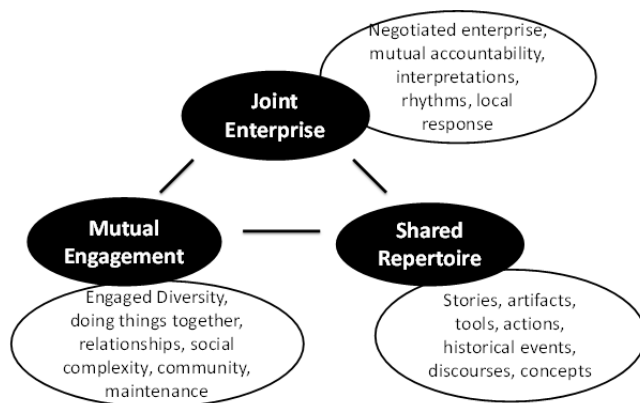


Figure 7: The dimensions of practice as the property of a community (Wenger, 1998, p. 73)

3.2.2 Learning in a CoP

Having established what the key characteristics of a CoP are (Wenger, *ibid*), the next section investigates learning through the lens provided by Wenger’s heuristic of the four characteristics of learning, namely: community, identity, practice and meaning (see Figure 8). According to Wenger (*ibid*, p.4), each of these components can translate in learning terms as: “learning as belonging” (community), “learning as becoming” (identity), “learning as experience” (meaning) and “learning as doing” (practice). These components are each discussed independently in the following section.

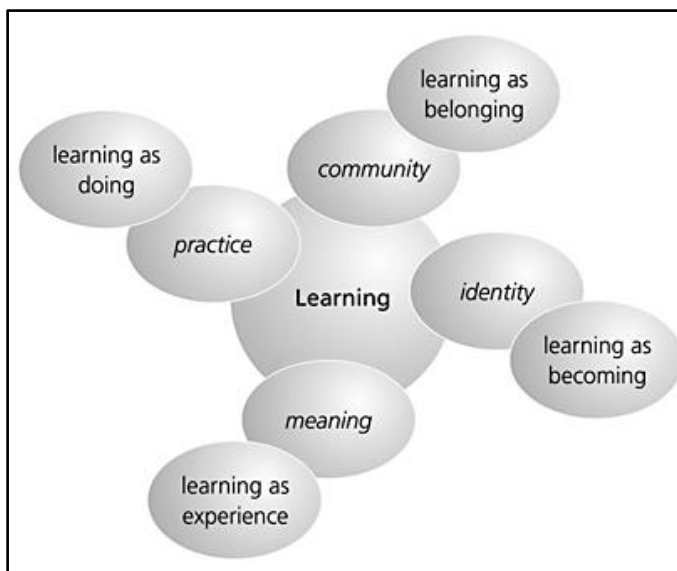


Figure 8: Four elements of learning (Wenger, 1998)

3.2.2.1 Community: Learning as Belonging

This component refers to learning as belonging which refers to “the social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence” (Wenger, *ibid*, p. 5). Firstly, learning as belonging implies the existence of a

group or community to which one can feel a sense of belonging and secondly, the element of engagement in practice is essential for this sense of community since “interrelations arise out of engagement in practice” (Wenger, *ibid*, p. 76). “Mutual engagement involves not only our competence, but also the competence of others. In other words, it refers to “what we do and what we know, as well as on our ability to connect meaningfully to what we don’t do and what we don’t know” (Wenger, *ibid*, p. 76).

3.2.2.2 Identity: Learning as Becoming

According to Wenger (1998), identity is “an ongoing process of evolving forms of mutual engagement, understanding and tuning their [the community of practice’s] enterprise, developing their repertoire, styles, and discourses” (p. 95), and in the process “learning transforms who we are and what we can do” (*ibid*, p. 215). Mutual engagement, shared environment and shared practice provide a context and conditions for the processes of personal and social identity transformation to take place. Learning, as seen through the lens of identity, is a process that “changes who we are and creates personal histories of becoming in the context of communities” (Wenger, 2009, p. 7).

3.2.2.3 Practice: Learning as Doing

Wenger (1998) states that entering into the process of learning through practice requires a common goal or purpose which he refers to as an “enterprise”. This enterprise is the practice that evolves as a result of mutual engagement in the community. Wenger states that “the concept of practice connotes doing, but not just doing in and of itself” and that “it is doing in a historical and social context that gives structure and meaning to what we do” (*ibid*, p. 47).

3.2.2.4 Meaning: Learning as Experience

According to Wenger (1998), meaning and experience are linked, in that meaning-making is only possible through experience. The context of a community that shares a learning environment whilst engaged in an agreed-upon practice provides the conditions conducive for meaning-making. Learning as experience is described as the development of individual and collective ability “to experience our life and the world as meaningful” (Wenger, *ibid*, p.5). Bawden (2009), in describing the integrated critical learning system, states that meaning is a prerequisite for action. Wittgenstein also recognises the link between meaning and action: Johnston (cited in Parker, 2010), explaining Wittgenstein, defines understanding as the

process of appreciating the meaning of a person's action and, like Capra (2002), claims that meaning cannot be separated from context. Capra (*ibid*, p. 73) elaborates:

Meaning is essential to human beings. We continually need to make sense of our outer and inner worlds, find meaning in our environment and in our relationship with other humans, and act according to that meaning.

Mezirow (1990, p. 1) explains when making meaning becomes learning:

To make meaning means to make sense of an experience; we make an interpretation of it. When we subsequently use this interpretation to guide decision making or action, then making meaning becomes learning.

In summary, it appears that understanding is about appreciating the meaning of one's action. Action depends on learning, which depends on meaning-making, which, according to proponents of situated learning, is always context-dependent.

3.3 Contributions towards an understanding of learning

In the previous section, I discussed Wenger's theory of learning. I now turn to Sfard (1998) for an elaboration of perspectives on learning. In her keystone paper on learning, Sfard (1998) introduces two metaphors for learning, namely the acquisition metaphor and the participation metaphor, and she warns against subscribing solely to one or the other.

The acquisition metaphor proposes learning to be about the acquisition and transfer of objectified and commodified knowledge, which is treated as unchangeable and brings with it a certain value and status transferred to the holder of the knowledge. The idea of knowledge transferred from a knowledgeable person into an empty vessel, that is, the person without the knowledge, is associated with this view. Thus, the focus according to the acquisition metaphor is on the "development of concepts" and the "acquisition of knowledge" (Sfard, 1998, p. 6). A move away from focusing on "concept" and "knowledge" hailed in a new understanding of learning as an active, social, participatory process with a focus on the active noun "knowing". According to this view, of which Wenger (1998) is a proponent, one doesn't 'have' knowledge; instead, you 'do' knowledge. Rather than being situated in the heads of individuals, "knowing and learning are located in processes of co-participation" (Blackmore, 2007, p. 523). In accordance with this view, Lave and Wenger (quoted in

Martin, 2009, pp. 50–51) state that “... learning, thinking and knowing are relations among people in activity in, with, and arising from the socially and culturally structured world”. Therefore, advocates of situated learning understand knowing as action. Meek (2011, p. 17) echoes this view when she states that “people can do knowing well...”.

Sfard (1998) proposes the benefits of research that integrates both the acquisition and the participation metaphor and, citing Guess and Habermas (*ibid*), she argues that this frees up the power of dialectical reasoning for the following reason: “When two metaphors compete for attention and incessantly screen each other for possible weaknesses, there is a much better chance for producing a critical theory of learning”. This idea of the power of dialectical reasoning is also described by Parker (cited in Lotz-Sisitka et al., 2012, p. 77) as “Bhaskar’s fertility of contradiction”.

However, having attempted to offset the effects of an imbalance in favour of the acquisition metaphor, it is important to point out that solely focusing on process and participation, Muller (2014, p. 260) points out, can lead to the danger of “black boxing the knowledge of which the practices are an expression”. Learning therefore, it is proposed, is most effective when both metaphors, namely processes of acquisition and processes of participation, are incorporated into learning processes. Blackmore et al. (2011), in the Knowledge, Learning and Societal Change project, recognise the nature of the theoretical middle ground where Sfard’s (1998) argument positions learning, by looking at it through critical realist lenses. In doing so, they argue for a hybrid epistemological space that emerges through the engagement of constructivist ideas of knowing and learning with ontological arguments based on critical realist ideas of transitive and intransitive truth.

Transitive knowledge objects are “socially determined and changeable”, whereas intransitive knowledge objects refer to “an external reality [that] exists independently of our conceptions of it” (Danermark et al., 2002, p. 200). Knowledge explorations in these so-called hybrid epistemological spaces are therefore not limited only to relativist knowledge claims, but because of these critical realist philosophical assumptions are also able to continually strive towards a better approximation of an unchanging external reality.

Blackmore et al. (*ibid*, p. 17) provide the following example of knowledge around the depletion of coastal marine resources:

... it is possible to recognize that coastal marine resources are being depleted (ontology); but that there *are different ways of knowing this* (e.g. through Traditional Ecological Knowledge *and / or* through Scientific Indicator Development (epistemology)).

Hence, this study explores whether the type of CS project modelled by the MSEP might open up a productive space for “inter-epistemological dialogue” (Beck as quoted by Blackmore et al., 2011, p. 17).

For this study, critical realism enables a moving forward into the discussions around knowledge limited, as explained in the previous section, by constructivist epistemologies. Critical realism does this by providing a philosophical foundation for an exploration of knowledge by allowing for the constructivist view in the so-called empirical domain whilst acknowledging the existence of two other domains outside the realm of experience that are unseen, but none the less real, and that generate the effects experienced in the empirical domain. Figure 9 below is a representation of the depth ontology proposed by critical realism. Danermark et al. (2002) describe differentiated reality as proposed by critical realism in the following way. The most basic domain is the domain of the *real*. It is the largest domain encompassing the other two domains. In the real domain mechanisms exist that can either produce factual events or not. The *actual* domain is where these factual events manifest. These events may or may not be observed. The experience of these factual events takes place in the *empirical* domain, where the event then becomes known as an empirical fact.

If, for example, our knowledge exploration of the phenomenon of eutrophication in Midmar Dam drew solely on a constructivist epistemology, the result would be limited to an understanding of people’s experiences in the empirical domain and would vary greatly. For example, some people would go swimming in the dam to cool off in summer, some would water their cattle at the dam, and others are rowers practising for the annual canoe marathon, whilst another might own a yacht to go sailing at sunset; some may even just see the water of the dam glistening in the distance having lived in the Mpophomeni Township all their life and never been there. These different experiences in the empirical domain are based on factors such as socio-economic status, level of education and interests, and would necessarily generate wide-ranging views with regards to eutrophication and the effect on water quality, people and animals. An in-depth study of the phenomenon requires tools that can deepen the exploration to reach beyond the people’s experiences in the empirical domain

to also include the “what” of the problem. Hence, with critical realism having done the ground-clearing theoretical work through “depth ontology”, this study was able to draw on social realism, a school in the sociology of education that has “been exploring how Critical Realist philosophy ... can be translated into a sociological framework applied to issues of knowledge and education” (Moore, 2013, p. 334).

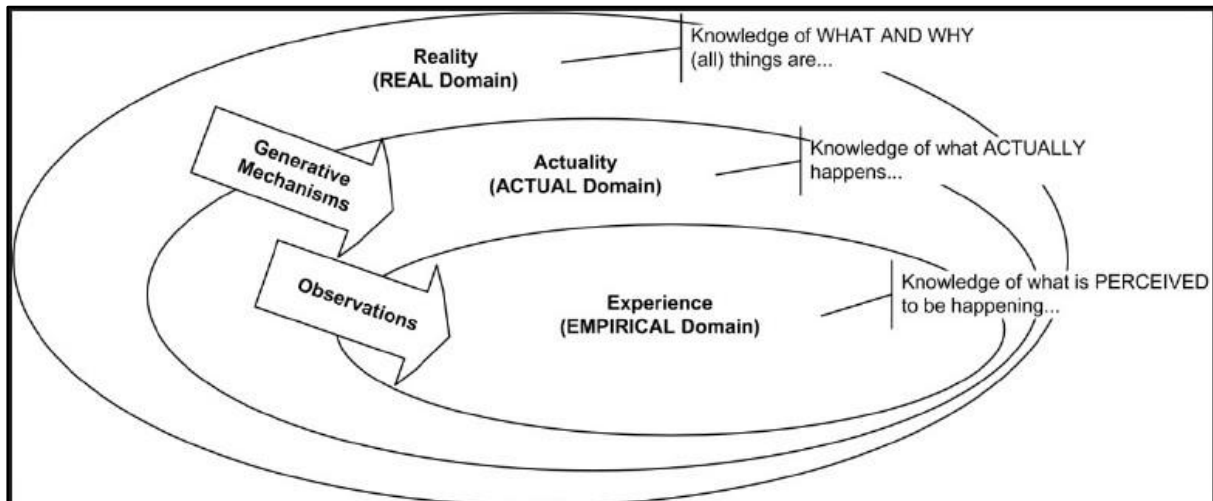


Figure 9: A Critical Realist concept diagram (Alexander, 2013)

3.4 Honing in on knowledge

Having established the philosophical foundation on which an in-depth exploration of knowledge is possible, and before elaborating further on this discussion in Section 3.4.2, it is important to trace the historical roots of our current understanding of knowledge in order to develop an understanding of how our epistemic default (Meek, 2011) manifests in society and ultimately on our ability to survive on this planet.

The following section is in the format of a short story about the historical development of ideas around knowledge, the resulting Risk Society (Beck, 1992) with its associated wicked problems (Rittel & Webber, 1973) and natural resources dilemmas, and the attempt to fix the epistemic default (Meek, *ibid*) to enable a different type of knowledge that may enable transformative learning for sustainability (Tàbara & Chabay, 2013).

3.4.1 Upsetting Des[apple]cartes

To clarify what is historically understood by knowledge, we draw on Meek’s (2011) definition: “... when we think of knowledge, we tend to picture it as information, facts,

statements and proofs”. Maton (citing Castell quoting Bell, 2014, p. 2) also refers to this conventional view of knowledge when he states that “knowledge is a set of organized statements of facts or ideas, presenting a reasoned judgement or an experimental result, which is transmitted to others through some communication medium in some systematic form”.

Maton (2014), although he presents historical views of ‘knowledge’ aligned with positivist, objectivist, reductionist views and ‘knowing’ as closely aligned with more recently developed social constructivist views of learning, maintains a perspective that incorporates both views. A brief referral to ‘knowledge’ and ‘knowing’ leads to the following question: who is the knower and what is the relationship of knowledge with the knower? These are epistemological questions that need to be explored when investigating the knowledge dynamics in this CS CoP. Moore (2013, p. 345) suggests that the problem with social constructivism is that in the downward collapsing of knowledge “into the situated experience and standpoint of knowers it conflates *what* is known with *who* knows – knowledge with knowers”. In Section 3.5 I will present social realist theories of knowledge which make a distinction between knowledge and the knower and in doing so legitimise the importance of both perspectives, but first it is necessary for a short discussion about what might be called the generative mechanisms of our current view of knowledge.

The study of the nature of existence and knowledge is not new and is deeply rooted in Western philosophical tradition. In his pursuit to understand the nature and limits of knowledge, the philosopher and mathematician René Descartes (1596–1650) made his landmark statement *Cognito, ergo sum* (“I think therefore I am”). His statement about the “certainty of his thinking self” was driven by his need to state one truth that can never be undermined. Descartes sought to uncover the meaning of the natural world with a rational approach through science and mathematics (Meek, 2011). Positivism under Auguste Comte flourished in this fertile soil (Capra, 2002) and, fuelled by logic and method (Gordon, 2014), resulted in “linear thinking about a reality that is non-linear” (Jörg, 2011, p.12).

Meek (*ibid*, p. 8) proposes that the effect of positivism to this day manifests in what she describes as our “epistemic default”, defined as “hidden yet influential presumptions about what knowledge is” (*ibid*, p. 12). To describe the epistemic default, Meek (*ibid*) devised a diagnostic tool which she calls, “a daisy of dichotomies”. The core of the daisy consists of the concepts of knowledge, facts, reason, theory and science. These concepts, she states, are

associated with objectivity, the neutral public space and masculinity. The petals of the daisy represent concepts such as belief, opinions, interpretation, values, morals, practical application, art and imagination. These concepts are associated with the subjective, private space as well as femininity (see Figure 10).

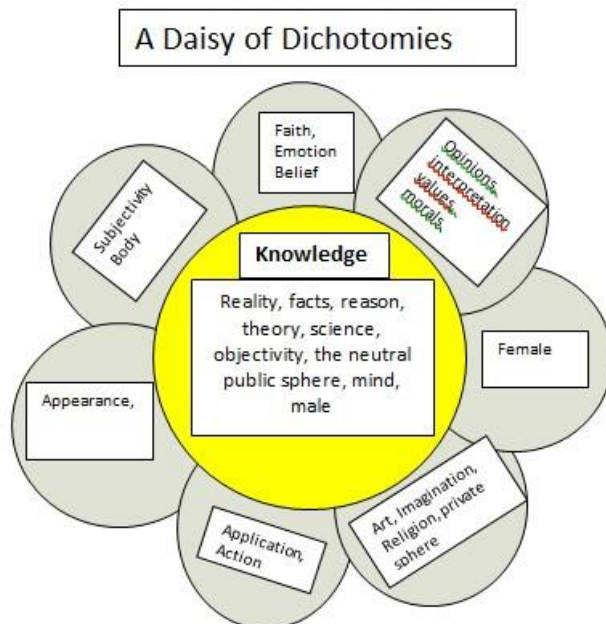


Figure 10: A diagram of the dichotomies that make up our “subcutaneous epistemic layer”, ultimately influencing the way we act in the world (Meek, 2011)

Also challenging the foundations of knowledge in modern Western society, Gordon (2014, p. 85) states the need for a “radical anti-colonial critique” that questions even the concept of logic and calls for a distinction between ‘rationality’ and ‘reason’. Gordon describes the different relationships and reactions of rationality and reason to logic and reality. He states that rationality, defined by consistency and logic, cannot afford to suspend logic and must at all times uphold its method and “generating grammar” (*ibid*, p. 85). Reason, on the other hand, can and must accommodate exceptions and contradictions in order to reflect on itself. Therefore, Gordon (*ibid*, p. 85) suggests that “science [as traditionally practiced] is more at home with rationality than it is with reason”. He goes on to argue that the colonisation of knowledge involved safeguarding “the notion of a law of nature” and controlling and limiting exceptions, and describes how the arranged marriage between science (rationality) and reason has been described as the “colonisation of reason” (Gordon, *ibid*, p.85). The demarcation of knowledge into different disciplines was in itself an act of discipline described by Foucault

(1977, p. 223) in his book *Discipline and Punish*: “The disciplines characterize, classify, specialize; they distribute along a scale, around a norm, hierarchize individuals in relation to one another and, if necessary disqualify and invalidate”. Gordon (*ibid*) argues that the mere fact that ‘knowledge’ came to be referred to in the singular indicates a disregard of other forms of legitimate knowledge. Gordon’s (*ibid*) views serve to inform a picture of dominant historic views associated with the concepts of knowledge and science that have been challenged in more recent times.

Thus, the stage was set for the age of “scientific imperialism and hegemonic powers” (Lotz-Sisitka et al., 2015) to dominate in science and philosophy for 300 years until relatively recently when a systems view of life proposed the challenge that “mind and consciousness are not things but processes” (Capra, 2002, p 33), thereby questioning deeply-entrenched ideas about learning and knowledge. The “Humboltian pursuit of knowledge for its own sake” (Muller & Subotzky, 2001, p. 168) and the “myopic preoccupation with academic forms of learning” (*ibid*, p. 175) for solving modern problems came under scrutiny, and increasingly the call is made to acknowledge, generate and reconfigure different forms of knowledge to enable social-ecological change (Muller & Subotzky, 2001; Blackmore, 2007; Young & Muller, 2010; Blackmore, et al., 2011; Bohensky & Maru, 2011; Cornell, et al., 2013; Tabara & Chabay, 2013; Lotz-Sisitka et al., 2015; Gibbons, 1998). Moore (2013, p. 338) offers a useful clarification when he states that “there are no positivists today, and have not been for a considerable time”, yet he goes on to acknowledge that “today they continue to haunt the landscape of post-modernism”.

Kress (quoted in Young & Muller, 2010, p. 12) highlights the need to challenge this dominant view when he states that “the appropriateness of the ontological/epistemological security of ‘knowledge’ is called into question in late modern society”. Meek (2011) joins the quest to restore an epistemology that will effect rather than prevent positive transformation in society. The following section will focus on describing the effects of this epistemic default in society.

3.4.2 Reforming the epistemic default.

How do we go about reforming the damaging epistemic default? Bates and Jenkins (2007) suggest that ontological and epistemological consideration is emancipatory in that it encourages reflection on the generative meta-theories driving our world, opening up the possibility of reflexive learning that can lead to the adaptation or change of dominant

destructive worldviews. Other authors echo this sentiment about the transformative potential of epistemic change: “If we always see how we’ve always seen, we’ll always be the way we’ve always been” (Bawden, 2009, p.1). Supporting this view, Sterling (2010) states that we need deep epistemic reform for social-ecological change to become possible. Bateson reinforces this idea when pointing out that “we are governed by epistemologies we know to be wrong” and that “this leads to a ‘lopsided competence’” (Bateson as quoted in Sterling, 2009, p.79). Furthermore, Maton (2014, p. 1) agrees that “seeing what is hidden by a blind spot requires a new gaze, a different insight”. Lastly, Palmer (as cited in Meek, 2011, p.5) proposes that “the shape of our knowledge becomes the shape of our living; the relation of the knower to the known becomes the relation of the living self to the larger world”.

Thus the implications for the project of describing an epistemology that will enable learning and knowledge practices for sustainability are the need to reintroduce the importance and legitimacy of the essential human traits and practices that have been relegated to the petals around the heart of Meek’s (2011) daisy (Figure 10). Echoing Wenger’s (1998) relational perspective, Meek (*ibid*) points out that “important things are being disparaged or dismissed: the legitimate and critical involvement of knowers, their perspectives, their passions, their communities, and their clout, in knowledge” (Meek, 2011, p.13).

3.5 Knowledge for Sustainability

Building on the discussion of the importance of epistemological considerations for this study, in the next section I will explore a range of contributions that propose a perspective which acknowledges both knowledge and knowers. Some are explicitly aligned with social realist theories of education and some are not explicitly aligned, yet resonate with these social realist ideas – such as the work of Tàbara and Chabay (2013) that provided a theoretical lens for my analysis of knowledge.

Section 3.4.1 reviewed historical definitions and understandings of knowledge. This section looks at definitions of robust social-ecological “action-enabling” knowledge for sustainability. It sets out to explain how deeply-embedded views of knowledge and understandings of what constitutes valid knowledge generate the kind of science and technologies that either sustain or destroy social-ecological systems.

For the purposes of their argument, Tàbara and Chabay (2013) introduce the concept of Human Information and Knowledge Systems (HIKS) in order to discuss the limitations

imposed on our thinking and understanding with regards to sustainability. One limitation, they propose, stems from separating the realities of the world into the information pools and knowledge produced solely by human society and the accumulated information in biophysical systems. The other limitation they state is based on the view of knowledge as a closed, finite system, the gaps of which can be filled. Tàbara and Chabay (2013) propose that knowledge of the human system and conditions must be considered simultaneously and at multiple scales with knowledge of the social-ecological system. This, they suggest, requires a complex systems perspective that is holistic and dynamic and linked to a social-ecological system that is recognisable by those agents that produce or use such knowledge. By social-ecological systems, they refer to biophysical life support systems on which human existence depends.

Their work “builds on the nearly four decade-old tradition of environmental sociology and social-ecological research devoted to the exploration of the content and dynamics of cultural paradigm change in science, society, policy, and education” (*ibid*, p. 78). Tàbara and Chabay’s (2013) work on knowledge worldviews bears some resemblance to Gibbons’s (1994) contribution to the sociology of knowledge field with his proposal of Mode 1 and Mode 2 knowledge production.

Other sociologists such as Young and Muller (2010); Muller and Subotzky (2001); Moore (2013) and Maton (2014) continue with this knowledge exploration; whilst, in the area of education research for sustainability, Sterling (2009, 2010) presented the idea of “transformative learning” and “ecological” intelligence (referred to in Section 3.4.2).

3.5.1 Human Information and Knowledge Systems coupled with social-ecological systems.

Tàbara and Chabay (2013) propose the re-orientation and transformation of Human Information and Knowledge systems to meet global sustainability challenges with the ultimate aim of producing robust social-ecological “action-enabling” knowledge for sustainability. Hence, what we now see emerging in citizen science is an interface where so-called “coupled epistemologies” (Tàbara & Chabay, 2013) of formal and informal knowledges, formerly regarded as incommensurate, may operate on an equal level to produce and reconfigure appropriate knowledge (Muller & Subotzky, 2001).

In the following section, I will discuss in more detail the idea of coupled epistemologies proposed by Tàbara & Chabay (2013). Associated with the type of knowledge/s that Tàbara & Chabay (*ibid*, p.72) advocate is the idea of “constellations of valid knowledge operating in an open knowledge space” and the idea of “knowledge configurations” appropriate for addressing sustainability issues in a specific context. Capra (2002) states that “meaning itself is a systemic phenomenon: it always has to do with context” (p. 73). Two forms of contextual knowledge are context-bound knowledge and context-specific knowledge. Context-bound knowledge is relevant only in the context where it is produced and used, whilst context-specific knowledge, although it is relevant to the context, also “enables the development of particular understandings of complexity and abstract knowledge that enables dialogue between contexts” (I. Schudel, personal communication, October 17, 2016).

The question that this study hopes to shed light on is: “What is the nature of the constituent parts of knowledge configurations or reconfigurations?” To answer this question I drew on the concept of “epistemic relations”, which is based on a social realist understanding of knowledge practices (Maton, cited in Schudel, 2014, p. 98). There are two types of epistemic relations, and of relevance to this discussion is what Maton (*ibid*, p. 98) calls “discursive relations between knowledge and other knowledges”, which refers to ... “the relationship between local, indigenous and everyday knowledges and abstract discipline specific knowledge” (Schudel, *ibid*, p. 98). It is these knowledge configurations that Schudel (2014, p. 103) states “[play] an important role in developing discursive epistemic relations and in developing ‘systems of meaning’”.

As stated before, knowledge configurations and reconfigurations are context-specific, but Schudel (2014, p. 96) highlights the importance of differentiating between “context-rich” and “context-bound” knowledge explorations. Muller and Subotzky (2001, p. 14) define knowledge as:

... involving sets of systematically related concepts and methods for their empirical exploration and the increasingly specialized and historically located ‘communities of enquirers’ ... with their distinctive commitment to the search for truth and the social institutions in which they are located.

They also introduce the idea of over- and under-socialised knowledge. Over-socialised knowledge, they say, ‘black boxes’ propositional knowledge, which is content knowledge, and under-socialised knowledge ‘black boxes’ the human element generating the knowledge,

which could lead to “ontological collapse” (Lotz-Sisitka, Mukute & Belay, 2012). In support of these ideas expressed by Muller and Subotzky (2001), Lotz-Sisitka et al. (*ibid*) propose that what is needed is a middle ground between over- and under-socialised knowledge. This type of knowledge is therefore both objective and historical at the same time. Related to this view is the critical realist understanding of emergent, reflexive learning processes, which maintains that meaning-making occurs in the “concrete universal” (Lotz-Sisitka et al., *ibid*). This type of learning produces knowledge that can be described as context-specific knowledge which also relates to the whole, in other words, to an understanding of both the local situation as well as how it relates to the bigger picture of the world.

Tàbara & Chabay (2013) describe two general ideal-type worldviews on HIKS. It is this heuristic that I used as a lens for my knowledge exploration. According to the one view of knowledge, knowledge is seen to evolve in a closed, linear space that is ahistorical, is separated from social-ecological systems and aims to reduce the knowledge to a single form of representation that is universally recognisable. Such closed knowledge systems are autonomous, organised in disciplines, with the research agenda set without input from society, politics and the media. The priority focus for this type of knowledge is knowledge exchange with peers in the scientific community, and it does not require validation in terms of sustainability. Furthermore, according to this view knowledge and life forms are organised according to hierarchical structures whereby ‘higher’ types of knowledge and of life forms, such as “hard” scientific knowledge, are situated ‘above’ other ‘lower’ types of knowledge and life forms, such as knowledge of an ethical, relational, intuitive or ‘everyday’ kind. This principle is also reflected in Meek’s (2011) daisy, where the so-called ‘higher’ knowledge types are positioned in the centre of the daisy with the ‘lower’ knowledge types relegated to the petals.

The second knowledge system described by Tàbara and Chabay (*ibid*) operates in an open knowledge arena that acknowledges multiple and diverse patterns of hybrid social-ecological practices and configurations embedded in a specific place at a specific time as is linked to social-ecological systems. According to this view, multiple sources and configurations of knowledge are valued for building socially-robust knowledge. Based on systems thinking, this view does not ascribe to the hierarchical ontological view of knowledge but rather recognises relationships and interdependence between different configurations of knowledge produced by different agents. This view of knowledge is inextricably bound to its social-ecological context.

Sterling (2010) described a similar dichotomy of two ways of thinking in his discussions about transformative learning and ecological intelligence. One constitutes the worldview of modernist thinking based on the Newtonian mechanistic metaphor, and the other an ecological worldview based on an organicist view of the world. Sterling (*ibid*, p. 82) explains the purpose of making explicit the worldviews that shape our thinking: “It’s a matter of ‘stepping out’ of this paradigm and recognising it – so that we master it, rather than it mastering us”. Bateson agrees that “we are governed by epistemologies we know to be wrong” (Bateson as cited in Sterling, 2009, p. 78). Therefore, the epistemological shift required to enable the production of socially-robust knowledge involves a deep-level worldview change. O’Sullivan, Morrell and O’Connor (2002, p. XVII) explain it in the following way:

It is a shift of consciousness that dramatically and permanently alters our way of being in the world. Such a shift involves our understanding of ourselves and our self-location: our relationships with other humans and with the natural world.

Milbrath (cited in Tàbara & Chabay, 2013, p. 78) understood the process of moving from one destructive worldview to an ecologically-based worldview as “social learning”.

Ideal Types (IT) used by Tàbara and Chabay (2013) are “heuristics consisting of the selection and amplification of a limited number of relevant traits that can be observed in collective behaviours, social, and cultural expressions, as well as institutional practices” (Tàbara & Chabay, *ibid*, p.73). Importantly, “IT [are only] ... starting points that aim at reflecting and summarizing key characteristics of particular realities to be further tested” and should not be viewed as claims to reality (p. 74). The value of using the IT heuristic for analytical purposes lies in the fact that it “provides a simplified characterization of two general worldviews observable in western science, education and policy” (Tàbara & Chabay, 2013, p. 73). How Tàbara and Chabay’s IT heuristic tool was used to analyse knowledge will be discussed in more detail in the next chapter about methodology in Section 4.5.3.

As mentioned in Section 3.5, Gibbons’s (1998) work on knowledge production in higher education contexts resonates with the work of Tàbara & Chabay (*ibid*). He distinguishes between two different modes of knowledge production, namely Mode 1, disciplinary knowledge production, and Mode 2, trans-disciplinary knowledge production. Mode 1 is associated with traditional expert-driven, elitist, unitary modes of knowledge generation and Mode 2 is seen as the more recent democratic, pluralist approach that is problem-based and

context-bound (Muller & Subotzky, 2001). Gibbons (1998, p. 54) states that when the “focus [is] on understanding complex systems, the need for different types of expertise becomes obvious”, and to meet “national and community needs ... [there is a need for] developing linkages between Mode 1 and Mode 2”.

The process of translating knowledge into a single scientific language of representation involves the standardisation and reduction of knowledge/s into universally recognisable components. The priority focus and outcome of creating a universal language of science is knowledge exchange between agents in the formal scientific culture (Tàbara & Chabay, 2013). Tàbara & Chabay (*ibid*, p. 77) state that “reductionism is a hindrance for the development of valid knowledge for sustainability”. Sterling (2009, p. 78) also describes the damaging epistemologies that underpin Western thinking as: “reductionist, objectivist, instrumental rationality that brings about a ‘lopsided competence’”.

Producing socially-robust knowledge involves multiple knowledge agents contributing to the process of knowledge production. This process of democratising the process of knowledge production and levelling the traditional knowledge hierarchies where scientific experts hold superior access to real knowledge is what citizen science has the potential to facilitate. In other words:

... if we place learning at the heart of transformation, recognizing that we can only transform in the right direction through learning, a transdisciplinary, integrative, open approach that blends insights from theory and practice, and from multiple disciplines and sources of knowledge and expertise, becomes essential (Tàbara, 2013, pp. 114–115).

The diagram in Figure 11 represents the two knowledge systems described by Tàbara & Chabay (2013).

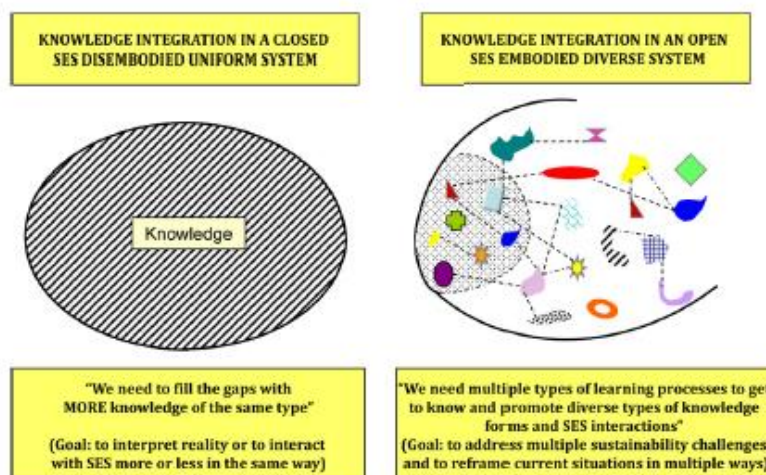


Figure 11. The two knowledge systems

(Tabara & Chabay, 2013)

3.6 Conclusion

This chapter discussed learning through the theoretical lenses provided by Wenger (1998), with his CoP theory. However, the study needed to look beyond learning theories to focus also on ‘what is being learnt’, that is, a focus on knowledge. Said to have a “blind spot” with regards to knowledge (Maton, 2014) or to “black box” knowledge (Muller & Subotzky, *ibid*) social constructivist learning theories leave us in a *cul de sac* with regards to the exploration of knowledge. Critical realism provides a philosophical motivation/foundation for looking beyond learning processes and people’s experiences in the world, at what is being learnt, through its depth ontology as explained in Section 3.3. Social realism as “a *sociological* approach that attempts to work through the implications of critical realism in relation to education” (Moore, 2013, p. 336) is generating the grammar needed. Maton (2014) provides a language that describes different knowledge practices. Maton’s recognition and description of different types of knowledge is proving helpful for the exploration of knowledge practices and potentially moves us towards better understandings of what constitutes knowledge for sustainability – the focus of this study. Tabara & Chabay (*ibid*) provide a helpful tool for analysing knowledge/s in the form of their IT heuristic of two worldviews and how they relate to social-ecological systems.

Chapter 4 Research Methodology

4.1 Introduction

This chapter begins by describing the research methodology of this study, specifically the ontological foundation and guiding research paradigm, the critical realist design and the case study research. This is followed by a description of the data-generation process and details about the data management. I continue by looking at the three analytical phases detailing the specific theoretical tools that were employed for the analysis. For an assessment of the validity and reliability of the study, criteria specifically developed for realist studies are then considered. Lastly, the ethical matters relating to this study are discussed.

4.2 Research Methodology

Research into complex social science phenomena requires a sense-making framework, also known as a scientific paradigm that needs to be made explicit by the researcher from the outset. Guba and Lincoln (cited in Healy & Perry, 2000, p. 118) identify four scientific paradigms, namely positivism; realism, critical theory and constructivism. Krauss (2005 citing Hunt) points out that “realism is also known as critical realism”. Danermark et al. (2002), writing about critical realism in social sciences research, use the terms ‘critical realism’ and ‘realism’ interchangeably, and this is also how these terms will be employed in this chapter. Healy and Perry (2000) identify the three elements of a paradigm, namely ontology, epistemology and methodology. The following section will elaborate on these three elements as applied in this study.

4.2.1 Ontological foundation and guiding research paradigm

This is a social realist study, under-laboured by critical realist philosophy. Critical realism’s contribution to this study lies in providing a framework for answering the most fundamental questions in research, namely “the ontological question of how reality is constructed and the epistemological question of our chances of acquiring knowledge about it” (Danermark et al., 2002, p. 10). Providing a philosophical foundation, as well as an epistemological starting point, Danermark et al. (*ibid*, p. 150) take care to point out that “critical realism is not a method ... [and] applying critical realism unambiguously in practical research would ... be a

misconception”. With regards to the relationship between critical realism (CR) and social realism (SR), Moore (2013, p. 336) states that “SR ... is underpinned by Critical Realist epistemology that secures a defence of knowledge in opposition to both constructionism and positivism”. He further states that social realism’s project is about translating the implications of critical realism for education through a sociological approach (Moore, *ibid*).

Whilst critical realism caters for ontological questions and epistemological considerations, it also proposes a set of methodological assertions that guide appropriate methods for realist research. With regards to what these appropriate methods might be, Danermark et al. (2002, p. 204) state that: “It [CR] does not ... exclude any method *a priori*, but the choice of method should be governed, on the one hand by what we want to know, and on the other by what we can learn with the help of different methods”. Danermark et al. (cited in Olsen, 2009, p. 4) also point to the explorative, iterative nature of the realist approach: “... the steps are not meant to be carried out in a pre-specified sequence. Instead, during a research exploration one expects to revisit earlier steps and re-work the earlier conceptual or data-collection framework”.

Returning to our discussion of critical realism’s contribution to research methodology, one of the most important contributions of critical realism is the focus on ontic depth (Olsen, 2009). As described in Section 3.3, critical realism’s depth ontology proposes the existence of an unseen reality independent of human experience, which cannot be proven empirically yet contains mechanisms which generate events that can be observed and experienced and about which knowledge can be created (Danermark et al., 2002; Moore, 2013). The implications of the view of the existence of three ontological domains are that “the method of obtaining knowledge cannot be reduced to observation of events” only (Danermark et al., *ibid*, p. 203). This element, also known as ontological realism, is one the three elements forming the pillars of philosophical critical realism according to Bhaskar (Moore, 2013).

The second pillar of critical realist philosophy, epistemological relativism, maintains that all knowledge is produced by humans and therefore fallible, being reflective of and shaped by the conditions under which it is produced. This is the arena where critical realism shares some common ground with social constructivism, yet diverges away again through the concept of emergence in the context of knowledge production, when it states that knowledge is about more than individual experience and subjectivity in that “new meanings are constructed from and *transform* existing meanings within modes of symbolic production”

(Moore, *ibid*, p. 344). Olsen (2009, p. 2) agrees that methodologically critical realism has much in common with strong constructivism but points out that it “would strongly alter its underlying assumptions and ... have little in common with empiricism”.

The third pillar of critical realist philosophy refers to the manner in which knowledge is produced. This principle operates on the premise that, from a power perspective, not all knowledge is equal. It suggests that knowledge can be powerful or not, depending on the reliability of the knowledge, which in turn is dependent on how that knowledge is produced (Moore, *ibid*, p. 345). Moore (*ibid*) explains epistemological relativism and judgemental rationality in the following way:

All knowledge is fallible because none is certain and open to revision through critique, but *how* this is done enables us *not* to assert that some knowledge is axiomatically better than others, but that some has been arrived at in *ways* in which we can be demonstratively more confident and, hence, more secure in what we choose to believe.

Barrett et al. (2017, unpagged) provide another definition of powerful knowledge when they state that “... Powerful knowledge ... describes systematic, specialised knowledge that facilitates the imagining of alternatives that extend beyond experience”.

In addition, another important feature of critical realism is that it is methodologically critical through the concept of emergence in that it allows for the possibility of transformative social action, and does so by rejecting the downward, upward and central conflation of structure and agency (Lotz-Sisitka et al., 2012).

Having described the ontological and epistemological foundations of this study I will now elaborate on the qualitative case study design of the study.

4.2.2 Research design in the critical realist metatheoretical context

Danermark et al. (2002, p. 163) redescribe qualitative and quantitative methods in terms of a critical realist metatheoretical context. Qualitative methods are viewed as intensive procedures which contain “substantial elements of data collecting and analyses of a qualitative kind”, and quantitative methods are viewed as extensive procedures that involve “quantitative data collecting and statistical analyses”. Viewed in this manner, both qualitative and quantitative methods can be employed alongside each other as “complementary empirical

procedures” in a research process guided by critical realist ontology (Danermark et al., *ibid*, p. 163). Though philosophically realism allows for the use of quantitative methods where required or deemed useful, this particular study only employed intensive empirical procedures associated with qualitative research.

4.2.3 Case study

Case study research attempts to provide in-depth insights into one or a small number of cases. Hence the questions that drive case study research are generally “how” or “why” questions as these questions require in-depth description and explanation (Easton, 2010 Danermark et al., 2002). Merriam (cited in Danermark et al., *ibid*) characterises case studies as interactions captured in ‘thick’ descriptions resulting from the observation of as many variables as possible over a long period. In this study, I aimed to provide a detailed description of the nature of learning and knowledge in a community-engaged CS project, and hence the case study design was deemed the most appropriate.

As the coordinator of the MSEP WESSA Eco-Schools Enviro Clubs component at the time of commencing this research project, I had an interest in the development, strengthening and sustainability of the project. The view that “research should have a practical purpose and that it should make a difference to the world around us” is widely held in the social science field (Bryman, 2012, p. 7). Therefore, the axiology or value bias of this study is aligned with the critical-ideological view that the researcher’s agenda towards development and emancipation is made explicit from the outset (Ponterotto, 2005). Egbo (2005, p. 274) highlights the transformational intention of research informed by critical realism, stating that it “should seek to empower the participants by legitimizing their voices and subsequently developing theory through the data that were generated from those voices”.

Critics of case study research as a scientific method point to problems with regards to theory, reliability, and validity (Flyvbjerg, 2006). The study of human affairs, Flyvbjerg (*ibid*) argues, does not allow for predictive theories and universals and is limited to concrete, context-dependent knowledge, but should nevertheless be viewed as valuable in the quest for knowledge.

Campbell (cited in Flyvbjerg, *ibid*, p. 224) states:

After all, man is, in his ordinary way, a very competent knower, and qualitative common-sense knowing is not replaced by quantitative knowing ... This is not to say that such common-sense naturalistic observation is objective, dependable, or unbiased. But it is all that we have. It is the only route to knowledge – noisy, fallible, and biased though it be.

On the assumption that generalisability is essential in order to produce legitimate scientific research and that case studies cannot be generalised, Flyvbjerg (*ibid*, p. 227) comments that “A purely descriptive, phenomenological case study without any attempt to generalize can certainly be of value in this process and has often helped cut a path towards scientific innovation”. He furthermore adds that “one can often generalize on the basis of a single case”, and suggests that “the force of example” is underestimated while “formal generalization is overvalued”. This however, is a critical realist case study, and in a CR discussion of causality, regularity and the possibility of generalisation is addressed (Sayer, 2000).

Critical realists argue “that while interpretative understandings was an important and necessary feature of any social science, it did not mean that there was no scope for causal explanation” (Sayer, 2000, p. 6). CR does not endorse the positivist view of causation based on data about regular occurrences. Sayer (2000) states that

what causes something to happen has nothing to do with the number of times we have observed it happening. Explanation depends instead on identifying causal mechanisms and how they work, and discovering if they have been activated and under what conditions (p.14).

4.3 Data Generation

To generate data, I conducted semi-structured interviews with a selection of involved MSEP participants who are active in different capacities in the organisation. To enable “triangulation”, the researcher has to use at least two methods in order to confirm the same information (Cohen, Manion & Morrison, 2000). For this purpose, in addition to the semi-structured interviews I consulted documents, conducted observations and facilitated a focus group discussion. Drawing on four methods of data generation enabled in-depth probing and triangulation of emerging data (*ibid*, 2000). Olsen, (2009, p. 14) states that “triangulation as a

means of exploring the world may lead to some confirmatory findings but is likely also to open up new avenues of discovery or deeper understanding compared with monomethod research”. The use of multiple methods is characteristic of case study research and results in what Gray (2004, p. 128) refers to as “converging evidence”, explained as “multiple pieces of evidence ... add[ing] up to a clear picture ...”. In their description of the methodology of the realism paradigm, Healy and Perry (2000, p. 123) also refer to the concept of “convergent interviewing”, explaining that “a participant’s perception for realism is a window to reality through which a picture of reality can be triangulated with other perceptions”.

4.3.1 Interviews

A total of 13 interviews were conducted with a selection of people involved with the MSEP. Gill et al. (2008, p. 292) state that “the purpose of the research interview is to explore the views, experiences, beliefs and/or motivations of individuals on specific matters”.

Using purposive sampling, I interviewed participants of the MSEP who fulfilled different roles in different aspects of the organisation, namely: Enviro Clubs, Enviro Champs and the community theatre group. This provided me with insights from grassroots to management level as well as specialist input from people involved in specific activities in the MSEP. Interviews were audio recorded. Interviews with English-speaking informants were conducted in English and transcribed verbatim by the researcher. Interviews with isiZulu speaking informants were translated and transcribed by a research assistant competent in English and isiZulu who was intimately familiar with the work of the organisation as he was, at the time, the coordinator of the Enviro Champs whilst fulfilling the function of an Enviro Champ.

(See Appendix 3 for examples of transcribed interviews from Round 1 and Round 2.)

The fine-tuning of the data-generation process is reflected in the changing structures of the interviews (see Appendix 3 for examples of transcribed interviews) as I adapted my methods to resemble more closely the semi-structured interview process. The first few interviews conducted with the help of a translator were semi-structured by design and intent, but played out in a structured way: pre-determined question (researcher) and response in isiZulu (respondent) and moving on to the next question. This was as the result of the researcher not being competent in isiZulu, and not having foreseen the “one-way” nature of a translated conversation. Realising the “shallow” nature of the data generated in the first few interviews

with isiZulu mother tongue speakers, I adapted a strategy allowing for richer data to emerge as a result of a more dynamic conversation with appropriate responses by asking the translator to play a more active role in facilitating the conversation, taking care to translate the respondents' replies back into English and vice versa. Gray (2004, p. 125) states that "the investigator must be able to respond quickly to the flow of answers and to pose new questions or issues". This, as can be seen from experience, is significantly more difficult to achieve when the researcher is not well-versed in the preferred language of the respondent.

4.3.2 Document analysis

Sixteen documents used and generated by the project, namely, teaching and learning support materials, monthly/ close-out reports, and monitoring data sheets, as well as documents that provide contextual information – current and historical – were sourced. Documentary research assumes that the meanings attached to documents are not objective and inherent to the document itself but, as subjective records of events, are themselves also subject to interpretation by the person reading the document (Hammond & Wellington, 2013). This view is aligned with the "philosophical hermeneutic" view of interpretive understanding proposed by Gadamer (as cited in Schwandt, 2003 p. 194), which states that "understanding is interpretation" and associated with being human.

4.3.3 Participant observation

To further inform the knowledge component of the study, two observations of Eco-Schools Enviro Club water quality monitoring fieldtrips were conducted. The observations provided insight into how participants of a miniSASS water quality monitoring activity learn and build knowledge through their interaction with each other and their investigations of a stream. Also observed was how they interacted with the miniSASS tool and the web portal where results were posted. The types of knowledge demonstrated were noted during the observations. The results of these investigations, for example the miniSASS score sheet, were also analysed as part of the documentary research. The data were captured videographically and transcribed in writing. The transcription and translation of this material was conducted by the researcher and a research assistant in order to ensure that the isiZulu narratives were accurate. All the materials – video and transcriptions – are available for verification.

(See Appendix 4 for an extract from a transcribed fieldtrip video.)

4.3.4 Focus Group

A focus group discussion was conducted in order to generate data on participants' understandings. The focus group firstly included discussions about the functions and practices of the MSEP over the last three years, highlighting the aspects that work well and impacts that have created value amongst those the project has intended to benefit. Secondly, we discussed what didn't work well and how to bridge the gap between what we would like to happen and what is currently happening. Lastly, mechanisms were identified that hinder progress, and ways in which these could be addressed were discussed. For the first activity participants worked in small groups. Selected photographs taken during activities over the last three years were displayed in the venue and served to trigger recollection and discussion. Groups were asked to write comments/memories/ information/knowledge/experiences that relate to the specific photograph, on a numbered note pad next to the photo page. Participants' responses were collated by facilitators on the photo page for viewing and discussion. Randomly-selected discussions were recorded using a cell phone, and these recordings were translated and transcribed with the help of one of the mother-tongue isiZulu speaking project managers.

(See Appendix 5 for an outline of the agenda of the focus group and Appendix 6 for the minutes of the focus group.)

4.4 Data Management

“Good data management was a critical pre-requisite to enable good data analysis” (Pesanayi, 2007), hence I took care to label data sources carefully and keep hard copies of interview sheets and documents in a suitcase file for future reference and queries, as well as electronic copies of scanned documents and transcribed interviews. The various roles fulfilled by the research participants were indicated in the data as follows: Enviro Champs [EC]; Mphophomeni Youth Productions [A=Actors]; the WESSA EcoSchools Environmental Clubs [SEC=Schools Environmental Clubs]; Project Manager [PM]; Enviro Champs Coordinator [ECC]. All effort were made to avoid “distorting, misrepresenting, reducing or losing data” through meticulous record keeping and transcription (Cohen et al., as cited in Pesanayi, 2007).

The data-generation process and inventory is outlined in Table 1 below and includes an inventory of data sources, dates when the data were sourced and the labels used to keep a systematic record.

Table 1: Inventory of data sources.

Description	Document Title	Date	Nature of the Document	Label
Interview 1	Interview with Project Manager – [PM]	11 March 2014	Transcribed interview	INT 01
Interview 2	Interview with FN Actor – [A]	19 March 2014	Transcribed interview	INT 02
Interview 3	Interview with NZ Actor – [A]	10 March 2014	Transcribed interview	INT 03
Interview 4	Interview with SN Enviro Champ – [EC]	19 March 2014	Transcribed interview	INT 04
Interview 5	Interview with BC Enviro Champ – [EC]	25 March 2014	Transcribed interview	INT 05
Interview 6	Interview with SD School Enviro Club – [SEC]	25 March 2014	Transcribed interview	INT 06
Interview 7	Interview with SN School Enviro Club – [SEC]	25 March 2014	Transcribed interview	INT 07
Interview 8	Interview with BM Enviro Champ – [EC]	21 April 2014	Transcribed interview	INT 08
Interview 10	Interview with ZN Enviro Champ – [EC]	28 April 2014	Transcribed interview	INT 10
Interview 11	Interview with LS School Enviro Club – [SEC]	29 April 2014	Transcribed interview	INT 11
Interview 12	Interview with LT [PM] and AL, Enviro Champs Coordinator – [ECC]	01 August 2014	Transcribed interview	INT 12
Interview 13	Interview with AL, Enviro Champs	November 2014	Transcribed interview	INT 13

Description	Document Title	Date	Nature of the Document	Label
	Coordinator – [ECC]			
Focus group	Focus group transcript of audio files and notes taken during meeting collated. Including photographs used to trigger discussion.	31 May 2014	FG observation	FG 01
Observation 1	miniSASS fieldtrip transcript of video files.	17 May 2014	An observation of a miniSASS fieldtrip	OBS 01
Observation 2	miniSASS fieldtrip transcript of video files.	2 August 2014	An observation of a miniSASS fieldtrip	OBS 02
Document 1	PopCyd Enviro Friendly Club sanitation isiZulu drama script (filmed) translated into English.	September 2014	A drama script translated from isiZulu into English	D11
Document 2	Photographs of Iceberg Conversation with PopCyd Enviro Friendly Club.	1 March 2014	Photograph of a poster outlining an Iceberg Conversation about blocked toilets. Output of a workshop with Pop Cyd Enviro Friendly Club.	D6
Document 3	Photograph of poster linking consumerism with sewage pollution in Mpophomeni generated during a workshop with the PopCyd Enviro Friendly Club.	1 March 2014	Photograph of a poster outlining a discussion around sewage pollution. Output of a workshop with Pop Cyd Enviro Friendly Club.	D7
Document 4	KL Enviro Champ completed monitoring forms over 3 years.	Feb 2012- May 2014	Map	D1
Document 5A	Overview map of Mpophomeni Township sewerage infrastructure	August 2014	Map	D10A
Document 5B	Map of BC's manholes.	August 2014	Map	D10B
Document 6	Pop Cyd Enviro Friendly Club drama	May 2014	Drama script written by learners translated from isiZulu into English.	D8
Document 7A	miniSASS introduction pamphlet	September 2013	Citizen Science resource	D5A
Document 7B	miniSASS history and definitions pamphlet	September 2013	Citizen Science resource	D5B
Document 7C	miniSASS dichotomous key for invertebrate identification	September 2013	Citizen Science resource.	D5C

Description	Document Title	Date	Nature of the Document	Label
Document 7D	miniSASS identification information	September 2013	Citizen Science resource	D5D
Document 9A	Pop Cyd Action Research Data poster (Youth Environmental Science Conference (YESC) submission)	June 2014	Poster – learners’ work.	D9A
Document 9B	Umthombo YESC poster	June 2014	Poster – learners’ work.	D9B
Document 10	Umthombo Enviro Club documentary film.	October 2012	Transcript of a documentary film.	D2
Document 11	MiniSASS observation details posted on the miniSASS web portal.	June 2013; September 2013; May 2014	Records of fieldwork observations on the miniSASS website.	D4
Document 14	Monitored manholes numbers and coordinates.	9 April 2013	List of names and coordinates	D3

4.5 Data Analysis

The analytical process was linked to the specific phases of the study as outlined in Table 2 below, according to the sub-questions 1, 2 and 3. I used the process of coding according to analytical categories which were constructed with the help of the guiding theories, namely Wenger’s (1998) CoP and Tàbara and Chabay’s (2013) IT knowledge worldviews. As explained previously, the transcribed interviews were coded in terms of themes proposed by the theories employed as analytical lenses. The coded data were then organised in the form of analytic memos. The reflexive and explorative nature of the realist research process is reflected in the example of the adjustment of the interview process above. In the text on research methods, Danermark et al. (as cited in Olsen, 2009, p. 4) state that “during a research exploration one expects to revisit earlier steps and re-work the earlier conceptual or data-collection framework”.

For analysis of the data, abductive reasoning was used as the main strategy. Danermark et al. (2002, p. 89) describe abduction as “... discovering, or drawing conclusions from, circumstances and structures that are not given in individual empirical data and involving “redescription / recontextualization”. Distinguishing abductive reasoning from the “empirical generalization” of inductive approaches and the logically rigorous approach of deductive reasoning, Collins (cited in Danermark, et al., 2002, p. 90) states that “abduction is to move

from a conception of something to a different, possibly more developed or deeper conception of it”. Achieving this requires a different skill set from the abductive researcher who, unlike the inductive researcher competent in “specific statistical analysis” and the deductive researcher skilled in “logical reasoning”, is required to display “creativity and the ability to form associations (Danermark et al., *ibid*, p. 93). The guiding theories mentioned above, namely Wenger’s (1998) CoP and Tabara and Chabay’s (2013) IT knowledge worldviews provided the theoretical starting point from where the process of “redescription” of learning and knowledge in the MSEP took place.

Taking individual phenomena, for example learners in the MSEP Enviro Clubs doing miniSASS water quality monitoring, I set out to interpret and recontextualise these phenomena within a conceptual framework – CoP learning theory and IT knowledge worldviews – to understand learning and knowledge in a new way by observing, interpreting and making sense of the activity in a new conceptual framework, that is community-engaged CS (Danermark et al., *ibid*). It is important to emphasise that the abductive approach does not claim to apprehend a truth, but instead proposes to produce a “conclusion [that] provides new insight ... a fallible insight, a form of hypothesis (Danermark et al., *ibid*, p. 90).

Table 2: The analytical phases, categories and guiding theories

Phase	Sub-question	Analytical categories and guiding theories	Data source/s
1	Sub-question 1: Can the MSEP be viewed as a CoP?	Mutual Engagement – ME Joint Enterprise – JE Shared Repertoire – SR (Wenger, 1998)	Int.01 – Int.10
2	Sub-question 2: What is the nature of learning in the MSEP?	Learning Identity – LI Learning Meaning – LM Learning Practice – LP Learning Community – LC (Wenger, 1998)	Int.01 – Int.11 D.01 – D.11 Obs.01 – Obs.02 FG. 01
3	Sub-question 3:	Knowledge as an open, diverse, social-ecological	

What is the nature of emergent knowledge in the MSEP?	embodied system: Codes A-J.	Int.01 – Int.11
	Knowledge as closed,	D.01 – D.11
	uniform, social-ecological	Obs.01 – Obs.02
	disembodied system: Codes 1-10.	FG. 01

Analytic categories will be discussed in more detail in the following sections. These data supplied raw material to enable thick descriptions, which follow in Chapter 5.

4.5.1 Phase 1: Analysis of MSEP as a CoP.

Phase 1 addressed sub-question 1 and looked at whether the MSEP functions as a CoP. This provided a foundation on which the rest of the study was built. In order to “derive a consistent set of general principles” (Wenger, 1998, p. 4) from complex social phenomena requires the artificial separation of the essentially inseparable such as the three criteria that define a CoP, namely: mutual engagement, joint enterprise and shared repertoire. Wenger (*ibid*, p. 5) also points to the “interconnected and mutually defining” nature of these concepts, and in the course of working with this theoretical construct it presented an ongoing challenge. I proceeded through careful reflection on the meanings of the three elements and a consideration of the ways in which they represent slight nuances of meaning. My understanding of the three elements developed as follows. Mutual engagement is different from joint enterprise in that it refers to *activities* not goals. A fictional example is the following statement: “To make them understand (JE) *we talk to people about what not to throw down the toilet*” (ME). Joint enterprise I understand to refer to *goals* shared by members of the CoP. This involves the conceptualising of an agreed-on course of action (ME) that constitutes the CoP’s negotiated response to the issue.

Finally, the criterion of shared repertoire refers to the shared concepts, actions, discourses, historical events and artefacts that arise from the activities of the CoP while engaged in the joint enterprise. In other words, shared repertoire has to do with the *content* and *structure* of the activities i.e. concepts, themes, specific language terms and tools used consciously or unconsciously by members of the CoP. Following is an extract from the analytic memorandum [AM1] for the analysis of the MSEP as a CoP. For Phase 1, the 13 semi-structured interviews provided the data that were analysed to assess whether the MSEP functions as a CoP.

Determining the nature of learning in the MSEP Community of Practice - A closer look at what makes the MSEP a Community of Practice.	
Category: Mutual Engagement = Code: ME. Working together and doing things together including awareness of complementary competences. ME refers to ACTIVITIES not goals and this might distinguish ME from JE. E.g. "To make them understand" (JE) we talk to people about what not to throw down the toilet (ME).	
Respondents included the Project Manager [PM]; Actors [A]; Enviro Champs [EC]; School Enviro Club members [SEC].	
Example of referencing data source: Interview 02 [Actor], page 2, line 38 = Int. 02[A].2/38.	
Response	Source
... we had this idea quite a long time ago that it would be nice for people who lived in the community to be Enviro Champs – people who could watch what was going on in the community ...	Int.01[PM].1/24,25.
It's very obvious and visual and in your face so but I think that it is an area that the Enviro Champs themselves need to address with their own councillors and put pressure on the uMngeni Municipality and jack up the service delivery ...	Int.01[PM].9/284-286.
... so they phone the plumbers ...	Int.01[PM].13/407.
... people were employed although is not that much, to teach the community how they can engage in decreasing the rate of spilling manholes,	Int.02[A].1/15,16.

Figure 12: An extract of the analytical memorandum [AM1] for Phase 1 (L. Boothway, 2014)

4.5.2 Phase 2: Analysis of learning in the MSEP.

Phase 2 set out to answer sub-question 2 and looked in depth at learning in the MSEP CoP. The following aspects highlighted by Wenger (1998) assisted with gaining an understanding of learning processes in a CS CoP. Firstly, learning and identity refer to the process of “how learning changes who we are and creates personal histories of becoming in the context of our communities” (Wenger, 1998, p. 5). Secondly, learning and meaning refer to how learning influences our “ability – individually and collectively – to experience our life and the world as meaningful” (Wenger, 1998, p. 5). This is reflected through the ability to establish connections between what we see and what we have learnt, and what we do / what happens in the world around us. Thirdly, learning and practice refer to shared activities that help members of the CoP to keep working together, for example the things that they do together like meetings, training days, fieldtrips, workshops, and social gatherings. Lastly, learning as community refers to “learning as belonging ... the social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence” (Wenger, 1998, p. 5). Following is an extract of the analytic memorandum

[AM2] for the analysis of the characteristics of learning in a CoP. Data from the semi-structured interviews, observations, focus group and documents informed this phase of the study.

Analytical tool and memo for learning in a CoP - Learning Meaning.

Determining the nature of learning in the MSEP Community of Practice - A closer look at the components of learning in a Community of Practice.	
Category: Learning Meaning = Code: LM. This criteria refers to "learning as experience ... talking about our (changing) ability – individually and collectively – to experience our life and the world as meaningful" (Wenger, 1998, p. 5). Making connections between what we see and what we've learnt and what we do/what happens in the world around us.	
Respondents included the Project Manager [PM]; Actors [A]; Enviro Champs [EC]; School Enviro Club members [SEC].	
Example of referencing data source: Interview 02 [Actor], page 2, line 38 = Int. 02[A].2/38.	
Response	Source
They're producing the information so Graham Jewitt is now interested in the social aspect, ok, so there are people involved here and working with people is more difficult than measuring the number of e.coli.	Int.01[PM].8/251-253.
In the past I didn't know that the river stream needs to be protected and living organisms in water need to be protected too.	Int.06[SEC].3/71,72.
The work I do leads to a healthier life for all of us when I am trying to make people understand about the environmental issues.	Int.07[SEC].1/22-24.
If people do take care of the environment I will tell people and future generations that I was the member of the MSEP project that brought the change to the Mpophomeni community.	Int.07[SEC].p.1/25-27.

Figure 13: An extract of the analytical memorandum [AM2] used for Phase 2 (L. Boothway, 2014)

4.5.3 Phase 3: Analysis of knowledge in the MSEP

Phase 3 addressed sub-question 3 through an investigation of the emerging knowledge in the MSEP. Ideal Type (IT) basic descriptors and metaphors for the two types of worldviews of knowledge were used to construct the analytical tool for this phase. The Weberian sociological IT heuristic provides a simplified characterisation of two general worldviews of knowledge systems currently observable in Western science, education and policy (Tàbara & Chabay, 2013). ITs constitute a fundamental device in the formulation of social theories and explanations. Importantly, Tàbara and Chabay (*ibid*) note that ITs cover a limited part of social reality and hence are merely starting points aimed at reflecting and summarising key characteristics of particular realities *to be further tested*. The two IT knowledge systems/worldviews that Tàbara & Chabay (*ibid*) describe in terms of the connection to social-ecological systems are: firstly, knowledge as an open, diverse, social-ecological

embodied system and secondly, knowledge as a closed uniform social ecological disembodied system. They identify the following indicators according to which the two knowledge systems were evaluated in this study.

1A) *Knowledge representation* as representing a single scientific language that is reductionist or standardised in nature or multiple configurations of contextualised knowledge that acknowledge the validity of multiple knowledge types;

2B) *Knowledge arena* as finite and closed or open;

3C) *Knowledge actors* as either limited to scientists or including a wide range of knowledge actors;

4D) *Disciplinarity*, referring to the knowledge produced demarcated into different disciplines or inter/transdisciplinary by nature;

5E) *Research agenda* as predetermined and detached from society, politics and the media or the result of society and knowledge actors participating in the setting of the research agenda;

6F) *Context*, relating to the knowledge being independent of the social-ecological context of reference or whether it can be described as context-bound knowledge for a purpose in a specific place;

7G) *Knowledge archive*, referring to whether the knowledge is captured in the dominant language of science in archives for future access or whether it is transient (like knowledge conveyed in oral cultures) and often lost;

8H) *Complexity*, referring to whether the knowledge reflects abstractions that reduce complexity, producing simple theories and explanations, or whether the knowledge reflects a holistic, dynamic, complex systems perspective;

9I) *Ethics and values* that relate to the question of whether moral and ethical values are separated from objective analysis or whether objective analysis is informed by moral and ethical values;

10J) Linked to criterion 9I above is the question of *responsibility and application of knowledge*. According to this criterion, the evolution of responsibility can either not be assumed from the producer, holder and applier of knowledge or be associated with the

producer, holder and applier of knowledge. In other words, it is knowledge that assumes responsibility.

These 10 criteria were used to explore the questions around knowledge in the MSEP during Phase 3. Data generated through the interviews, document analyses, observations and focus group served to inform this phase of the study.

See the extract from the analytic memorandum [AM3] below used for the analysis of knowledge. See Appendix 14 for the full analytical memorandum (AM3).


Themes/Codes: A/1:Representation; B/2:Knowledge arena; C/3:Actors; D/4:Disciplinary; E/5:Agenda; F/6:Context; G/7:Knowledge archive; H/8:Complexity; I/9:Ethics; J/10:Responsibility																						Integrated
Extract	Source	Codes A-J: Knowledge as an open, diverse, social-ecological embodied system.										Codes 1-10: Knowledge as closed, uniform social-ecological disembodied system.										
		A	B	C	D	E	F	G	H	I	J	1	2	3	4	5	6	7	8	9	10	
Our babies get diseases from that leakage and also our animals that we live with, swim there and come back with cholera. Even us we are old we also get that sickness all the time. We also get blocked noses, rash and runny stomach.	D.2.01/26-29.	x					x															
We would be happy if some people in high places, will come and solve our problem, because this place is disgusting. They always come but they don't do anything about the manhole. They don't come and fix this manhole. It's been 9 months now.	D.2.01,02/29-31.									x												
Name: Thandanani Luvuno.	D.3.01.			x			x															
Code: TL1	D.3.01.			x			x															
Coordinates: -29,56633/30,192396	D.3.01.																			x		
TL5: -29,55971/30,18533	D.3.01.										x											
 minIAS observation details	D.4.01,02.	x	x			x						x						x			x	

Figure 14: An extract of the analytical memorandum [AM3] for Phase 3.

4.6 Realist criteria for validity and reliability

Healy and Perry (2000) identified the need for criteria to test the quality of realist research that are drawn from the realist paradigm and not derived or adapted from either positivist or constructivist paradigms. As a result, they developed a set of six criteria specific to realism research, which I will describe in the following section. I then continue by demonstrating how this research project complied with Healy and Perry's (*ibid*) six criteria. The first two criteria are derived from realist ontology, and the third criterion from realist epistemology, and the last three were based on the realist methodological stance.

4.6.1 Ontological appropriateness

The first criterion relates to the question of ontological assumptions underpinning the study. According to this criterion, to qualify as a realist study the world being investigated must be *ontologically appropriate*. In other words, in realist terms, it must be a world that is a complex, social world involving reflective people. Learning and knowledge as it “plays out” in a citizen science project that aims to address a complex social-ecological problem, namely water pollution, and the views of people involved in the project as well as the knowledge products were investigated. Hence, it can be concluded that the study looked at ‘a complex, social world involving reflective people’ and was therefore ontologically appropriate.

4.6.2 Contingent validity

This criterion, like the previous one, also relates to the ontological views of the study. It speaks to the validity about generative mechanisms and contexts that make them contingent. To qualify as a realist study it assumes social reality to be an “open fuzzy boundary system” and hence rejects the lab testing nomothetic approach (Healy & Perry, *ibid*, p. 123). At best it aims “to develop a family of answers” (Healy & Perry, *ibid*, p. 123) that involves not only descriptions but also probing the causal mechanisms. Not only did the study describe the current civil action taken by citizens to address the problem of water pollution in their community, but it also provided the contingent context of historical political civil action and related the legacy of the Apartheid policy of racial separation and the unequal distribution of services to the current problem and response. Thus it can be said to have considered contingent validity.

4.6.3 Multiple perceptions of a single reality

The third criterion relates to realist epistemology that assumes multiple perceptions about a single reality. Through the method of triangulation, the study reaches beyond the limit of participants’ subjective views towards an approximate understanding of an unseen objective reality. Therefore, interviews that reflect the perceptions of participants in the MSEP were supplemented by three other methods of data generation – document analysis, fieldwork observations and focus group discussions – to enable triangulation of data.

4.6.4 Methodological trustworthiness

This criterion relates to realist methodology that aims to provide a comprehensive database to inform future studies as well as validate the claims in the research report. In the case of this study, such a comprehensive record of documents has been carefully kept and is available on request. Another strategy that reflects methodological trustworthiness is the use of direct

quotation, gleaned from the interviews and other data sources, in the research report. Chapter 5 of this report contains examples of direct quotations that enabled “thick descriptions” such as have come to be associated with realist research.

4.6.5 Analytic generalisation

Analytic generalisation is also a methodological criterion referring to the realist aim of theory-building. This study did not set out merely to test the theories that assisted with providing a starting point for investigation such as Wenger’s (1998) CoP theory, Tàbara and Chabay’s (2013) ideas about worldviews, and social realist ideas around knowledge. Using abductive reasoning, the study took these theories that are applicable to a wide range of social contexts and re-contextualised these theories in terms of a citizen science context. It therefore aimed not just to test the mentioned theories, but also to build theory by generating a new analytical tool for knowledge exploration.

4.6.6 Construct validity

The last criterion suggested by Healy and Perry (*ibid*) is also derived from methodology and refers to the quality of the measurement of the theoretical constructs used in theory building. Constructs used in theory building need to be measured. The theoretical constructs employed for the learning component of this study were developed by Wenger (1998) and have been tried and tested over the last few decades and found to be valid and useful. One only needs to research the number of studies that have drawn on CoP theory to verify this claim. The constructs used to look at knowledge aspects were based on theoretical work done by Tàbara and Chabay (2013) on IT knowledge worldviews.

4.7 Ethical aspects of the study

In the following section I will describe the ethical aspects of the study and report on my compliance in terms of current ethics protocol. However, it is important to point out that protocol is continually being revised in the interest of producing more ethical, better quality research. Gray (2004, p. 58) states that: “The ethics of research concern the appropriateness of the researcher’s behaviour in relation to the subjects of the research or those who are affected by it”. Generally-accepted ethical considerations in scientific research are: voluntary participation and harmlessness; anonymity and confidentiality; disclosure – information about the study; and analysis and reporting (Bhattacharjee, 2012, p. 137).

In terms of the first criteria of voluntary participation and harmlessness, I informed participants of the purpose of the study, emphasising the voluntary nature of their contribution and their right to withdraw their involvement and input at any stage during the research process. A letter from Rhodes University introducing my study was presented in both English and isiZulu and consent forms to be signed by the participants were also available in both languages. A copy of the Rhodes University endorsement letter as well as a copy of the consent form to participate in the research can be seen in Appendix 7 and Appendix 8.

With regards to the second criteria of anonymity and confidentiality, research participants were assured of anonymity and all data used was coded instead of using the participants' names. This served to protect respondents from come-back if sensitive information were to be revealed and it gave them more confidence to share without fear of consequences. Observations of fieldtrips recorded on video were transcribed in writing to ensure the anonymity of participants. Photographs used in the report were blurred to obscure the faces of the participants except in one case where the subject gave permission for his photograph to be published in the report (Figure 20) (See Appendix 8).

In terms of the disclosure criteria, I reiterated the purpose of the study before each individual data-generation event, such as the focus group and the fieldwork observations, and committed to making the research results available in the form of this research report on completion of the project. This leads to the fourth criteria, namely analysis and reporting. My position as a participant insider researcher and my interest in strengthening the project was made clear from the outset. This assists with reading the analysis as the inevitable bias of the researcher, though not avoidable, is acknowledged. Before finalising the report it was sent to the project manager to scrutinize for errors and misinterpretations. The reporting aspect presented an ethical challenge unique to this particular case for the following reasons. Exposing facts about the long-term spilling of raw sewerage into a provincial water source as a result of the lack of infrastructure maintenance could impact on future funding from the very authorities responsible for maintaining the infrastructure. As projects like the MSEP generally struggle for survival in spite of their relatively 'frugal' financial needs, it presents a careful balancing act on the part of respondents in terms of expressing their frustrations about a lack of sufficient responses on the part of the authorities, as well as on the part of the researcher when presenting the findings of the study.

4.8 Being an insider-researcher

Herrmann cited in Unluer (2012) states that: “Insider participant observation ... is considered the most important and challenging instrument in qualitative studies” (p. 2).

The role of the insider-researcher can be described in the following way: “... generally insider-researchers are those who choose to study a group to which they belong, while outsider-researchers do not belong to the group under study” (Unluer, *ibid*, p. 1).

For this study, I was both an insider-researcher by virtue of the fact that I was involved with the MSEP in my capacity as the clubs coordinator and an outsider-researcher because I was not a member of the Mpophomeni community, as most of the MSEP participants were, and, therefore did not experience the problem of sewage pollution first hand. In addition my inability to converse in isiZulu situated me in an outsider position.

The advantages associated with being an insider-researcher with regards to the MSEP included having a good prior understanding of the organisation; my presence not affecting the natural flow of interactions and lastly, having established good relationships with the research informants which enhances the possibility of informants telling the truth and of the researcher judging the validity of the information offered (Bonner & Tolhurst cited in Unluer, *ibid*). Smith and Holian cited in Unluer (*ibid*) state that “in general, they [insider-researchers] have a great deal of knowledge, which takes an outsider a long time to acquire” (p. 1).

Disadvantages associated with insider-research are the potential loss of objectivity and the danger of making assumptions based on the researcher’s existing knowledge of the situation (DeLyser and Hewitt-Taylor cited in Unluer, *ibid*). Role-duality is cited as a third potential disadvantage faces by an insider-researcher as can be difficult to balance the insider and researcher roles (DeLyser and Gerrish cited in Unluer, *ibid*).

Data collection can be influenced when the insider-researcher is in a position of power over the research informants (Smyth & Holian cited in Unluer, *ibid*). In my case this did not apply to the majority of respondents who were involved with the aspects of the MSEP not managed by me. Being intimately familiar with the functions of the MSEP also enabled me to collect a range of data continuously and during meetings and excursions which would not have been known or accessible to an outsider-researcher. This enabled the collection of what Unluer (*ibid*) describes as “more detailed and more versatile, and ... more trustworthy data” (p.5).

Determining a research question can also be influenced by the insider status of a researcher in that the researcher may find it difficult to formulate a question to which they feel they already know the answer. In my case the research question was a “real question” which I, through the process of data collection and analysis, discovered.

4.9 Conclusion

The interest of this study was to gain an in-depth understanding of the nature of the kind of learning processes that take place within a CoP and, inextricably linked to the aspect of learning, the nature of knowledge that emerges from these learning processes. The aim was to explore, describe and explain learning and knowledge that enable social-ecological transformation in order to facilitate and enable these processes in contexts where natural resource dilemmas present wicked problems (Rittel & Webber, 1973) with wide-scale social-ecological impacts. This required the in-depth mining for “rich data” (Gray, 2004), and for this purpose I used an intensive case study research design (Easton, 2010). The research methods employed were guided by a social realist epistemology and under-laboured by critical realism. The analytical approach was based on abductive reasoning with a view not to prove anything or be able to generalise findings but rather to redescribe and recontextualise the phenomena of learning and knowledge within a citizen science context (Danermark et al., 2002). The reliability and validity of the study was assessed according to realist research criteria. A discussion of ethical aspects concluded the chapter. Figure 15 provides a diagrammatic summary of the study.

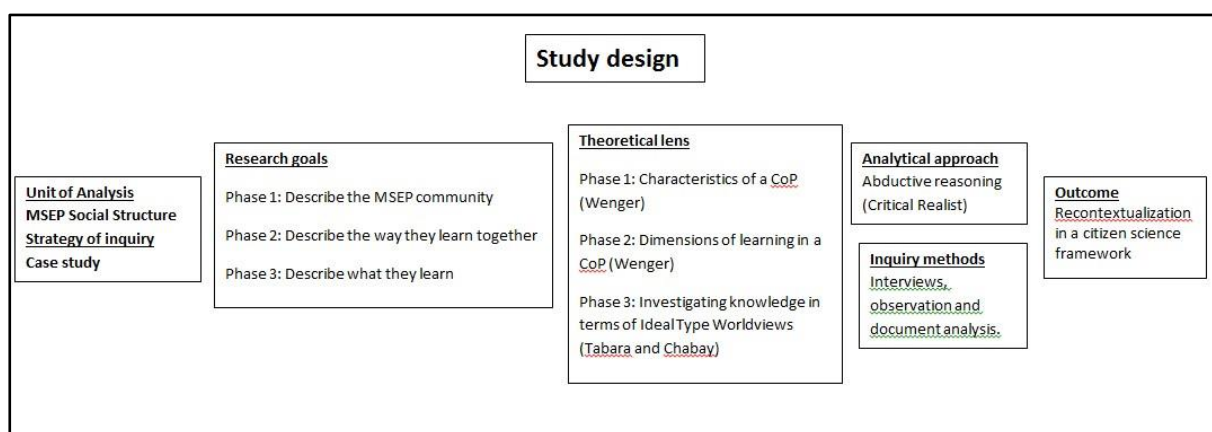


Figure 15: A diagrammatic summary of the study design (L. Boothway, 2018)

Chapter 5 A presentation of the data

5.1 Introduction

The purpose of this chapter is to present the findings that resulted from my exploration of learning and knowledge in the MSEP as a community-engaged CS project. The chapter is organised according to the three research sub-questions. Wenger's (1998) CoP theory provided the theoretical lenses for sub-question 1: Can the MSEP be viewed as a CoP? and sub-question 2: What is the nature of learning in the MSEP? Lastly, Tabara & Chabay's (2013) IT heuristic of two knowledge worldviews provided the theoretical lens for answering sub-question 3: What is the nature of emergent knowledge in the MSEP? Through the use of direct quotations from interviews with a range of participants in the MSEP and a focus group discussion, as well as excerpts from documents analysed and fieldwork observations, this chapter aims to provide a thick description of the data generated by the study.

5.2 An overview of MSEP activities

Section 1.5.1 provides a brief description of the three components of the MSEP. In the following section I will provide more detail with regards to the specific activities that took place. This section will also feature some of the documentation used as well as documents and tools that were developed in the course of the MSEP's work and served as data to inform the study.

5.2.1 Enviro Champs

As mentioned in Section 1.5.1.1 the Enviro Champs are volunteers living in Mpophomeni who have been appointed to report sewage spilling events in their designated area, usually near their own homes but also in other parts of the township. Table 4 below is an excerpt from a table outlining the names/numbers of the monitored manholes as well as their GPS coordinates. For purposes of confidentiality the names of the Enviro Champs have been replaced with codes.

Table 4: Examples of named manholes with GPS coordinates (A. Lipheyana, 2013)

No	Name							
1	Enviro Champ TL	TL1 -29,56633 30,192396	TL2 -29,56552 30,19193	TL3 -29,56494 30,18888	TL4 -29,56124 30,18634	TL5 -29,55971 30,18533	TL6	TL7
2	Enviro Champ NZ	NZ1 -29,57171 30,194025	NZ2 -29,57140 30,194084	NZ3 -29,571297 30,194736	NZ4 -29,571318 30,194233	NZ5 -29,57094 30,194174	NZ6 -29,57103 30,193958	NZ7
3	Enviro Champ MD	MD1 -29,57684 30,19212	MD2 -29,57682 30,193008	MD3 -29,576942 30,192953	MD4 -29,574886 30,193672	MD5 -29,57484 30,194477	MD6	MD7

The duties of the Enviro Champs involve the immediate reporting of sewage spilling events to the municipal call centre and the completion of the report sheet which stipulated that the following information had to be provided: name of Enviro Champ; cell number; house number; name of ward councillor and numbers of manholes for which the Enviro Champ is responsible. In terms of the details about the actual spilling events, the following information was required: date of spilling manhole; manhole number; date reported; name of plumber and contact number; date fixed; days spilling after reporting; causes of blockage (nappies, rags, spoons, plastic bags; building material; vandalism (rocks); scrap metal; animal parts); other comments. The reporting form also has columns for reporting potable water leaks as well as a space for comment about rubbish collection and illegal dumping. (See Appendix 1 for an example of the EC reporting sheet and Appendix 9 for an example of a map of the manholes allocated to one Enviro Champ.)

Data gathered by the Enviro Champs were collated monthly by the Enviro Champs coordinator and submitted to scientists at GroundTruth Environmental Consultants who further interpreted the information in the form of Excel spreadsheets and maps. Figure 16 contains a summary of results of monitoring data over the period 2012–2014:

TOTAL NUMBER OF SPILLAGES REPORTED FOR THE PAST 3 YEARS IS 272	
As the result of	
-INFRASTRUCTURE FAILURE	=13.97%
-BLANKS	=12.5%
-HOUSEHOLD SOLID WASTE	=61.03%
-Misc	=5.88%
-ANIMAL PARTS	=1.1%
-VANDALISM	=1.1%
-BUILDING MATERIAL	=4.78%
TOTAL NUMBER OF DAYS OF MANHOLES SPILLING AFTER REPORTED FOR THE PAST THREE YEARS IS 4525 DAYS	
AS THE RESULT OF	
-INFRASTRUCTURE FAILURE	=92%
-BLANKS	=1.77%
-HOUSEHOLD SOLID WASTE	=4.44%
-Misc	=0.66%
-ANIMAL PARTS	=0.044%
-VANDALISM	=0.09%
-BUILDING MATERIAL	=0.99%

Figure 16: Collated results of monitoring of the causes of blocked manholes during the period 2012–2014 (A.Lipheyana, 2014)

The monitoring work done by the Enviro Champs was the main reason why the MSEP started but, recognising the importance of education to address the problem in the long run, the two other complementary components were introduced.

5.2.2 Mpophomeni Youth Productions

The background to the Mpophomeni Youth Productions involvement in the MSEP is outlined in Section 1.5.1.2. Their informal, non-threatening approach aimed to nurture an atmosphere of openness and social cohesion whilst raising awareness of the problem. The project manager describes the activities of the MYP in the following way:

It was all done in a very kind of jovial and fun way, but the community and the people that were watching could recognize that action and then that would bring up a discussion about it, or they would portray somebody throwing some, even sanitary pads – they talk about that – and nappies and condoms and they’d have somebody throwing that down the toilet and the people in the audience would laugh and then they’d say, ja, they know people that do that, so that would bring up some kind of discussion as well (L. Taylor, personal communication, March 19, 2013).



Figure 17: An actor from the Mpophomeni Youth Productions acting out “The Toilet Play” (Photo: L.Boothway. 2013)

The plays written and performed by the MYP team always ended with the slogan “Together we can do more” accompanied by the raised clenched fist gesture associated with the “amandla/power” cry of the Apartheid struggle. The transposing of historical political activism into the social-ecological domain to address the human-rights issue of sewage pollution, is reflected in the use of the ANC party’s slogan and associated gesture.

Depending on the audience the sound of the “together we can do more” ending is adjusted to be friendly or fun or activist or loud. The context or audience calls for the appropriate tone. It is thus an adaptable situation that can connect and co-engage with people rather than be predetermined. (L. Taylor, personal communication, February 2, 2019)

5.2.3 WESSA EcoSchools Environmental Clubs

The following information was obtained through personal experience as the coordinator of the WESSA EcoSchools Enviro Clubs for the period of 2012–2014, as explained in Section 4.2.3. The WESSA EcoSchools Environmental Clubs were affiliated with the main local high schools in the township and were known as: *The Earth Guardians*; *The Pop Cyd Enviro Friendly Group* and *The Eco Wonders*. Whilst enriching their own environmental skills and knowledge through their participation in the clubs, the learners assumed the roles of environmental educators themselves and shared what they learnt with their fellow students at

school and with their families. Water was the dominant theme throughout the programme, but learners employed different, creative methods to do research and share their findings. Methods generally involved the use of cell phones to record interviews with people in the community and to take photographs. In addition, a laptop computer was used by the learners to upload miniSASS results, type research reports and transcribe interviews, as learners had limited access to electronic media facilities and were eager to interact with technology. Creative mediums such as drama and music were also popular choices. As a result of this approach a diverse range of knowledge products emerged, some of which will now be discussed in more detail.

5.2.3.1 Documentary film about water pollution in Mpophomeni

The making of the film “Mpophomeni – Born.Bread.Buttered” (see Appendix 10 for the written transcript of the film) originated in the learners’ involvement with the UKZN-initiated Mathuba Schools and Citizens River Health Programme. The project aim was:

... to create opportunities for learners of all ages (the youth as well as the community at large) to become personally involved in a variety of fieldwork activities relating to the health of rivers, particularly local rivers, their immediate environments and the catchments to which they are connected (Dent, 2013).

Mathuba required of the learners to take photos of environmental problems in their community, pin the images to the exact location on Google Earth and post the images with short Iceberg discussions (Senge et al., 2008). (See Figure 19 of the diagram of the Iceberg Conversation as a way of explaining reality.) A description of the Iceberg Conversation model follows in Section 5.2.3.2. Learners’ involvement in the Mathuba project supported the development of a range of skills such as the ability to recognise and record local environmental problems, becoming proficient at using the Google Earth programme, learning to think through the unseen causes behind visible phenomena, and developing a holistic understanding of the world around them. With this foundation of knowledge and skills, *The Earth Guardians* decided to document the problem of sewage pollution in their community in the form of a short film. Interviews conducted with residents in the community informed the script. The process of transcribing the isiZulu interview data into English was done on the laptop computer by one of the learners. A visiting British cinematographer assisted with the making of the film.



Figure 18: Screenshots from the documentary film uploaded on YouTube

Following is a transcribed extract from the film (D.2) which was uploaded on YouTube:

[Words on the screen] We the students of Mpophomeni want to educate our town about this serious crisis.

[Footage of waste water with solid waste in a wetland near a manhole]. Student in school uniform standing on the manhole, talking and pointing in the direction of Midmar Dam].

Midmar Dam is 2 km away from this manhole.

Animals drink from this manhole and they eat this grass [footage of chickens walking in the wetland and a cow grazing near a polluted stream] and then they go back at home and people eat them. So that's how people get germs because of this manhole.

If this doesn't get clean it goes into Midmar and it affects the clean water in Midmar.

It's because people put the wrong things in the toilet [footage of a used sanitary pad on the edge of the spilling manhole] like you see paper, socks and everything. [Photo of a group of young people on the edge of a spilling manhole with clipboards having a discussion with a person standing on an 'island' in the middle of the stream of waste water flowing from the manhole. Photo of a used condom lying in the grass. Photo of a learner standing next to a very polluted stream taking a photo].

Not the toilets the bins!! (D.2.01/12-25). (See Appendix 10 for the film transcript.)

5.2.3.2 Iceberg Conversations

To assist with developing a holistic understanding of the issue of water pollution, learners engaged in discussions aimed at uncovering the underlying causes of these visible phenomena in order to effect long-term change at a deeper level. The idea of Iceberg discussions to achieve deeper understandings of generative mechanisms is based on CR depth ontology described in Section 4.2.1 and was first conceptualised by Senge et al. (2008). The diagram in Figure 19 below illustrates the main questions behind the different layers of

reality identified as events, patterns/trends, systemic structures and mental models, with the potential for transformation residing in the deepest layer, namely, mental models.

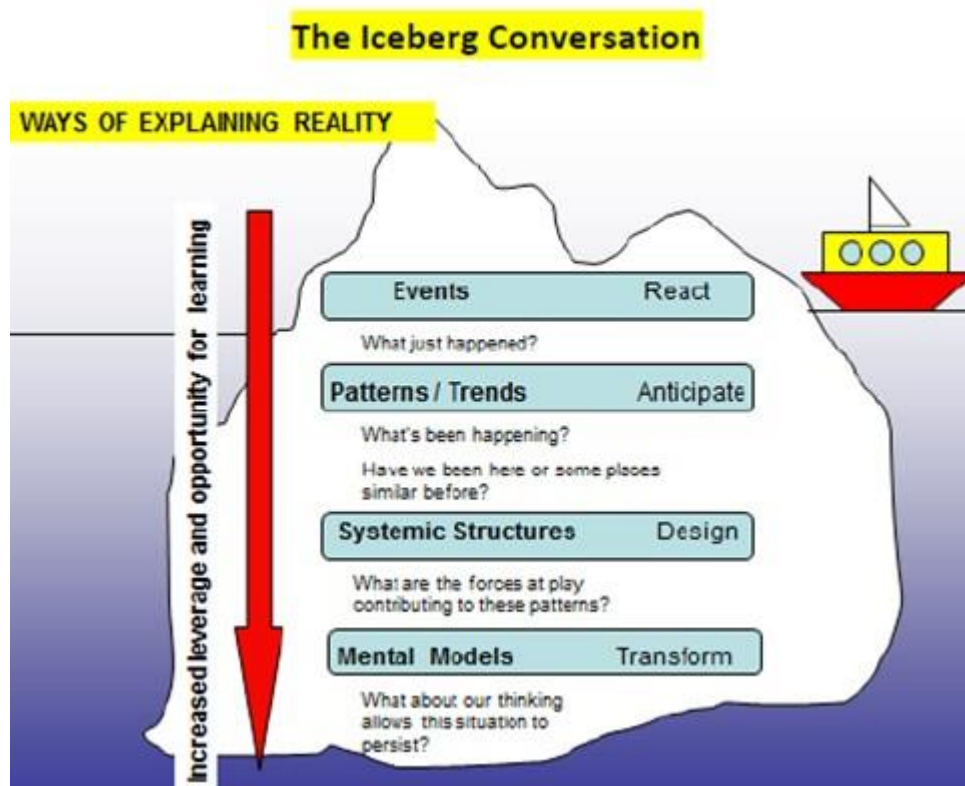


Figure 19: A diagram of the Iceberg Conversation as a way of explaining reality (Senge et al., 2008)

During the course of the discussions participants are encouraged to identify the visible event, patterns and trends associated with the event, systemic structures that enable the event and finally the mental models that people hold that provide the supportive infrastructure for these events to be possible and be maintained. Following is an example of a discussion that took place with *The Pop Cyd Enviro Friendly Group*.

Event/s

Blocked toilets, illegal dumps, dirty water in Mpophomeni.

Pattern/Trends

5/6 toilets block/week.

It takes 3 weeks to fix.

Plumbers fix toilets over weekends.

Systemic Structures

Male culture

“you are gay if you don’t vandalise the toilet”, no toilet paper learners use stones, grass etc.

Learners throw papers, plastic, pads down the toilet.

Mental models

Priorities/values: People choose airtime, Coke, burgers, Doritos instead of paying for toilet

paper.

Ignorance/Habit: Rural person “I don’t use this, what is this? Give me newspaper” (D.6.01).

5.2.3.3 Youth Environmental Science Conference

The Youth Environmental Science Conference (YESC) is a local event aimed at preparing learners interested in participating in the national Eskom Expo for Young Scientists by providing them with a first, local, “safe” opportunity to execute and present a science project and get feedback about their projects from professional scientists.

During the 2014 YESC, *The Earth Guardians* presented a poster of the results of several miniSASS fieldtrips to test the water quality in the uMthinzima stream that runs alongside the township and into Midmar Dam (Figure 21). Their findings reflected a relationship between the sewage spilling into the river and degrading water quality. The contribution of this knowledge product for the exploration of context-specific and scientific knowledge will be discussed further in Section 5.5.1. *The Pop Cyd Enviro Friendly Group* presented a project on illegal dumping in a few sites around the township (Figure 22). Waste audits were conducted to generate data about this issue. Feedback from professional scientists working for the South African Environmental Observation Network and the University of KwaZulu-Natal provided valuable input to the learners’ work.



Figure 20: A scientist from UKZN provides feedback to the WESSA EcoSchools Enviro Clubs poster contributions (Photo: M. Becker. 2014)

Lastly, an important feature of the functioning of the MSEP was the “doubling up” of Enviro Champs and MYP actors as group leaders for club gatherings and the inclusion of participants of all three components during workshops and training sessions. During these sessions mutual respect and admiration for the unique contributions from all three of the MSEP components was cultivated and evidence of this can be seen in the following data presentations on findings regarding the MSEP as a CoP and on the learning processes in the MSEP.

5.3 Findings about the MSEP as a CoP

The following section will elaborate on the findings for Phase 1, sub-question 1 of the research process, which was: Can the MSEP be viewed as a CoP? The analytical memorandum AM1 provided the data that informed the findings and can be viewed in Appendix 12.

Data presented in this section illustrate that residents of Mpophomeni involved in the Mpophomeni Sanitation Education Project are functioning as a CoP as defined by Wenger

(1998). The MSEP CoP members are working together in order to achieve negotiated goals and in doing so they have developed a set of shared activities, tools, concepts and concerns.

5.3.1 The joint enterprise of teaching in the MSEP

Section 3.2.1 discusses the different elements of a CoP including that of joint enterprise. Working together effectively requires an awareness of individuals' own competences as affirmed by others as well as the competences of others in the CoP. This allows for meaningful connections to that which individual members don't do or know in terms of contributions and knowledge, enabling a more comprehensive set of skills and knowledge in the group as a whole. The following examples drawn from the data reflect how the respondents saw themselves and how they interpreted their individual roles in the community. Due to the interconnected nature of the concepts in Wenger's (1998) theoretical constructs (see discussion in Section 4.5.1), this criterion also touches on aspects of identity. An awareness of one's own competencies starts with a clear understanding of one's role, and one's identity is linked with the role one fulfils. This is reflected below in responses from an actor, an environmental club learner and two Enviro Champs:

I am contributing by passing the information on to the community through drama ... (Int.03[A].1/28).

My role is to take care of the community and work together with different people, keeping Mpophomeni clean and taking care of the environment, also trying to control things that affect the environment. (Int.07[SEC].1/6-8)

Being an Enviro Champ makes our township clean because we report spilling manholes, water leakages and illegal dump sites. (Int.08[EC].1/6,7.

Every day 3 times a day I check water released from Umngeni Water works if it's clean and I record the score. (Int.09[EC].1/7,8)

As seen from the data above, the MSEP participants fulfil a variety of functions within the organisation; however the one function which they all seem to have assumed is that of teaching. The following statements from interviews reflect that teaching is viewed as an important activity for all the people involved in the MSEP, regardless of their official roles. In the data below an actor talks about his role teaching the community how to reduce the amount of sewage pollution. One Enviro Champ notes that he reports spilling manholes and

teaches people, working for the municipality, about the issue. Another Enviro Champ comments on how the learners from the enviro clubs are teaching other kids and their parents. And finally, an actor interprets his role to be that of teaching people through demonstration.

People were employed ... to teach the community how they can engage in decreasing the rate of spilling manholes. (Int.02[A].1/15,16)

As an Enviro Champ I report the spilling manholes, water leaks and sometimes go to the municipality offices and teach people water related issues and dumping issues. (Int 04[EC].1/6, 7)

They [the Umthombo Enviro Club] are applying what they've learnt through conversation when they're teaching other kids and their parents. (Int.04[EC].3/79,80)

Sometimes acting or demonstration is the better way of teaching people. By doing the toilet play some people understand now exactly what they have to put in the toilet while before they didn't know what causes blockage of manholes. (Int.02[A].3/82-84)

5.3.2 Mutual recognition within the MSEP between participants of the value of their contributions.

An important characteristic of a CoP is that, as a result of mutual engagement (Section 3.2.1), members display a mutual recognition and appreciation for the roles fulfilled by other members in the CoP. In the following two examples an actor expresses an appreciation for the work done by the Enviro Champs. In another example an Enviro Champ – an adult member of the community – recognises the contribution of the environmental club learners, adding that they are applying what they have learnt.

I think the contribution of Enviro Champs makes the MSEP a success. (Int.03[A].1/31)

... the Umthombo Enviro Club ... are applying what they've learnt through conversation when they're teaching other kids and their parents. (Int.04[EC].3/79,80)

This mutual respect is enabled through what can be described as a culture of tolerance and cooperation, reflected in the descriptions of meetings attended by a wide range of stakeholders which, realistically speaking, could end up in conflict because of the need to identify the main culprit of the problem. The MSEP participants however display a commitment to working together.

All people from different walks of life just came together for a common purpose to deal with the problem of water pollution and illegal dumping in Mpophomeni and Howick and we were able to have a long meeting of 3 or 4 hours talking about different issues with different people contributing to the conversation and there was a spirit of sharing and learning and solving problems and respecting each other's point of view and I just thought it was really, really positive and I just think this is the only way to go forward really ... (Int.01[PM].6/186-191)

*I think what makes everything work well is that the local municipality people and the community get on very well. They are in these issues together.
(Int.04[EC].1/22-24)*

5.3.3 Valuing people, community and cooperation

Mutual engagements can result in the development of a “tight node of interpersonal relationships” (Wenger, 1998, p. 76). (See Section 3.2.1.) The following data reflected a commitment to work together and get on with everyone, and this forms the basis for the agreed-upon course of action and enables community maintenance. The project manager makes this stance clear from the outset by labelling the project as a community project. Whilst she could have stated that it is a project about water pollution, she instead foregrounds the importance of relationships in the process of working to address the problem of water pollution. The strong relational focus is reflected throughout the data, as can be seen in the following examples of responses from the project manager as well as an Enviro Champ and a learner from the environmental clubs.

I think I've spoken a lot about the human relations which to me seem to be the most important thing since it is a human relations type of project. It's a community project. (Int.01[PM].4/128,129)

I think the best thing is that people are at the moment really willing to get on with each other and work with each other to the best of their ability.

(Int.01[PM].3/77,78)

It's a very open space where people can come together and share ideas in a non-threatening way. Whether it is stated upfront or whether it's an understood thing in the meeting that we're here to share and grow. We're not here to bring up our own problems and point fingers and expect somebody else to do the work because each person that comes to the meeting has got their own lives their own set of problems their own situation in their own job that we might not understand.

(Int.01[PM].6/192-196)

Working together is one of the success factors of the MSEP. (Int.05[EC].2/38,39)

So ja, I think that's what made it most successful, the people I was working with.

(Int.10[SEC].4/130,131)

5.3.4 Perceptions of positive impact

The following findings relate to the CoP characteristic of shared repertoire (Section 3.2.1). In order to get the work done, members of the MSEP have developed a shared set of views, concepts, actions, discourses, historical events and artefacts. A view expressed by a number of MSEP members reveals the perception/belief that the project is having a positive impact in terms of the reduction of spilling manholes, as well as on the level of knowledge and skills in the community with regards to water quality monitoring. Both the fact that this view is shared amongst the members and the appreciative nature of the view serve to strengthen the MSEP's functioning as a CoP.

Ok so I think that some of the good examples are that people are more aware of spilling manholes so they've learnt that, what a spilling manhole is and what it looks like and that it can actually be fixed by the plumbers ...

(Int.01[PM].13/405-407)

Before I never knew anything about testing water but now I have a full knowledge of how to test water to see whether it is in a drinkable condition or not.

(Int.02[A].3/74,75)

... when I joined the MSEP is that I learnt new things about manholes and water especially that the uMthinzi stream goes directly into Midmar dam.

(Int.03[A].1/14-16)

The things that made me happy when the project began is that the project made the Mpophomeni community realize how spilling manholes pollute our rivers. We started to pay more attention to how we can stop the spilling of manholes. The project delivered more information about how we can report the spilling manholes or contact the right people for the fixing of spilling manholes.

(Int.05[EC].1/14-18)

And the rate of spilling manholes has changed or decreased since the project has started. (Int.02[A].1/20,21)

Since we started to visit schools and acting in schools the spillages of manholes is not the same as before. The community and school children are more educated.

(Int.03[A].1/23,24)

The first good thing that happen there was a reduction of spilling manholes in my area. (Int.04[EC].1/14,15)

... before the MSEP there were no Enviro Champs. Manholes used to spill for quite a long time because no-one reported it to the plumbers and the plumbers had no idea that there is a manhole spilling somewhere and children will get sick when they play near that manhole. (Int.08[EC].1/18-20)

5.4 Findings about learning in the MSEP CoP

The following section will elaborate on the findings for Phase 2, sub-question 2 of the research process which was: What is the nature of learning in the MSEP? The analytical memorandum AM2 provided the data that informed these findings and can be viewed in Appendix 13.

5.4.1 Validation in the community

According to Wenger (1998), the community component of learning translates as “learning as belonging”. The data reflects that the MSEP’s work is recognised as important and valid by a wide range of people and organisations. This includes academics and scientists who developed the water quality monitoring tools and process the data generated by the Enviro Champs into various scientific knowledge products. Furthermore, the approval of local councillors (Int.02[A].2/45, 46) and plumbers (Int.03[A].2/35,36) also serves to validate the work of the MSEP in their immediate and extended community. Other respondents refer to positive feedback from neighbours (Int.05[EC].2/43, 44), members of the community (Int.06[SEC].1/33, 34) and the deputy-mayor (Int.08[EC].2/46-49). This validation of the MSEP’s work also sends a message of the MSEP as belonging: belonging in the scientific community, belonging in the community taking action to solve the problem of water pollution, belonging to the academic community, belonging to the Mpophomeni community, belonging to the community promoting an active citizenry. Example quotes from the data follow:

So I think the fact that GroundTruth takes us seriously and that we have [name withheld] working on the concentration of the sludge and the clarity tube and that we’ve got the university supporting us. That also is a very positive thing. (Int.01[PM].4/131-133)

It’s supported by well-respected scientists as well (Int.01[PM].4/134-135). I mean uMngeni Valley people [names withheld] that he attended our meeting and gave us positive feedback. All those people give it a kind of substance that’s real. It encourages me to keep going. (Int.01[PM].5/141-143)

5.4.2 Becoming a teacher in the process of learning

In Section 3.2.2.2 Wenger’s (1998) ideas about the close connection between learning and identity are discussed. “Learning as becoming”, as understood in this study, not only enables transformation: it also transforms the individual, shaping his/her identity in the process of learning. This finding overlaps with that of the teaching finding in Section 5.3.1. What the data for this study reveal is that while learning the participants in the MSEP start assuming the identity of teacher. With this role comes a sense of importance, and this is derived from

the realisation that they are sustainability teachers. Their teachings, they feel, could make the difference to whether and how people continue to live.

I think I play a big role in terms of teaching people about the importance of nature and environment to make them understand that if they affect nature in a bad manner and if they not protect natural resources like water in the near future they are the ones who will suffer. (Int.02[A].1/6-8)

I sometimes go to the municipality offices and teach people water related issues and dumping issues. (Int.04[EC].1/6,7)

Being a member of MSEP has changed the way I think and now I am well educated. I have been teaching the community. (Int.02[A].2/60,61)

... before I joined MSEP I had little knowledge about sanitation and water, but MSEP has broadened my knowledge and I am passing that knowledge to the members of the community. (Int.03[A].1/25,26)

The following data excerpts reflect that the learners in the WESSA Ecoschools Enviro Clubs also assume the identity of teacher, fulfilling this role with a sense of pride about making a meaningful contribution:

My role is to teach new kids from Umthombo and the ones who recently joined the enviro club about the importance of environment ... (Int.06[SEC].1/6,7)

There is not much that I am, but passing the knowledge I have to the people makes me proud. (Int.06[SEC].1/26,27)

The comment above indicates how a positive identity is shaped around the sharing of knowledge, making this learner, who feels that she herself “is not much”, feels a sense of pride and purpose.

5.4.3 Self-esteem is positively impacted through involvement in the MSEP

Another finding related to “learning as becoming” is the development of a positive self-esteem associated with being involved in the MSEP. The data in the following excerpts

indicate that it is through involvement with the work of the MSEP that participants get opportunities to present their work. Opportunities for speaking in public, as well as opportunities to gain scientific fieldwork and monitoring skills, boost the confidence of the participants. The link between leadership, self-confidence and proficiency in speaking and writing English is unexplored in this study, but it is worth noting that all the learners who provided this feedback display a high level of proficiency in English.

*The work I do makes me happy because it has built my self-esteem. Now I can speak freely in front of many people teaching them about the environment.
(Int.06[SEC].1/21,22)*

Before I didn't know how to do MiniSASS but now I can do it perfect. I couldn't speak in front of people but now I am not shy anymore. I can speak freely in front of many people. MSEP has boosted my self-esteem (Int.07[SEC].3/67-69)

One respondent refers to her evolving identity as community 'hero' and building a personal legacy through her involvement in this work:

*I would like to see myself as a hero for the work I've done to serve the community about the environment and how people are taking care of the environment
(Int.07[SEC].1/24, 25).*

Finally, the power of understanding learning as a process of becoming is reflected in the following statement by a schools environmental club member who described how his involvement with the environmental clubs has enhanced his confidence and future hope:

... you get that surety that you yourself can be ... you know, you can go further than you think go can go ... (Int.10[SEC].2/34-36).

5.4.4 MSEP participants are making meaningful connections through learning

This understanding of learning as experience is about 'connecting the dots' between what is learnt and experienced and the world. The close relationship between learning, meaning-making and context is discussed in Section 3.2.2.4. The following quotations refer to incidents of meaning-making resulting from the learning processes in the MSEP. In addition,

important understandings with regards to the causes of the problem emerged. These findings served to debunk a popular understanding about people in Mpophomeni being the problem and instead provided a more balanced understanding of the problem.

I suppose the one thing that I didn't realise; I thought that the whole Mpophomeni sanitation infrastructure was mainly impacted by people misusing the toilets (throwing the wrong thing down the toilet). I thought that was 90% of the problem ... what have I learnt, what is the most meaningful learning experience, that comes in there as well that the actual infrastructure itself was really, really badly laid down. (Int.01[PM].11/346-350)

This understanding has significant implications with regards to who is held responsible and what constitutes a solution/s. In a sense, blaming the people of Mpophomeni is a convenient option.

What came out of that quite clearly was that it was basically the infrastructure that was a problem. There were at least 6 or 7 manholes, probably more, that could not be fixed by the plumbers and they didn't even go near them, they didn't even try and fix them, and then there were some others that they did try to fix but it was a bit hopeless. (Int.11[PM][ECC].2/38-42)

Hence, gathering grassroots information revealed that the problem was not entirely due to people's practices – a prevalent, popular assumption – but also due to infrastructural faults. This had the potential to result in a more balanced, less prejudiced understanding of the problem. The effectiveness of learning through first-hand experience leading to local expert knowledge is also reflected in the following comment:

Sometimes people understand because they know what is happening because in most cases spilling of manholes occurs in their homes. They have full understanding (Int.04[EC].2/62,63).

As holders of this expert first-hand knowledge, the realisation emerges that citizens have the right to report service-delivery problems and to hold local government accountable for delivering basic services.

I didn't know that if rubbish is not collected we have a right to report the matter to waste management at the municipality offices. (Int.05[EC].2/65,66)

Through doing the miniSASS water quality test some respondents were able to make meaningful connections between the organisms found in the water and the quality of the water.

I have learnt more about water especially MiniSASS where we check the state of water. Now I know that when there is a stonefly in water that means the water is clean and in a good condition. (Int.03[A].2/58, 59)

A strong understanding of the causal link between water quality, sewage influx and specific micro-organisms inhabiting the streams is reflected by respondents' comments:

There are organisms expected to be found in water that will indicate the state of the river (Int.04[EC].1/26, 27).

... at my age seeing nature affected the way it was affected especially animals living in the water because of spilling manholes going directly to the river stream (Int.05[EC].1/20,21).

In the past I didn't know that the river stream needs to be protected and living organisms in water need to be protected too (Int.06[SEC].3/71,72).

This process of learning as meaning through experience may lead to a better understanding of the problem as described in the following data:

Ok, all I'm saying is that the new reporting sheet it shows exactly which manhole is spilling and how often they get spilling, cause on [name withheld] reporting sheet he will write like "on the 21st the manhole is spilling and it was getting fixed maybe on the 22nd. On the 5th and then he reports again, the manhole is been spilling and fixed on the 26th but on this new reporting sheet it shows that it's two manholes not one. The one it gets fixed and when it gets fixed the neighbour of that one starts spilling (D.11[PM][ECC].11/364-369).

Featured in the documentary film discussed in Section 5.2.3.1 is a resident of the Mphohomeni community, speaking in isiZulu and making meaningful connections between the sewage pollution and chronic illnesses in the community.

Our babies get diseases from that leakage and also our animals that we live with, swim there and come back with cholera. Even us we are old we also get that sickness all the time. We also get blocked noses, rash and runny stomach. The smell is very bad. (D.2.01/25-28)

5.4.5 Learning in the MSEP results in people being willing to ‘go the extra mile’

Learning as doing relates to the CoP element of joint enterprise. The following data confirmed that members of the MSEP CoP show a high level of commitment to their joint enterprise. This is particularly evidenced through the fact that an actor used his own airtime to report a spilling manhole in spite of the fact that it is not officially ‘his job’.

The thing that I do remember is the warmth and friendliness of the people that I work with and the willingness to put themselves out over weekends or after hours or on a Sunday to meet with me or plan a project or talk about it or that sort of thing. (Int.01[PM].3/84-86)

The training as well seems to be working really, really well ... people seem to put in more than I can possibly imagine on the day. They want to stay longer and they bring such richness to the experience as well. (Int. 01[PM].3,4/98-104)

... so for example on the 28th of February [name withheld] whose one of the actors when he was walking along the road, noticed a spilling manhole, now he wouldn't have normally done anything about it because he's not an Enviro Champ per se, he's an actor and he decided to phone me and tell me about it and used up his own airtime money to phone me and then he, I said, "well look I'm not there and I don't know where the manhole is that you're talking about maybe phone [name withheld]". So he phoned [name withheld] and [name withheld] phoned the plumbers straight away and within the day by that afternoon it was fixed. (Int.01[PM].13/407-413)

The findings about the MSEP as a CoP, and the learning processes in the MSEP provide insights about the knowers and the processes of getting to know. An adherence to the participation metaphor for learning (Section 3.3) foregrounds people, that is, the knowers inevitably black boxing that which is known (Section 3.3). Data presented in the following section aim to shed light on knowledge in the MSEP.

5.5 Findings about the nature of emerging knowledge in the MSEP

The following section will elaborate on the findings for Phase 3, sub-question 3 of the research process, which was: What is the nature of emerging knowledge in the MSEP? The analytical memorandum AM3 provided the data that informed the findings and can be viewed in Appendix 14.

The analytical memorandum was organised according to Tabara & Chabay's (2013) worldview indicators described in Section 4.5.3. which were used to analyse the knowledge aspect of this study. Evidence for some indicators came out more strongly than for others. The following indicators for which evidence emerged are discussed in the following section, namely: 1. Representation, Knowledge arena and Knowledge agents; 2. Context; 3. Complexity and 4. Ethics and values.

5.5.1 Representation, Knowledge arena and knowledge agents

As described in Section 4.5.3, the indicator of knowledge representation refers to whether the knowledge investigated is represented as a single scientific language that is reductionist or standardised in nature, or through multiple configurations of contextualised knowledge that acknowledge the validity of multiple knowledge types. Knowledge arena refers to the exclusivity or inclusivity of the knowledge contributions. The criteria of knowledge actors pertain to the contributors being either limited to 'expert scientists' or including a wide range of knowledge agents.

In terms of the findings reflected in the data, a wide range of knowledge agents are building knowledge to address the issues in Mpophomeni. The following statement by the MSEP project manager reflects a conscious decision to open up the knowledge arena, acknowledging the value and importance of different experiences and understandings:

... they're [people in the Mpophomeni township] full of their own knowledge and experiences and traditions and way of life and we really, really need to connect

with that ... so I think it works well the way that we run these workshops that it's very open in allowing them to bring their experiences to the picture (Int.01.04/103-107).

A meeting that took place on the 24th of February 2014 represents a highlight for the project manager because of the diversity of knowledge actors who participated:

Well I suppose my best memory because it's a recent memory is our meeting that we had on the 24th of February in the library, because there were all sorts of different people that came together: people that were in charge like [name withheld] and other kind of role players that are higher up. Maybe, very well educated people university lecturers, professors that type of thing all the way through to community members and residents of Mpophomeni [name withheld] from Shiyabazali who doesn't speak English and is illiterate. All people from different walks of life just came together for a common purpose to deal with the problem of water pollution and illegal dumping in Mpophomeni and Howick and we were able to have a long meeting of 3 or 4 hours talking about different issues with different people contributing to the conversation and there was a spirit of sharing and learning and solving problems and respecting each other's point of view and I just thought it was really, really positive and I just think this is the only way to go forward really ... it is a very open space where people can come together and share ideas in a non-threatening way (Int.01.06/179-190).

The level of involvement of the different knowledge agents varies. Some offer advice, like

...experts from uMngeni Water [names withheld] who's in charge of repairs of the pipes so they all know their jobs very well and but they don't contact me ever about anything ... (Int.01.12/388-395).

Other experts are very involved with the development and testing of appropriate citizen science tools, such as experts like [name withheld] with his miniSASS and [name withheld] with calibrating the clarity meter and how that relates to sludge and the nitrogen and phosphorous content (Int.01.12/388-395).

Being well-connected beyond the boundaries of Mpophomeni and having a good understanding of the bigger picture within which the Mpophomeni problem is set enables the project manager to engage effectively with representatives from the Department of Water Affairs and the University of KwaZulu-Natal, who through their involvement could potentially contribute as knowledge agents.

So if I get phone calls from Department of Water Affairs or the university or whoever who might be interested I feel it's part of my role to go out of my way to meet those people and involve them and see what they can contribute as well.

(Int.01.01/15-17)

Other knowledge agents operating in the MSEP knowledge arena include residents of Mpophomeni, MSEP participants, post-graduate university students (UKZN Hydrology and Geography departments) and environmental scientists (GroundTruth, UKZN). An interview with the MSEP project manager and the Enviro Champs coordinator reveals how 'ordinary community members' in Mpophomeni make a voluntary contribution as knowledge agents.

AL: Now it works very well, 'cause for example on the 26th of July a guy phoned me telling me there's a spillage somewhere and he give me direction of the spillage.

LT: Just an ordinary community member (Int.11.06,07/200-202)

The Iceberg Conversation (discussed in Section 5.2.3.2) which resulted from a workshop with the Mpophomeni High school *PopCyd Enviro Friendly Club* about the causes of sewage pollution in Mpophomeni Township provided the foundation for a deeper understanding of the underlying social and cultural causes, which were then creatively reflected in two plays written and performed by learners from Mpophomeni High School. (Appendix 11)

This reconfiguration of knowledge to be appropriate for the learners' context is an example of knowledge produced by the MSEP for the MSEP, based on in-depth discussions and holistic understandings, and appropriate and relevant for the context. The creative medium and cultural flavour makes it accessible to the target audience. Following are some excerpts from the two plays.

(Note: The scripts were transcribed and typed up by the learners and what is presented in this chapter is the original un-edited work.)

D. 8: Excerpt 1

Bongani: Your problem is that you the mamas baby too much.

Sipho: You see now you taking me for granted (insult). Who is mamas baby?

All boys: you

Thami: Okay if you not mamas baby show us

All boys: proof

Bongani: put some stone here

Sipho: That is waste, our own toilet come on be serious. Care for your environment.

Sizwe: You just being a cheese boy. You don't know how real man lives

Sipho: Okay I will show you

Narrator (He did put the stones)

Bongani: A real man does that. (D.8.02,03/60-70).

Excerpt 2

Learner3: It boring and there is that annoying gay. I told them to join me and bank but they don't want. They want to attend history lesson. I don't understand anything the teacher is saying.

Leanrer4: Let make of how we can leave the school. I can't be here today.

Learner3: I have the plan and I have lot of plans actual I have a dictionary of plans. Let destroy the toilet.

Learner4: That is a problem where we will release ourselves?

Learner3: Go and get some stones and we make this gay vandalize the toilet.

Learner4: I can't do that

Learner3: I know you can my brother. You my boss go and get stones.

Learner1: What are you doing with me?

Learner3: Take these bricks and put them in the toilet and you better be fast. Do it fast time is not in our side. I will beat you if you keep wasting my time. (D.11.99-109)

D. 11: Excerpt 1

Eish toilet is calling me. Aibo! What will I wipe myself with? My mother and father got paid yesterday but there is no toilet paper let me use a newspaper but toilet will block but I don't have a choice and I don't care. Let me use many father's newspaper (Isolewze) (D.11.27-29)

Excerpt 2

(Phone ring)

Father: Hallow bass. How are you sir? I am fine thank you sit down. You want me at work now now? I am going to be right there now bass. Thank you [sit down]. Ooh Mehlemamba wants me at work now. Where is my newspaper? Let me use man's room. Ayi ayi ayi! What is this I see with my eyes? Mamlangeni, Cijimpi, Ntombizodwa and what is this I see with my eyes in the toilet?

Ntombizodwa: it a pent horse[Penthouse]

Father: It no pent horse this is my newspaper. Mamlangeni I told you that I don't want children with big heads and they will do as they please. Where were you Cijimpi? We all come from this side and you come from the other side. (D11.32-40)

Whilst the script of the play reveals the awareness of the abuse of the sewerage infrastructure it also reveals citizens who are conscious of the joint responsibility of local authorities to address the problem.

Excerpt 3

Principal: I greet you all. Today I have good news. Toilet blockage will be fixed. Secondly this wetland will be taken care by Umngeni, DUCT and Umngungundlovu has agreed to take care of this place and they will fence it. Lastly during the course of cleaning this place there will be job opportunities for Mpophomeni community. (Everyone making noise as signs of happiness) All we need as a community is to hold each other's hand. What they say in English?

All: Together we can do more. (D.11.202-207) (Appendix 11)

The following data piece (D9B.01) – a poster summary of MiniSASS fieldtrip results conducted in the uMthinzima river – was developed by *The Earth Guardians* Enviro Club. Learners used recycled paper lining from cigarette boxes to indicate the stream, with degrees of pollution indicated with black pen and sediment. The proximity of Midmar Dam to the township is indicated. The road that runs from Howick to Mpophomeni is labelled R617 and the bus that travels the route regularly is identified as a “TAROS” bus. The quality of the water in the stream is indicated with a MiniSASS score of 7,6 for “clean water” at the source

of the stream, “moderately modified” further along the stream and “largely modified” where the stream enters Midmar Dam.



Figure 21: Youth Environmental Science Conference poster submission by The Earth Guardians (2014).

Another example of WESSA EcoSchools Enviro Club members developing appropriate knowledge products is the poster by *The PopCyd Eco Friendly Group club* (D9A). On the poster they describe the three sites in Mpopomeni where litter audits were conducted, display the raw data and summarise the results, ranking the levels of pollution as A, B or C.

... you're now working with people in the community [Enviro Champs] who are ... now working with maps and linking what they're seeing on the map to what they're seeing on the ground and filling in those forms (Int.11.08/239-241).

The following image (D. 10.B) (Figure 23) is a snapshot of a map of monitored manholes in Mpopophmeni, produced by GroundTruth Environmental Consultants with the assistance of the Enviro Champs coordinator. It documents the involvement of the scientists working as knowledge agents in the MSEP producing knowledge in this open knowledge arena.

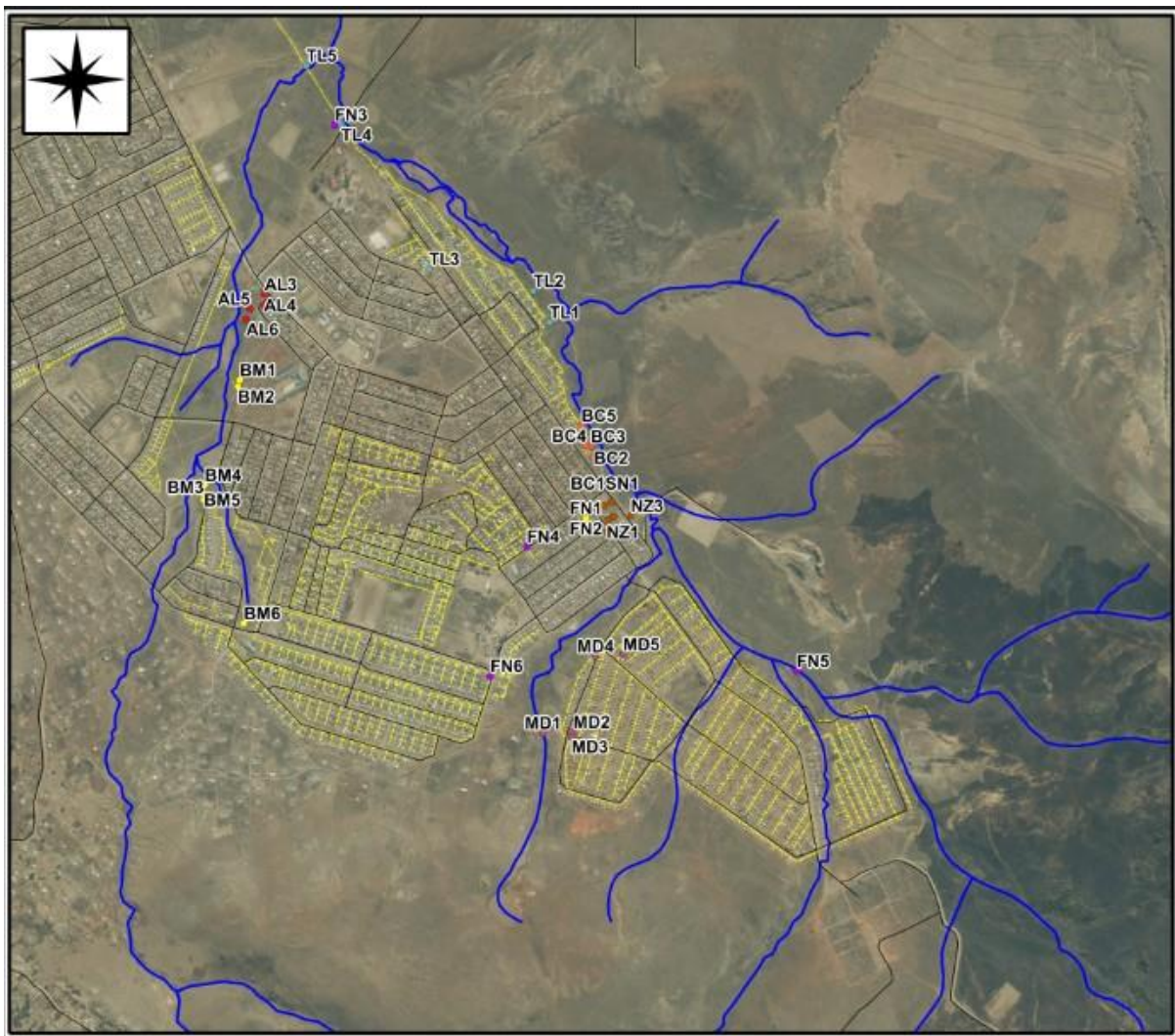


Figure 23: Snapshot of the map of monitored manholes (GroundTruth, 2014).

The Enviro Champ based at Shiyabazali informal settlement near the Howick waste water treatment facility describes her role as knowledge agent:

Every day 3 times a day I check water released from Umngeni Water works if it's clean and I record the score. The score of the dirty water is less than 4

(Int.09.01/7, 8). I use a turbidity tube to check. There is something in the tube, I push it away until I don't see it then it will indicate the score of water
(Int.09.01/10, 11).

The actors working with the Mpophomeni Youth Productions also operate in this open knowledge arena, producing knowledge in the form of their plays. The creative, humorous nature of this knowledge product makes it a popular and accessible form of information. Following are some excerpts that reflect on how the actors view their role in the MSEP knowledge arena:

I think I play a big role in terms of teaching people about the importance of nature and environment to make them understand that if they affect nature in a bad manner and if they not protect natural resources like water in the near future they are the ones who will suffer (Int.02.01/6-8).

I am an actor. My role is to pass on information or teaching through acting especially in schools, and to learn more from the Enviro Champs (Int.03.01/6,7).

5.5.2 Context

The knowledge indicator of context relates to the knowledge under investigation either being independent of the social-ecological context of reference or being able to be described as context-rich knowledge for a purpose in a specific place. A study of the data reveals that knowledge shared and produced in the MSEP is context-specific and context-rich knowledge (see Section 3.5.2). It is produced by residents from Mpophomeni in collaboration with a range of 'outside' knowledge agents who have an interest in addressing the issue of water pollution in Mpophomeni. Examples of context-specific knowledge which emerged from the data are as follows:

5.5.2.1 "INGUBO YAMASELE"

The following discussion took place during the focus group and was prompted by an inquiry about algae which is present in local streams and dams. The discussion illustrates the development of context-specific knowledge which involves the linking of indigenous/local knowledge with abstract disciplinary knowledge to produce knowledge which is not only specific to a place but can also enable dialogue in another context.

Speaking of polluted rivers or waters I grew up in rural areas, we used to go to the rivers and we would call that algae "ingubo yamasele" the blanket for the

frogs. When you tell people that the water is polluted from the algae caused by nutrients people will tell you that algae is the habitat for the frogs, so I get confused but I understood it the way you explained it to me and even in the scientific way but it is still not easy to tell people about the cause of algae. The reason why I say this is that you find eggs of frogs in the algae confusing the people resulting in them calling it the habitat of frogs. (FG.1.08/239-245)

Clarifying that there is a difference between algal growth caused by the process of eutrophication which floats on the surface of water bodies and appears green, and ‘bio-films’ which are also green but are found attached to plants or rocks:

[UKZN MSc Hydrology student] There is a difference between algae and ‘bio-films’ but we won’t get in to that which will confuse you a lot. There is some green stuff which is not algae but ‘bio-films’ “ingubo yamasele” and this is usually attached to plants or rocks in streams and algae is on the surface and usually floats (FG.1.08/239-245).

... it is the amount of algae that’s important. If you walk down the stream and see that it is clear but you see algae on the edges of the stream with green patches growing in the river but most of it is clear you can see the bottom, smell the water and do a MiniSASS and assume this is a healthy stream. But if you walk down there and see green everywhere, that is not natural, something else is happening to the stream (FG.1.08/252-256).

Prior to the “ingubo yamasele” discussion, during the same workshop, a foundational understanding of the phenomenon of eutrophication was established through a brief explanation by the project manager on the process of eutrophication.

The algae in the water is the example of eutrophication in the initial stages as this is a small body of water as more nutrients come into the water as a result of sewage poo, which brings more nutrients in the water which feeds the plants in the water increasing their growth and start covering that area and they take a lot of oxygen out of the water so insects that need oxygen cannot survive here. The water can also become toxic so it is dangerous for cattle and humans to consume that water. The water has to go through a lot of treatment before it can be consumed properly for example the Hartbeespoort Dam as talked about this

morning is covered with green slime and also areas of Midmar Dam also have this slime as seen in many aerial photographs (FG.1.05/147-155).

5.5.2.2.1 MiniSASS as context-specific scientific knowledge

The results of the MiniSASS citizen science water quality test below demonstrate how context-specific knowledge can be transposed to another context, and therefore acquire meaning in another context. The results of monitoring of the uMthinzima stream mapped on the MiniSASS website were reconfigured by learners from *The Earth Guardians* enviro club in the form of a poster discussed in Section 5.5.1. It serves as a good example of the reconfiguration of knowledge to be context-appropriate. (See Figure 24.)



Figure 24: An example of contextualised, reconfigured knowledge.

5.5.2.2.2 Manhole ‘names’

The manholes in Mpophomeni have been labelled using the initials of the names of the Enviro Champs responsible for their monitoring. This ‘naming’ of the manholes in Mpophomeni serves as an example of contextualised knowledge that potentially enables the association of responsibility. The manholes were named using people’s names in order to improve the reporting system and hence the validity of the monitoring data, yet it had the

associated benefit of the Enviro Champs also taking ownership of their designated manholes. The use of numbers and GPS coordinates did not work as effectively as the naming of the monitored areas. The following quote reflects the background to the decision to label the manholes using specific responsible people's names:

So he [GroundTruth scientist] was sitting in a lot of the meetings and looking at what we were talking about and it became quite obvious to him and [name withheld] that we needed to name each of the manholes (Int.11.02/60-62).

And the plumbers got phoned by 3 people all about the same one, so we needed to streamline the system from a reporting point of view, but also we want to know exactly which manhole spills all the time and exactly which manhole is totally blocked and leaks underground all the time. Where is it? What is its GPS coordinates? And has it been fixed? (Int.11.02,03/66-70).

And, so if we can have this information over a number of months, we could eventually work out, for example how many manholes spill continuously, just never stop? What is the average time that it takes for the plumbers to come and fix the thing? Is it half a day, a day, 2 days? And, how long does it take them to fix it? And, how long after they fixed it does it start spilling again, because that number appears on our spreadsheet and then you can tell when it starts to spill again. And also looking at the whole map, which area is causing the most trouble? Is it [name withheld] 6 manholes, or [name withheld] 6 manholes? Where is the problem? And, also very importantly, there a column for writing down what comes out of the manhole, so you could say 90% of the time it's household waste, but 1% of the time it's builder's rubble, whereas at the moment maybe everybody's saying "ha, it's builder's rubble all the time", but there's no facts and figures to prove that (Int.11.03/73-84).

The naming of the manholes in the Mpophomeni Township has resulted in more effective reporting and hence more accurate data. (See Figure 23 for the map of monitored manholes (D.10.B) featuring the names of the manholes.)

5.5.3 Complexity

The indicator of complexity refers to whether the knowledge under investigation reflects abstractions that reduce complexity, producing simple theories and explanations, or whether

the knowledge reflects a holistic, dynamic, complex systems perspective. In terms of this indicator the following findings emerged. Knowledge practices in the MSEP reflect holistic, systems understandings that are consciously facilitated and promoted by the project manager and supported by the Enviro Champs coordinator and the WESSA EcoSchools Environmental Clubs coordinator.

I think what my role is with the Enviro Champs and community members and the drama teams and people that we meet, is to form a sort of contextual picture of why we are so passionate about this particular issue – the Mpophomeni sanitation system. That it's not functioning well and that it's polluting Midmar Dam and that Midmar is part of the uMngeni Catchment and the uMngeni river itself from source to mouth is the most important river in the whole of KwaZulu-Natal providing something like 100 billion litres of water per day (I'll get the figures right but it's a huge amount of potable water) so, the uMngeni Catchment itself is very important (Int.01.10/317-323).

... it's just a very interesting and complex system at play and it's I see myself as helping to give that picture to the Enviro Champs or to the drama team so that when they do their work they're more educated about the bigger picture ... (Int.01.10/326-330).

Holistic understandings and the making of connections between what is happening in the natural world and actions taking place in the social world are enabled through fieldtrips such as described by an environmental club member from *The Earth Guardians* enviro club:

It was a fieldtrip. We went at Emashingeni from the source of uMthinzi stream. At the source we found stonefly, the indication of clean water, but as we go down the stream there was dumping in the river and we couldn't find the stonefly showing that water was now dirty and it was not safe to drink that water. People should stop dumping in the river (Int.07.03/84-87).

Linking the presence/absence of the stonefly nymph to people dumping in the river is an example of the coupling of HIKS and SES that Tàbara and Chabay (2013) suggest is what is needed.

Surface understandings lead to the assumption that the main cause of the sewage spilling was social practices such as “putting the wrong things in the toilet” or manholes. However, the

data that were collected by the Enviro Champs over 3 years, captured in a scientific format such as the Excel pivot table, and analysed by the Enviro Champs coordinator and scientists from GroundTruth consultants, reflected a different story. A more complex picture of the causes of sewage pollution in Mpophomeni emerged, with infrastructural failure recognised as a major cause.

What came out of that quite clearly was that it was basically the infrastructure that was a problem. (Int.11.02/35,36)

And so what came out of that study was, well first of all uMgungundlovu thought that it was what people were throwing down the toilet that was causing all the blockages because every time the plumbers did have a successful freeing of the system it was household waste that came out. Plastic, nappies, knives and forks and rags and panties and things that come out of households, but there were these ones that just absolutely couldn't be fixed. So they realised that the whole of Mpophomeni needed an upgrade. (Int.11.02/39-44)

5.5.4 Knowledge associated with values and ethics

The indicator of ethics and values relates to the question of whether moral and ethical values are separated from objective analysis in the knowledge studied or whether the knowledge is informed by moral and ethical values. The following findings reflect that the knowledge produced in the MSEP is imbued with cultural and social values. Respecting one's elders is a generally recognised cultural imperative, hence young people attempting to teach the older generation about sustainability practices may find it difficult to overcome cultural adherence to respect for elders. The reference to a lack of financial resources would be widely recognised in this community where unemployment and poverty are norms. Lack of change can be as simple and complex as a lack of money to be able to afford toilet paper, or a value system that prioritises other needs, like airtime, over toilet paper (See Section 5.2.3.2).

The following example from the play about sanitation practices touches on this issue:

Zandile: Grandmother you must not use the newspaper in the toilet.

Grandmother: It a bad lucky for MaMlangeni, now you ordering me? I don't have money for toilet papers and newspapers are too strong [easily available]. You full of English [you are telling me what to do now that you're educated – full of English]. (D.8.02/48-51).

The following excerpt is reflective of assumptions held by some young men in Mpophomeni high school about what constitutes a ‘real man’. The young man labelled as ‘mamas baby’ and ‘cheese boy’ is faced with the choice of socially acceptable behaviour vs. undertaking a socially-conceived rite (which amounts to vandalism of school property) in order to prove his manhood. It demonstrates the nature of the pressures faced by young men in this township high school environment and how sewage spilling events can be linked to cultural beliefs and understandings.

... what I have also learnt is that the local municipality and the district municipality make a lot of promises and they say that they are going to fix things and that they are very committed to fixing the problems but actually they're not really and I can see that the plumbers are caught in a system that's not really supporting them. (Int.01.11/349-353)

The potential environmental impact of a destructive worldview is evident in this excerpt from the play written by learners in a school environmental club:

Why does it matter of how we destroying nature. They don't know what they saying because nature it belong to all of us and it is our gift from God (D.8.03/96-98).

In this way a belief about human dominance of the planet can operate as a generative mechanism not only preventing transformation but actively destroying our ecological systems.

5.7 Conclusion

The MSEP can be viewed as a CoP. Aspects of mutual engagement, joint enterprise and shared repertoire are reflected in the data. The different “faces of learning” (community, identity, meaning and practice) described by Wenger emerge from participants’ views about their experiences in the MSEP. With regards to the nature of knowledge in the MSEP, data confirmed that the MSEP can also be viewed as an example of an open knowledge system generating knowledge that is steeped in context and produced by multiple knowledge actors who actively configure and reconfigure knowledge appropriate for addressing their particular problems. Community players are very active and provide most of the input and content; this is less so from the scientific community, which generally provides the tools of citizen science

but with limited interaction with the community participants in the field. The knowledge produced is contextual and context-specific and in some instances transferable to other contexts. Holistic systems understandings are reflected in the emerging knowledge, and knowledge produced is associated with responsibility, values and ethics.

Chapter 6 Findings and Recommendations

6.1 Introduction

Chapter 5 presented thick descriptions of the data generated through four case study methods, having been structured according to the theories used to analyse the data. Wenger's (1998) CoP theory guided my investigation during Phase 1 (sub-question 1) and Phase 2 (sub-question 2) of the study (Section 4.5). Tàbara and Chabay's (2013) IT of two knowledge worldviews guided Phase 3 (sub-question 3) of the study. This chapter considers the data presented in Chapter 5 and presents the findings of the research question about understanding the nature of learning and emerging knowledge in the MSEP. Section 6.2 will discuss the findings related to whether the MSEP can be said to function as a CoP (sub-question 1). Section 6.3 outlines the findings about the nature of learning in the MSEP and Section 6.3 discusses the findings about emerging knowledge in the MSEP. The chapter concludes with recommendations and a critical review of the research.

6.2 Findings about the MSEP as a CoP

The findings confirm that the MSEP functions as a CoP, enabling learning processes and knowledge for social ecological transformation. An investigation of the interactions between MSEP participants confirmed that the MSEP does function as a social learning space where participants contribute both their practice and who they are – their unique person and who they are becoming through their involvement in the MSEP. Wenger's (1998) concept of mutual engagement (Section 3.2.1) was evident in the statements by participants that reflected mutual respect and recognition for other MSEP participants across the spectrum of functions within the MSEP. With regards to Wenger's criteria of joint enterprise, participants in the MSEP were clear on the focus of the project being to address the problem of sewage pollution in their township. As Wenger suggests, taking ownership of the task of solving the problem of pollution in Mpophomeni has been an important driver of success (Section 3.2.1). In the process of addressing the problem of sewage pollution the participants also identified the related issue of illegal dumping in the township, which they took the initiative to address. Learners from the one enviro club submitted a poster to the Youth Environmental Science Conference about this problem, indicating that through their involvement with the MSEP

they were developing the ‘lenses’ to recognise other environmental issues in their community to which they can respond. (See Figure 23 in Section 5.5.1.) The Enviro Champs’ monitoring forms also evolved over time to include information about illegal dumping events.

6.2.1 Analytical statement 1: The MSEP reflects the relational focus associated with CoP and effective social learning processes

The commitment to cooperation displayed by the respondents is a key feature of social learning processes that enable the “co-created creative solutions” proposed by Wals (2011), and discussed in Section 2.4. The Theory U process, likewise described in Section 2.4, also assumes a commitment to cooperation, in that there is a necessary stage of suspension of one’s own ideas in order to come up with co-created solutions. The MSEP’s participants display this commitment to cooperation and it is notable that the project manager, by fulfilling the role of “social artist” through skilful facilitating of “subtle and complex dynamics” (Wenger, 2009, p. 2), is playing an important role in consciously enabling this culture of tolerance, cooperation and mutual respect. ‘Culture’ here is used in the biological sense of creating conditions conducive for growth, and for the MSEP this means conditions conducive for learning. CoP can create these cultures conducive for learning and the MSEP is an example of such a CoP, reflected in the foregrounding of people and relationships between people. This speaks to the ideas expressed by Sterling (2010) and Bawden (2009), outlined in Section 2.4, about the relationship between our worldviews and our actions. The relational worldview reflected in the MSEP CoP is a potential enabling mechanism for social learning processes that can bring about social-ecological transformation.

6.3 Findings about learning in the MSEP

6.3.1 Analytical statement 2: MSEP participants demonstrate an engagement of their identity in the learning process

Wenger (1998, p. 215) describes the aspect of ‘learning as becoming’ as a process that “transforms who we are and what we can do” (Section 3.2.2.2). Participants in the MSEP demonstrated how identity is shaped positively through their involvement in the learning activities of the MSEP and through the fulfilling of their roles in the MSEP. The data described in Section 5.4.2 and Section 5.4.3 indicate a strong connection between positive actions and positive self-esteem. The changing of self in the process of positive mutual engagement is another contributing factor towards a culture of learning that enables a range

of knowledge agents to configure appropriate action-enabling knowledge. This will be discussed in more detail in Section 6.4.

6.3.2 Analytical statement 3: The MSEP CoP demonstrates purposeful learning processes

The data about learning in the MSEP reflect that the participants view themselves as environmental sustainability teachers while they are engaging in the MSEP activities learning. Therefore, learning processes in the MSEP empower the learners to assume the role of teacher in a kind of ‘in service training’ scenario through passing on the knowledge as you gain it. It could be due to the nature of the subject – being about knowledge and practices linked to sustainability. It could also be the shaping of identity building of self-esteem associated with these types of learning processes mentioned in Section 6.3.1. This finding indicates that the kinds of learning processes in a CoP result in the learners maintaining an external focus. It is purposeful learning and knowledge not just for its own sake such as Muller and Subotzky (2001) describe, as quoted in Section 3.4.1. The learning processes enabled in the MSEP CoP result in learning and knowledge that is both willing and able to take responsibility. The data collected by the Enviro Champs over a number of years offer substantial scientific evidence of the problem and the possible causes and this enables an effective response. This is the action-enabling nature of learning in the MSEP that would be required to produce transformational knowledge. In other words, this finding relates to ideas around how our epistemological assumptions manifest in our world and our actions (Section 3.4.1) and demonstrate that “knowledge is not a separate object from the people who produced it or even the process of producing it” (Wenger, 2009, p. 3).

6.4 Findings about emerging knowledge in the MSEP

The following section discusses the four main findings with regards to the nature of emerging knowledge in the MSEP.

6.4.1 Analytical statement 4: The knowledge practices in the MSEP generate embodied knowledge

Data about knowledge practices in the MSEP indicate that the knowledge agents are producing embodied knowledge. ‘Ontic relations’, a sub-dimension of epistemic relations in Maton’s construct of knowledge practices (Maton, 2014), refers to objects of practices and meaning-making. Section 3.2.2.4 refers to the close connection of meaning-making with

context described in Section 5.4.4. The data include statements that the Mpophomeni people understand the problem of sewage pollution completely due to the fact that they are experiencing the effect in and around their homes first hand. This statement about people understanding because what is happening is happening ‘in their homes’ is meaningful on another level, in the sense that humans now need to recognise the Earth and its life-support systems as their home and not just a temporary site to use and dominate over. This is the sense of “situatedness” in the world that is required for knowing, according to Meek (2011) when she states that: “Knowing begins from the ... sense of our situatedness in the world. It starts with somebody home” (Meek, 2011, p. 32). Tàbara & Chabay (citing Latour, 2013, p. 71) also mention the result of the supremacy of disembodied knowledge in the following statement: “The moderns do not know where they live. They have no world to reside in. They are homeless”. The idea of “somebody home” is what Tàbara & Chabay (*ibid*, p. 71) describe as the coupling of human information and knowledge systems with social-ecological systems to produce “robust social-ecological knowledge”.

Associated with contextual embodied knowledge (6F in Section 4.5.3) is responsibility (10J in Section 4.5.3). In other words, embodied knowledge is the kind of knowledge that can be held responsible for bringing about a better world. It is knowledge with a purpose and closely linked with the purposeful learning processes described in Section 6.3.2. It is knowledge “with ‘sustainability validation’ regarding the social-ecological contexts in which the knowledge and innovations would ultimately be utilised” (Tàbara & Chabay, *ibid*, p.72). This has significant implications for the human project of sustainability. As one of the indicators of Tàbara & Chabay’s (*ibid*) IT worldviews (Section 4.5.3), it points to responsibility and application either being associated with the knowledge system (in open knowledge systems) or not (in closed knowledge systems).

In Mpophomeni, the manholes have been positioned using the Global Positioning System and are identified on the maps using the responsible EC’s initials: not a generic number or the area/ward number, but linked directly to a person in a place (Section 5.5.2.2.2). The allocation and naming of the manholes in Mpophomeni enabled the Enviro Champs to more effectively report on what was happening with the sewerage system, resulting in more accurate data. It is important to consider the kind of language used by the coordinator of the Enviro Champs when talking about the work done by the Enviro Champs, implying a measure of ownership being assumed with regards to the physical infrastructure for which a

particular EC is responsible and which is named according to his/her initials. Referring to a particular spilling manhole as “So and so’s” manhole, and noting an EC stating in an interview that he is proud to take care of manholes, indicates ownership and responsibility, which I propose, to some extent, is the result of embodied knowledge practices in the MSEP. GroundTruth Environmental Consultants, a partner in the MSEP project, produces maps, but these maps only acquire concrete meaning with the potential to transform when used by the Enviro Champs who know the roads and the locations of the manholes in their own township. They are in fact the only knowledge agents qualified to verify the scientific information processed by the scientists and displayed on the maps, and they provide the essential data about what is happening on the ground. They do this for no other reason other than having an interest in improving their life quality. They are demonstrating the nature of action-enabling knowledge.

6.4.2 Analytical statement 5: In the MSEP multiple knowledge configurations are produced by a diverse range of agents in an open knowledge system

Tàbara (2013, p. 114) suggests that producing “socially robust” knowledge involves multiple knowledge agents and the redistribution of the right and responsibility to become knowledge producers. This process of democratising the process of knowledge production and levelling the traditional knowledge hierarchies where scientific experts hold superior access to “real” knowledge is what the MSEP model of citizen science has the potential to facilitate.

In the MSEP, the knowledge arena is open and we see “constellations of valid knowledge operating in this open knowledge space” (Tàbara & Chabay, 2013, p. 72).

When looking at the data with regards to knowledge in the MSEP, we see multiple configurations of knowledge produced around the social-ecological issue of water pollution. This includes *The Pop Cyd Enviro Friendly Group’s* original drama scripts about the problem of blocked toilets in the township and also Iceberg Conversations about the underlying causes. The open knowledge arena features a documentary film made by *The Earth Guardians* about the problem, and the results of the miniSASS fieldtrips posted on the miniSASS website to add to the picture of river health in South Africa. In addition, we see the Youth Environmental Science poster contributions by the Enviro Clubs: maps of the township indicating the exact positions of monitored manholes. We see monitoring forms for data about spilling events and a summary of the results of EC monitoring over three years.

These knowledge products were produced by a diverse range of knowledge agents for the purpose of solving the problem of sewage pollution in their community. Thinking about science as being a conversation – which is social by nature – these knowledge agents are having a conversation in an open knowledge arena such as Benhabib (cited in Edwards, 2011, p. 38) describes in the passage quoted in Section 2.5.1.

It is therefore suggested that the MSEP offers an example of how this kind of open knowledge system with its diverse range of knowledge agents plays out on the ground. Associated with this open knowledge arena is the idea of uncertainty, and Jörg (2011, pp. 5–6) recommends “embracing uncertainty as enabling ‘a new world of the possible’”. Closed, certain knowledge arenas leave no doors open for possibilities. So the idea is to embrace “complexity as self-potentiating” (Luhmann in Jörg, 2011, p. 5) and to enable these self-potentiating scenarios by creating open knowledge arenas

6.4.3 Analytical statement 6: The citizen science tool miniSASS used in the MSEP is an example of a tool that produces concrete universal knowledge

The idea of ‘concrete universal’ knowledge stems from CR thinking and relates to the “socially and ontologically located nature of learning and agency” (Lotz-Sisitka et al., 2012, p. 63). Such knowledge is appropriate, custom-made and transferable. It is, by nature, relevant outside the scope of the local context and recognisable inside and outside the scope of the local context. Upon looking at the data with regards to knowledge in the MSEP, I want to propose that the MSEP may be an example of a citizen science project which through its knowledge practices is providing a means for universal knowledge to be contextualised to enable social-ecological transformation. More specifically, miniSASS is an example of a tool that produces ‘concrete universal’ knowledge. Both scientifically rigorous and accessible, it empowers its users to participate in science for transformation in order to address issues near to their homes and hearts. miniSASS is transferable in the sense that the same method can be and has been applied in different parts of the world to determine the quality of the water.

6.4.4 The MSEP demonstrates the value of intuitive knowledge

The following account demonstrates the value of intuitive knowledge. As mentioned in Section 5.3.2.1, *The Earth Guardians* club produced a documentary about the problem of sewage pollution in their township (Appendix 10). Narration for the film was not pre-written and relied on the learner–presenter’s knowledge about the topic. During the course of the film

the following statement is made: “Animals drink from this manhole and they eat this grass and then they go back at home and people eat them. So that’s how people get germs because of this manhole”. At a glance this appears to be a sweeping unfounded statement not grounded in ‘hard science’. However, opening one’s mind to the possibility that this learner ‘might be onto something’ stimulates further research. Upon further investigation into this matter, the following scientific evidence transpired from information provided by a veterinarian:

It is ill-advised to allow cattle to drink from sewage spill. Harmful bacteria could affect the animal's health. Even though the muscles (i.e. the meat) are unlikely to be infected with organisms such as E. coli, people should avoid eating the intestines where harmful bacteria would indeed be found (J. Flamand, veterinarian, personal communication, October 22, 2016).

Considering that people in Mpophomeni do eat the animals grazing around the township, and considering that the organs of the animals are preferred by some people for their nutritional value, the tender texture of the meat and the taste, there is in fact a chance that people could get sick by eating the organs of the animals that drink from the manholes. This little vignette serves to demonstrate the value of suspending preconceived ideas about ‘other’ knowledge input, and entering into that open knowledge arena where different knowledges interact on an equal footing to produce socially-robust social-ecological knowledge.

6.5 Recommendations

This study set out to conduct an in-depth investigation of the nature of learning and knowledge in the MSEP CoP – an example of a community-engaged citizen science project with a transformational focus. The study took place in three phases, which were linked to the sub-questions driving the study. The findings discussed in Section 6.2, 6.3 and 6.4 can be summarised in the following way. Firstly, the MSEP functions as a CoP and this is evidenced through the project’s strong relational focus, mutual engagement in a clearly defined joint venture, and use of a shared repertoire of tools, ideas and practices. Secondly, the learning processes in the MSEP have a strong bearing on the identities of the participants in the project and can be described as ‘purposeful learning processes’. Lastly, the findings about the nature of emerging knowledge in the MSEP relate to the embodied nature of the knowledge

and the diverse range of knowledge agents, as well as the concrete universal nature of the knowledge produced.

In terms of recommendations to strengthen the project in future, the findings of the study show that the scientists involved in the project are mostly ‘silent partners’ in the MSEP, developing the tools for citizen science and assisting with the processing and interpretation of the data. It is recommended that the scientists become more involved with the work on the ground, connecting with the people in the field who are using tools developed by them, and in doing so strengthening epistemic knowledge aspects whilst developing an appreciation for the contribution of the citizen knowledge agents.

6.6 A review of the research

Firstly, a consideration of the research methodology prompts the recommendation with regards to the fine-tuning of the knowledge analytical tool in order to test its generalisability. Unlike Wenger’s theories that have been tried and tested and applied in many different contexts with success, this is a newly developed tool and therefore it needs critical review and opportunities for testing in different contexts in order to be fine-tuned. During its application for this study some aspects seemed more relevant; perhaps on further testing it could be ascertained whether indicators such as the ‘archivability of knowledge’ (Indicator 7 Section 4.5.3) are really useful to retain. Future work might include a detailed exploration of the knowledge practices using Maton’s (2014) 4-K model.

Secondly, the need for suitable theories to assist with the analysis of the knowledge component presented a challenge in the study, which was resolved in the following way. Tàbara and Chabay’s (2013) IT heuristic of two dominant worldviews structured the analytical process, and even though Tàbara & Chabay (*ibid*) do not make their ontological and epistemological assumptions explicit, Tàbara, by acknowledging “a reality both out-there-and-in-here” in the following statement, provided enough of a resemblance to CR thinking to set my mind more at ease about using their work alongside that of the social realists.

So one possible way to explore how to overcome all this is to think in phenomenological terms, focusing on experiences, meaning and reality construction, but without forgetting that indeed at the end of the day there is a reality both ‘out-there-and-in-here’ that exists and which can – and should, if you focus on learning –

be explored, especially if you think in sustainability/‘survivalability [*sic*] terms’ (D. Tàbara, personal communication, December 2, 2016)

Lastly, Healy & Perry’s (2000) criteria for testing the reliability and validity of realist research, discussed in Chapter 4, are not commonly drawn on in the literature about research methodology. It would be good if more researchers attempted to apply these criteria in order to develop case study examples demonstrating the effective use of these realist criteria for quality research.

6.7 Conclusion

The MSEP represents a particular brand of CS, different from species monitoring programmes and other models of CS. It engages real people, facing real sewage flowing through their homes, drawing on appropriate science to bring about transformation of this social (human rights) and ecological issue. The strong relational focus of the MSEP CoP creates a culture conducive for learning. Jörg (2011, p. 2) describes the kind of science practiced in the MSEP: “We need a more practical kind of science for being able to deal with the big questions and issues in the real world”. The following statement by one of the actors from the Mpophomeni Youth Productions reflects this vision of science: “We are all scientists and community science is the best transformation” (FG. 01.6/197-199). The MSEP CS project provides an example of community science with a transformational focus, where people and science are valued equally for their contributions to the cause of sustainability. Learning processes in the MSEP are purposeful and engage the identities of the participants. The MSEP does so by involving a wide range of knowledge agents, in an open knowledge arena, who engage in social learning processes that result in knowledge practices which are both epistemic and social by nature.

I propose that these types of CS projects are more likely to emerge from developing contexts where the effects of bad planetary stewardship are directly experienced by people on a daily basis and where citizens and scientists are willing to work together to address these problems. This type of CS represents fruitful ground for developing learning processes and insights that will serve the good of the planet and her people. If there is somebody “home”, as Meek (2011) suggests, taking care of the home – as was originally intended – there might still be hope yet.

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Appendix 1



ENVIROCHAMPS REPORT SHEET - JULY 2014

Name:
House Number: B32
Ward: Call centre sewage: 0800 864 911,
Councillor:
Manhole number: AL1 , AL2 , AL3 , AL4 , AL5 , AL6 , AL7

Cell Number:
Collect Rubbish: 033 239 9245



DATE OF SPILLING MANHOLE	MANHOLE NO.	DATE REPORTED	NAME OF PLUMBER. CELL NO.	DATE FIXED	DAYS SPILLING AFTER REPORTING	CAUSE OF BLOCKAGE					COMMENT (OTHER ITEMS, METHOD OF REPAIR)
						nappies, rags, spoons, towels, plastic bags	building material (sand, stones)	vandalism (rocks)	scrap metal	animal parts	

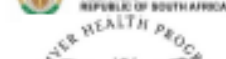
ABOUT WATER LEAKS

DATE REPORTED AND TIME	DATE FIXED AND TIME	HOW MUCH WATER HAS BEEN LOST	PHONED. NAME AND NUMBER	COMMENTS

NOTE ABOUT RUBBISH COLLECTION

SITE INFORMATION TABLE		Date (dd/mm/yr):
River name:	Collectors name:	
Site name:	School/Organisation:	
GPS co-ordinate Lat:	Long:	Comments/notes: e.g. weather, impacts,
Site description: e.g. downstream of industry	Other plants, level of flow etc.	
pH: Water temp: Dissolved oxygen: Water clarity/turbidity: <small>see clarity table at www.minisass.org</small>		

GPS co-ordinates in degrees, minutes, seconds (e.g. 29°10'23" S / 30°10'10" E) OR in decimal degrees (e.g. 29.1064° S / 30.1717° E). If you don't have a GPS, register to upload your results at www.minisass.org, find your site on the map, click to upload your results and then enter the co-ordinates for you!



GROUPS	SENSITIVITY SCORE
Flat worms	3
Worms	2
Leeches	2
Crabs or shrimps	6
Stoneflies	17
Minnow mayflies	5
Other mayflies	11
Damselflies	4
Dragonflies	6
Bugs or beetles	5
Caddisflies (cased & uncased)	9
True flies	2
Snails	4
TOTAL SCORE	
NUMBER OF GROUPS	
AVERAGE SCORE	
Average Score = Total Score ÷ Number of groups	

Scoring

1. On this table circle the sensitivity scores of the identified insects.
2. Add up all of the sensitivity scores.
3. Divide the total of the sensitivity score by the number of groups identified.
4. The result is the average score, which can be interpreted into an ecological category below.

Interpretation of the miniSASS score: Although an ideal sample site has rocky, sandy, and vegetation habitats, not all habitats are always present at a site. If your river does not have rocky habitats use the **sandy type** category above to interpret your scores.

Ecological category (Condition)	River category	
	Sandy Type	Rocky Type
Unmodified (NATURAL condition)	> 6.9	> 7.9
Largely natural/few modifications (GOOD condition)	5.8 to 6.9	6.8 to 7.9
Moderately modified (FAIR condition)	4.9 to 5.8	6.1 to 6.8
Largely modified (POOR condition)	4.3 to 4.9	5.1 to 6.1
Seriously/critically modified (VERY POOR condition)	< 4.3	< 5.1

For more information or to put your results on the miniSASS map visit the website www.minisass.org/



Version 2.0 September 2013

miniSASS can be used to monitor the health of a river and measure the general quality of the water in that river. It uses the composition of macroinvertebrates (small animals) living in rivers and is based on the sensitivity of the various animals to water quality (note: miniSASS does NOT measure the contamination of the water by bacteria and viruses and thus does not determine if the river water is fit to drink).

Equipment list

- net
- white container / tray / ice-cream box
- pencil
- magnifying glass (optional)
- shoes/gumboots
- Hand wash / soap

How to make your own net

Take any piece of wire, for example an old clothes hanger, and bend it into the shape of a net. Then tie the netting (which can be any porous material) to the wire with a piece of string. Alternatively cut the bottom out of an ice cream container and staple netting to the bottom.

Now you have a net!



Method

The best sites are those with rocks in moving water. Not all sites have rocks (**rocky type** rivers), but may be largely sandy (**sandy type** rivers).

1. Whilst holding a small net in the current, **disturb** the stones, vegetation, sand etc. with your feet or hands.
2. You can also lift stones out of the current and **pick** insects off gently with your fingers or forceps.
3. Do this for about **6 minutes** whilst ranging across the river to **different habitats** (biotopes).
4. Rinse the net and turn the contents into a plastic tray and **identify** each group using the identification guide (see insert: you could start with the dichotomous key and then use the identification guide for more information).
5. **Mark** the identified insects off on the identification guide.
6. Fill in the site information and **add up** the sensitivity scores to determine the average score (see scoring sheet on back page).
7. Remember to **WASH** your hands when done!

History of the miniSASS tool

South Africa has been a world leader in biomonitoring techniques using macroinvertebrates. The most successful of these is the South African Scoring System version 5 (SASS5). miniSASS is based on SASS and also uses the presence of macroinvertebrates to indicate the "health of a river". Where SASS5 contains over 90 different macroinvertebrate classes, miniSASS only has 13 different classes, allowing for simpler identification and understanding. miniSASS has been found to provide similar indications of "river health" status as the more comprehensive SASS5 assessment, thereby providing a good means of generating useful biomonitoring data. The original miniSASS (version 1) was developed based on approximately 2000 SASS4 data records, whilst this updated miniSASS (version 2) is based on over 6000 SASS5 records. This makes miniSASS v2 more robust as a useful water quality monitoring tool & more widely applicable in Southern Africa.

Macroinvertebrates

What are they?

Macroinvertebrates are animals that have no backbone and can be seen with the naked eye.

Why they're used for biomonitoring?

- Different macroinvertebrates have different sensitivities to pollution. The higher their score, the more sensitive they are.
- They are generally easy to collect and identify.
- They are relatively sedentary which allows the source of pollution to be detected.
- They integrate the water quality conditions at a site, providing an overall measure of the "health" of a river.
- They can provide a picture of the historical water quality at a site.

Learn more at www.minisass.org



What is the importance of water quality monitoring and management in South Africa?

Fresh water is essential for most life on earth. It is also used in all spheres of human life, namely agriculture, industry, biodiversity conservation, sanitation and hydration. However due to the amount of rainfall that South Africa receives, it is classified as a water stressed country. This means that if we do not monitor, manage and conserve our current water resources, we will be placing them and the population under tremendous stress in future!



As the general public, we can play a part in making a difference to managing freshwater resources in a community. miniSASS has the potential to be a powerful 'red flag' indicator for the identification of aquatic pollution sources. By using miniSASS we can actively take an interest and management in the health of freshwater bodies in our community. Your interest and knowledge can be enhanced by adopting a local river in your community and monitoring it over time. Identifying sources of pollution and taking **local action** to make a difference. You could also encourage more members of the community to take positive action towards monitoring and conserving water.

Download copies of miniSASS

www.minisass.org
www.groundtruth.co.za

Additional resources

www.wrc.org.za
www.wessa.org.za
www.dwa.gov.za



Upload your results to the miniSASS map on the website www.minisass.org to contribute to a developing picture of river quality in South Africa.

(or send your results to results@minisass.org)
For queries or comments email info@minisass.org
miniSASS is also available from Share-Net
www.sharenet.org.za PO Box 394, Howick, 3290. Tel (033) 3303931

River safety: take special care in polluted waters. Beware of dangerous animals (crocs/hippot!) and fast flowing waters. Wear protective gear when necessary and wash your hands regularly with soap and clean water wherever possible!!

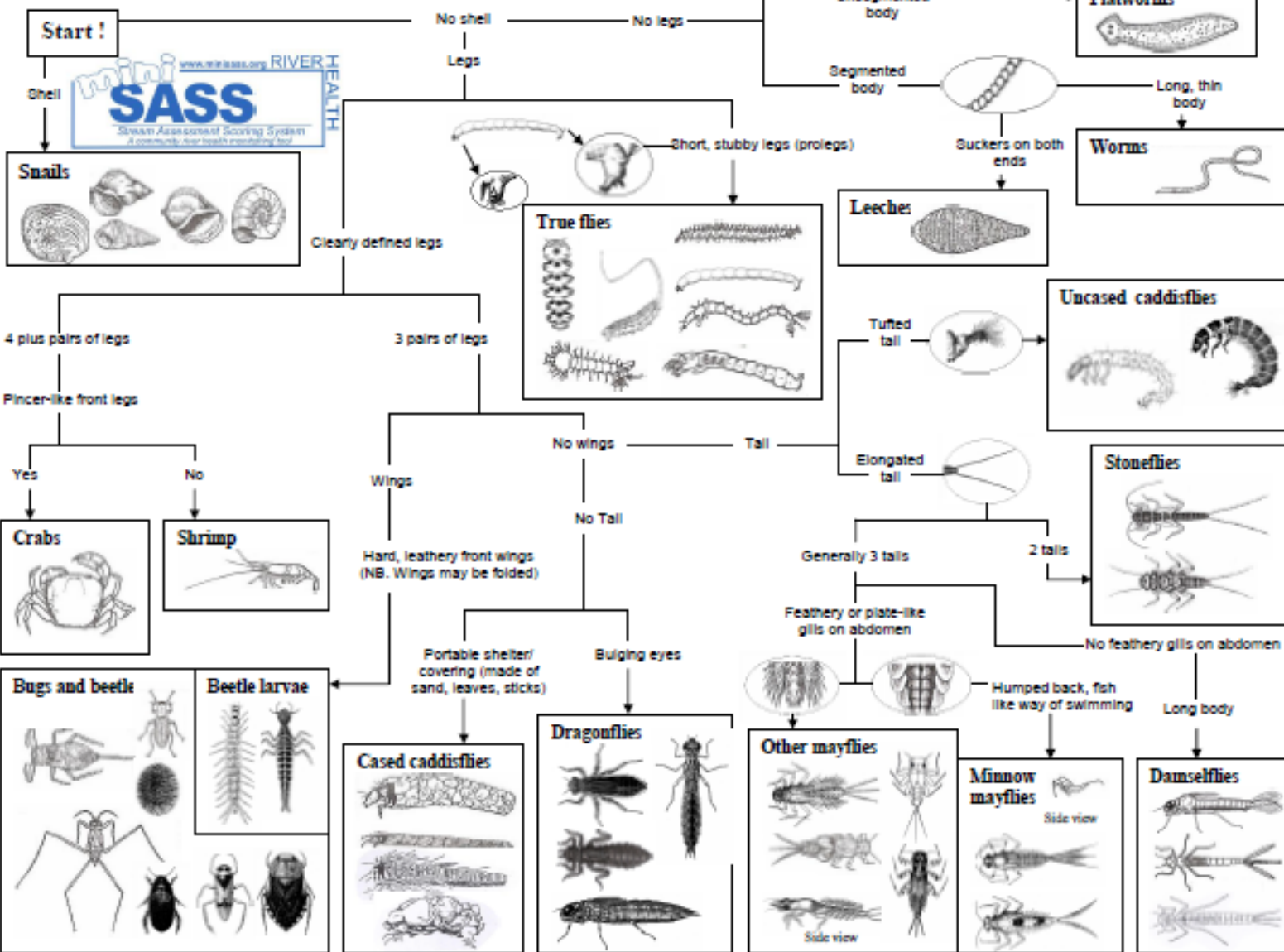
Key words for further reading/resources:

macroinvertebrates, benthic, water quality, conservation, biodiversity, water quality, river health, aquatic pollution.

Glossary

Biomonitoring: the monitoring of biodiversity using biological organisms
Biodiversity: diversity within species, between species and of ecosystems
Conservation: the maintenance of environmental quality and functioning
Ecosystem: a complete community of living organisms and the nonliving materials of their surroundings.
Sedentary: inactive, motionless, not moving

DICHOTOMOUS KEY



Flat worms

Flat worms are characterised by their flattened shape and soft bodied, worm-like form. They have an arrow-shaped head with two dorsal eyespots and are generally mottled or dark grey in colour. Flatworms move with a gliding action and are generally scavengers or carnivores.

Leeches

Leeches are segmented organisms that have very flexible bodies. When moving they expand to become long and thin, and then contract to become short and stubby. They have suckers on both ends of the body that are used for feeding and locomotion. Leeches are variable in colour, from grey, to red-brown and black. They swim with a fast, snaking movement and are found under stones, vegetation and debris.

Worm:

Worms are long and segmented and have a cylindrical shape much like small earth worms. Their colouring is usually pink to brown. They are usually seen writhing around in debris digesting the substrate they fed on.

Snails

Snails are molluscs with hard shells that vary in size, shape and colour. Habitats vary, with some snails such as limpets clinging to rocks, whereas clams and muscles are found in sand. The more common snails move over stones and vegetation. Some snails are host to bilharzia, a serious health hazard for humans.

Crabs and shrimps

Crabs and shrimp form part of the order Decapoda (ten legs) and have bodies and legs hardened to form a tough shell. They have four or five pairs of legs and eyes that are carried on stalks and are movable. Crabs are scavengers that feed mainly on leaf litter but will feed on animals when given the chance. Shrimps are mostly scavengers or deposit feeders.

Stoneflies

The nymphs of adult stone flies usually have two long tails and three pairs of legs each having two claws at the tip. A characteristic feature of stonefly nymphs are the tufts of gills on the side of the body as well as gills between the two tails. Wing pads on the thorax are often dark and obvious. Some species run across the substrate very efficiently and are potent predators on other invertebrates. Other species are smaller and feed on plant material. Most live in well oxygenated, clean water.

Caddisflies

The aquatic larvae of adult caddisflies have a hard head with three pairs of legs which are attached to an elongated, soft body. Finger-like gills on the abdomen and anal appendages can be seen with the naked eye. Some caddisflies construct portable shelters/cases from sand grains, bits of vegetation and/or silk that are glued together to form a characteristic case shape. Most of the case-building types cannot swim whereas the case-less type swim freely across the substrate. Some feed on algae and debris whereas others are predators.

Damselflies

Damselflies have elongated bodies with generally three broad tailgills on the tip of the abdomen. Damselflies are carnivorous and have a 'mask' over the lower part of the face which hinges out to reveal a pair of pincers with which they catch their prey. They are often to be found in vegetation growing on the edge of rivers.

Dragonflies

Dragonflies are robust creatures that are stout and have a large head and protruding eyes. Some have short legs whilst others have long legs. They do not have tails, but swim using 'jet propulsion' by forcefully ejecting water from the abdomen. Dragonfly nymphs are usually the largest organisms found in a sample and are the most powerful invertebrate predators in the water.

Bugs and Beetles

Bugs can be defined as having a piercing and sucking beak for mouthparts, and two pairs of membranous wings. Beetles on the other hand have 'jaws' and outer wings that are hardened to protect the inner wings. Some bugs and beetles are well adapted to swimming, such as water boatmen, backswimmers, pond skaters and water sliders. Most bugs and beetles are carnivorous, but some feed on algae.

Mayflies

Mayfly nymphs vary greatly in shape and size and live only for a day or two. In this time they will never feed and live to mate and lay eggs in the water. Mayflies fly close to rivers and lakes, usually swarming in the early evenings.

Minnow mayflies

These mayflies have a narrow head and a small, slender, but not flattened body. They have leaf shaped gills on both sides of the abdomen and two but more commonly three tails, depending on the species.

Other mayflies

Other mayflies are characterised by an elongated body, large head, well-developed mouthparts and stout legs. They live in a variety of habitats including burrowing in mud, crawling amongst decaying leaves, and scurrying over stones in fast flowing currents.

True flies

Most fly larvae have a fairly indistinct head but elaborate tail ends. They often have small, soft legs (prolegs), segmented bodies and have the appearance of maggots. Some have bristles/spines and antennae. True flies live in a variety of habitats including sand, mud and stones in fast flowing water. They can either be carnivorous or filter feeders.

Appendix 3

APPRECIATIVE INQUIRY INTERVIEW SCHEDULE TO EXPLORE LEARNING, KNOWLEDGE PRODUCTION AND CHANGE IN THE MPOPHOMENI SANITATION EDUCATION PROJECT

Name of Interviewee: S'the Nkomo

Date: 19 March 2014

1. Please give a brief description of your role in the MSEP.

As an Enviro Champ I report the spilling manhole, water leaks and sometimes go to municipality offices and teach people water related issues and dumping issues etc.

DISCOVERY: REFLECTING ON AND DISCUSSING THE BEST OF WHAT IS CONCERNING THE MSEP.

A: Questions 2-5 pertain to the overall impression of the MSEP

2. When you remember the beginning of the MSEP what is the first good thing that happened that comes to your mind (personally and perhaps in the community)? What do you feel were the specific contributions of the people who started the project? And how did you contribute to the setting up of the project?

I joined the project along the way. The first good thing that happened there was a reduction of spilling manhole in my area.

3. When you think of doing the work (monitoring sewage spilling/acting out environmental/sustainability plays/monitoring water quality in the nearby stream) what kind of mental picture emerges spontaneously that you are particularly happy with? What do you like to remember regarding the work of the MSEP? What works particularly well, and why? What is your specific contribution you can be proud of?

Most of the things that makes me happy is that some of the things are not happening as before like dumping site reduction, occurrence of spillage manholes has decreased. I think what makes everything work well is that local municipality people and the community get very well. They are in this issue together. I would like to remember MinSAS and tell people about it. MinSAS works well because everything is practical. There are organisms expected to be found in water that will indicate the state of the river. I am proud of taking care of manholes and rivers.

4. What are the success factors of the MSEP? What works very well from your perspective?

The involvement of Enviro Clubs from different schools from Mpophomeni. School children take knowledge and pass it back to their parents and siblings.

5. What positive feedback do you get from the people in Mpophomeni/plumbers/municipality officials? With which aspects are they particularly satisfied? (e.g. what is happening, the way that it is happening and where it is happening?)

Yes I strongly believe they are satisfied especially the plumbers because when they are invited to workshops they come and appreciate the work of MSEP.

B: QUESTIONS 6-9 RELATING TO LEARNING AS SOCIAL PARTICIPATION (COMMUNITY, IDENTITY, MEANING AND PRACTICE)

6. Do you know the other people involved in the MSEP work and get on well with them? What is your best memory about the group of people who are working together to solve the problem of water pollution and illegal dumping in Mpophomeni and Howick?

I know other people involve in the MSEP and we get well on each other. I once worked with counsellors to solve illegal dumping and Liz help when I was doing petition for cleaning the street and I produce it to Don Mtshali at municipality and the street was cleaned.

7. Would you say that participating in the MSEP has affected the way you think about yourself and your role in life/your community? In what way has the MSEP changed the things that you think about, say, do and deem important?

Yes has MSEP changed my way of thinking and of the community too. Through drama and Enviro Champ the community is well educated and they taking action about solving manhole spillage. Before I joined MSEP I didn't care about river issues and now I care a lot.

8. Please share the most meaningful learning experience you have had through your involvement with the MSEP.

There are many ways of learning. Drama is the meaningful learning to me.

9. What are the actions/activities that you have learnt to do (and become good at) as part of your work with the MSEP?

To report spillage of water and sanitation issues and to conduct petition

C: QUESTIONS 10-13 RELATING TO KNOWLEDGE PRODUCTION THROUGH PARTICIPATING IN THE MSEP.

10. Please tell me more about the contribution you are making as an Enviro Champ, actor or Eco-Schools Enviro Club member in terms of the facts (recording sewage spilling event date, cause, miniSASS scores) discussions and understandings (drama team) around water and sanitation problems in Mpophomeni.

Sometimes people understand because they know what is happening because in most cases spillage of manholes occurs in their homes. They have full understanding.

11. What is the one thing that you know now (related to water/sanitation/ people's practices/people's attitudes/the local and district municipality etc.) that you did not know before you joined the MSEP?

To communicate with counsellors and plumbers

12. Can you please share your experience of how you got to know this? Can you remember details of the occasion?

Since we are dealing with same problems with plumbers that how I started to communicate with them. I started to communicate with the counsellors when I was conducting the petition.

13. Are there any experts involved with the MSEP project? If so, please tell me who they are and what they are experts at (what they know more about)?

Yes there is one person I think of is Mohamed. He is a scientist at Ground Truth.

D: QUESTION RELATING TO CHANGE

14. Please share good examples of the people participating in the MSEP and people in Mpopophomeni using/applying what they have learnt through the project (in conversation, practice).

I think Umthobo Enviro Club. They applying what they learnt through conversation when they teaching other kids and their parents.

APPRECIATIVE INQUIRY INTERVIEW SCHEDULE TO EXPLORE LEARNING, KNOWLEDGE PRODUCTION AND CHANGE IN THE MPOPHOMENI SANITATION EDUCATION PROJECT

Name of interviewee: LS – Eco Wonders Enviro Club Chairperson

Date: 29 April 2014

1. Please give a brief description of your role in the MSEP.

At Injoloba Eco Wonders Club I am the chairperson, so the biggest problem that we are dealing with is water wastage, the Problems mostly

How are you personally doing that? What is it that you Lindo are doing in your capacity as chairperson? So you're looking at freshwater leaks and so on but describe a bit more about what it is that you are actually doing in the process of addressing the water leaks issue?

Well in the process of addressing that issue I make sure that our club members as the Injoloba Eco Wonders know fully on the problem that we are facing and we also try to find out problems on how to fix that problem. For example as we tried to fix the water leakage problem on the 15th of March at KwaMevana so that is what we mostly do and we're here to try and help them get more information on that.

Ok, so how would you get more information?

Well there are many places from which you can get information on water wastage for example we can do research go over the internet and google about it and we also have Sandile who's there to help us, so we don't have much of a hard time to try and find the information.

Can you tell me what Sandile does?

Sandile has been facing a problem, not exactly a problem, but he's been trying to fix problems on water wastage around Mevana and other places, for example like leaking pipes and all the water that is getting wasted in the process. And he's also assisting us on the fieldtrips that we are participating in and that we are taking this year.

Do you do anything else other than looking at water leakages? Are you looking at any other topics or problems.

Ja, we are, for example we are about to be on a new chapter of our project and it's called Healthy Living so that is where we ensure that people and the environment is safe for people to live around in it. Ja, so that is what we will be doing.

DISCOVERY: REFLECTING ON AND DISCUSSING THE BEST OF WHAT IS CONCERNING THE MSEP.

A: Questions 2-5 pertain to the overall impression of the MSEP

2. When you remember the beginning of the Enviro Clubs what is the first good thing that happened that comes to your mind (personally and perhaps in the community)?

Well certainly I got to meet a lot of people and when you meet a lot of people you get that surety that you yourself can be ... you know, you can go further than you think go can go so ja, you meet a lot of different kind of people, so ja, that's was the best thing that ever happened to me.

Firstly what do you know about that project? The Mpophomeni Sanitation Education Project. Liz Taylor started that project and the Enviro Clubs fall under that project. Let's start from the beginning, what do you understand that project is doing?

Well basically what that project does is that it does not only fall under Mpophomeni, but it makes sure that the areas that are around Howick keep their rivers, streams, ja they make sure that their rivers are clean. They provide information on the regularities on how to clean those river and and I feel that they are doing quite a good job actually.

So what were the specific contributions of the people who started the project?

I think that the people who are doing that project, contribute a lot in the community because most of our streams fall under different communities, so we can say that they are doing a good job.

Do you see yourself as part of that?

Ja I do see myself as part of that project.

And how did you contribute to the setting up of the Enviro Club at Injoloba?

Well, when you begin something, when you start to form something, it's not exactly everyone who will understand what you are doing, even you yourself sometimes question yourself, "what am I exactly doing?" So ja, you just have to be patient because everything will fall into place as time goes. So I would say that patience has driven us to where we are today.

3. When you think of doing the work (monitoring sewage spilling/acting out environmental/sustainability plays/monitoring water quality in the nearby stream) what kind of mental picture emerge spontaneously that you are particularly happy with?

I would say that as I meet with other kids the information and knowledge that I gain at that time make me want to continue and do more about those things, so ja that is the very broad picture for me.

It makes you happy?

Ja it does.

What do you like to remember regarding the work of the MSEP Enviro Clubs?

Well what I would like myself to remember is that the difference that we made in the process of being MSEP and being under it. So ja, the difference is what I want to remember actually.

And do you feel that you are making a difference?

Well a difference cannot occur as from now, but I feel as time goes by there will be a huge difference if only people could get educated and stuff.

What works particularly well, and why?

Well, the club, in the club we have different people and they provide very different characteristics so what makes them stand firm is that you need to support them, you know, do not only show them that you're the quite... you're much more advanced information more than them, but you have to be at their own level sometimes and that makes them feel secure.

What is your specific contribution you can be proud of?

Well, I am a matriculant, so time is what's really not on my side, but actually I tried, it's not because I've tried, but I like to spend time with them so I think my time is more valuable to them actually so that what I'm happy about contributing it.

Don't you think it makes a difference that one of the kind of senior's at school is taking an interest isn't it also perhaps changing the way that others look at the club because you are involved?

Ja, it does, cause mostly I won't lie I'm the only grade 12 that's involved and people question me, what's so important about this thing and I get to explain for example that day that you guys came to the assembly has left a lot of learners wondering 'wow' is this what we live up to daily and I say "no it's not but the information or the knowledge behind that play is what we live up to every day, it's not what we live up to but it's what we try to live up to... So ja

So really that day was an interesting day because I heard booing...

Ja, you did hear booing, well let me just say in life you cannot just experience the good things you just have to have the negative things in order for you to have the power to succeed. So ja the booing

gave us a lot of power in order to try and make sure that we don't get the booing that we got last time.

Excellent, but is booing part of the school culture would you say?

No it's not, but it depends on how people think and what actually they are booing about some other learners they don't quite have an interest on what we do, so that's why when we try and develop power in order for them to know what we're doing.

How do you develop power?

Well for example it was about two or three weeks ago we were at assembly and then we tried to make a presentation even though it wasn't successful but some other learners they were taken away by the presentation but some others you know are all over the place (**disruptive?**) ja, they just enjoy being disruptive to what you're doing.

So do you think that you gained some ground with that presentation, that some learners thought "Hey this is interesting"?

Well, some others but some have not really come forward to make sure that what we talked about is really happening, but at the club mostly members are 'sinking in' they're coming, so maybe the presentation did quite do a spot on their heart.

Look I've seen a growth in that club of yours from very few to now quite a busy bunch of learners.

How did that happen?

Well at school not people are interested in what we do, but when we get a chance maybe I have a free period I go to each and every class and I ask them about interest in the environment that they live in, I also tell them that the environment best describes your personality so I think that motivates them.

4. What are the success factors of the MSEP? In fact is it successful?

Well ja, I think it is successful, because if the MSEP isn't successful probably it would have been the end of it even the time when it begun, but I think it is successful because it's still existing even now.

What works very well from your perspective?

What would be very boring actually is not to have any fun on that project and MSEP is quite a very fun project and quite a very teaching project at the same time so I think that's what makes it very very successful, because I don't think that you can enjoy something whereby you get to be serious all the time. You need to have for which you know you can have a good time, so that's what makes it successful from my own side of things.

That kind of takes me back to the Youth Water Workshop and you being dressed up and actually acting as part of the team and doing a very good job of acting and having fun...

Well that play, it was my first time doing plays since primary, well it rose to me some happiness from which I couldn't describe cause I get to be part of the person whose making a difference on the environment so ja that gave me a lot of power in order for me to perform and make sure that I do very well. So ja, that play is one of which I think I will never forget in my life.

Certainly, they set the standard high, you can't be shy you have to jump in with all fours and you definitely did I mean it looked like you were an expert like you've done this all your life.

Well it depends on who you're working with. I was working with Thandanani and Vuvozi well Vuvozi, I met him the day before, and we became quite best friends at that time and we still are right now. So ja, Thandanani was also supportive, he even gave us the basics of how to perform so that's why I think that we had such a very, very fun time performing and not showing that we lack knowledge on how to perform and stuff. So ja, I think that's what made it most successful, the people I was working with.

5. What positive feedback do you get from the people in Mpophomeni/plumbers/municipality officials? With which aspects are they particularly satisfied? (e.g. what is happening, the way that it is happening and where it is happening?)

The community as a whole, well KwaMevana, some people lack knowledge on exactly what we're about mostly when I go on fieldtrips or even sometimes when I feel like wearing my tshirt, they ask me "what exactly is this tshirt for?", I try to elaborate with them I try to explain to them but some quite develop an interest. Even at school, well recently we lost our principal and he was quite interested in the process of the club, he was the one who made sure that you know, even we asked for an office but he tried to make sure that we got one.... But some teachers have that kind of a negative feedback so not all people like what we do...

So is it Mr. Ndaba only who was supportive? Do you have support or positive comments from your teachers?

It's not only Mr. Ndaba we have quite about 6 teachers who are interested in the work that we do who are interested in the club and praise us a lot and they do make sure that we keep on with the club and where we lack they provide information and guidance actually on what we do, so I would say that actually we do have quite firm support at school.

Wonderful that makes a huge difference. Do they actually tell you what it is that you are doing well?

Well last year well at school we have a stream and there's a bridge on top of it this stream was very, very dirty, so we took our sport time to try and clean it and that gave us a lot of feedback from our school teachers saying that they didn't think that we had noticed that our school is in a very, very

very bad position so ja seeing you do something that gave them the courage to praise us. That gave them the words to praise us.

B: Questions 6-9 relating to learning as social participation (community, identity, meaning and practice)

6. Do you know the other people involved in the MSEP work and get on well with them?

Well I do know Louine Boothway, she's our sort of like our Earth Mother and ja we do have quite a lot of people who are involved like Liz Taylor, Jim Taylor, Thandanani and the guys a lot of people are involved though I cannot mentioned all of them they are involved.

Ja most certainly I do.

What is your best memory about the group of people who are working together to solve the problem of water pollution and illegal dumping in Mpophomeni and Howick?

Well a memory I think for me I think it was that time that we (sort of like the extended family as you said) got together and we went to Shiyazi to identify the problems they face from which they face there and we went to uMngeni Valley to discuss the problems from which we saw that the people we facing. So ja that's quite a memory for me.

7. Would you say that participating in the MSEP has affected the way you think about yourself and your role in life/your community?

Ja, well if I'm exactly doing my job as I should be doing it that would really make a difference to me and ja, I think it has done I have noticed a few things in my community a few years back if I wasn't part of that project I wouldn't have noticed and I wouldn't have cared about it that's what changed me.

Ja, it has been affected for example when I was in primary doing grade 7 I wanted to be a teacher or something, well as I got to be more involved in the project I wanted to deal with environment and ja so my career started to change and I wanted to change it immediately so I decided that it's either I want to do Environmental Management or maybe I could figure something that may not take me away from working with the environment, because I love working with the environment.

In what way has the MSEP changed the things that you think about, say, do and deem important?

8. Please share the most meaningful learning experience you have had through your involvement with the MSEP.

Well I would say leadership, well leadership is not something from which you can sort of like say softly, you have to be two different kind of people you have to be at a position where you are the member and sometimes you have to be in the position from which you are the leader you have to try and control the doings of the club and also make sure that you're also part of the club and that

the members don't always feel that he's sort of like, I'm always controlling them, so ja I have to be both sides.

Is that what you've learnt?

Ja

I've noticed that you have not missed a single meeting or fieldtrip. Do you want to comment about that?

It's all about well let me just say, besides school the club is my second priority, so that's why I make sure that at every single meeting I'm there to see how things go and to see if we're having success on that meeting or what, so maybe that's what drives me to make sure that I don't even miss a single meeting.

9. What are the actions/activities that you have learnt to do (and become good at) as part of your work with the MSEP?

Well when I started the club I was much of a very, quite shy person I still am right now but not much cause it has taught me to work with many people, people from many backgrounds so that's quite ... to shy away. So ja, it has helped me with my personality.

Maybe speak a bit about working with Andrea Kolbe on the power point presentation for your youth water workshop

Andrea, still is a student at some varsity but she was like quite there for us she found time to help us, try to polish our presentation. Even when we were went to the school that we went to, we went to Epworth, she was like, ok this is what we didn't do right at the water workshop and we need to fix here and there and we need to research more on our power point presentation and we did that actually and that presentation at Epworth was a success so ja I would say that she's quite a very, very influencive person.

Tell me about that day, I was in Grahamstown. How was it received and that?

Well at Epworth the crowd was more different than the crowd at uMngeni Valley because there were many lot of people schools and we got to interact with many people and ja the presentation was quite a success for my side, I don't know about the other people's side but it was a success because I think that the people that were there got the message. Even Mark Dent came to us and said that the presentation was quite a very, very, very, very teaching one.

C: Questions 10-13 relating to knowledge production through participating in the MSEP.

10. Please tell me more about the contribution you are making as an Enviro Champ, actor or Eco-Schools Enviro Club member in terms of the facts (recording sewage spilling event date, cause, miniSASS scores) discussions and understandings (drama team) around water and sanitation problems in Mpophomeni.

Well knowledge when we started we all lacked knowledge so we still tried to find some certain knowledge that we can bring for the MSEP project but as action we tried to make sure that the areas that are around us are fit enough or good enough for us to ... out and say ok this is what we've been doing.

Tell me the KwaMevana freshwater leak project...nobody's done that before .. .it seems like such a normal thing to do but it hasn't been done before...most people just look at the leaks and they go "that's very bad"

Ja, they just go like that but they don't think about fixing them, ja when you see a problem you have to find a certain In order for you to try and fix that problem so ja I would say that most people would said ja this is a problem but they never took part in trying to fix it.

It's a very interesting contribution you made there because you actually came and fixed it in front of people and then you saved thousands of litres of water which we still have to do all the calculations of.

11. What is the one thing that you know now (related to water/sanitation/ people's practices/people's attitudes/the local and district municipality etc.) that you did not know before you joined the MSEP?

What I would say my knowledge I didn't know that people would just develop a very heartless reaction towards water. Water it's sort of like life to many of us, some people just don't care about how the water is wasted so I would say that it's very very harmful and very bad towards the environment.

12. Can you please share your experience of how you got to know this? Can you remember details of the occasion?

As on the fieldtrip we were with a plumber, Baba Mlungisi, before a problem, before we tried to fix a problem he would just elaborate tell us what is happening on that situation. He told us that people, they know that a tap is leaking but they don't even budge to buy a rubber band for that tap which doesn't even cost much so ja, that is very, very disappointing towards people but when you come to the things that they possess it's quite very, very priceless.

You had a very interesting experience with the home owner of the first house where you fixed the leaks....

Well that guy, I was on my way back from school to my house and I met him, I don't know how he recognized me, but he was like, "ok, you were part of the team which were at my house during last week and I was like "ja you saw the work that we did" and he was like, "no guys, you never did anything except that the water is more broken than before, and I was like ok, so you yourself if you took the initiative to try and fix that problem maybe the tap wouldn't be much broken as it is right

now and he was like ok so who do you work with and I told him and he was like “ok” and on my mind I got that feeling that “no, it’s not exactly curiosity that’s driving him, he’s a bit upset that we noticed a problem before him and that the eyes of the community laid on him because of the actions that he makes towards that house. He doesn’t care about that house so that’s what pretty much upsets him. So that’s what I would say.

That’s very interesting so did Sandile not go to every house and speak to every house owner about coming there and fixing their issue?

Sandile did, I think he did, cause most of the people were expecting us I would say that.

So while he was sober he was quite happy to have us fix all the problems at his house?

Ja I think the influence drove him to be who he was on that day.

All right well that is a very interesting theory about him feeling like all eyes are on him now but did, was he able to tell you cause there were three leaks there was a toilet leak a bath leak and a tap leak at the back. Did he tell you which one is worse than it was before? Cause we actually fixed three.

I don’t think ... no he never told me, he just told me that the situation in his house is worse than before so I got to my mind that “no he was just being himself under the influence”.

13. Are there any experts involved with the MSEP project? If so, please tell me who they are and what they are experts at (what they know more about)?

Ja, at the MSEP project there are a few experts for example in the drama part Thandanani is there.

He’s always, like for now, we have a competition that we plan to enter – the Baswe le Metse project – he’s helping us prepare a play. So ja, I would say that he’s quite involved in that drama department.

Are there any other experts involved with the water studies that you do or any advice with regards to the other EcoSchools themes that you are pursuing or is that the main one that comes to mind?

Well besides Thandanani we have you who has always, you know, given us a hard time – not exactly a hard time but a hard time in trying to be more successful at what we do, so we have you in the leadership department so ja I would say that ja.

D: Question relating to Change

14. Please share good examples of the people participating in the club applying what they’ve learnt in the project even personally, are you applying what you’re learning? So you see water waste are you doing something about it, you see perhaps water pollution have you adapted what you do? And perhaps do you know about anybody else in your community or in your club your families who are doing...

I am adapting to my learning actually and Sandile, he's not only working with us the other day I saw him at some house busy trying to identify that problem and he's is quite more hands-on with his work and most of my club members I tell them at each and every meeting at school that what we claim to do, we mustn't only claim to do it at the fieldtrips but we have to also apply it at home even at our close communities. They have to see what we are about so that's what they do actually.

Wonderful thank you very much!

Appendix 4

A new line after a space indicates a new speaker.

LB: I'm going to now step away, become a researcher myself. I would like to ask you if you would give me permission to film the miniSASS so that I can use it as part of my master's dissertation research. If someone has a problem with that please come and talk with me and I will make sure that I don't include your handsome face in the frame, but from now on I'm going to step back and be extremely quiet which of course you will know is quite hard for me to do but I'm excited about having a good citizen scientist and capable person in charge from now on. Thanks Nduh.

NC: Here's what's going to happen I'm gonna explain the equipment, is it ok if we do it here? I'm carrying a net here on my hands. We're gonna use the net for picking up the insects, mostly in the deeper areas of the stream and around the edges in the reeds. Ok and ...I have my brush, the brush is used for whenever you want to remove something from the rocks you just use the brush and then put it here on your yoghurt containers. Ja, also you're gonna use these water containers to take out water from the stream and then check if you see anything. Let's say you found something very interesting inside the water, you use these containers to put it in (*showing the small clear plastic sample bottles*). These are the containers, then you can use the magnifying glass to actually see what it is that you had caught. Ok, you have a pipette (*holding up the pipette*), so if ever you find something very small you can just use this to get it out and then put in here on your tray. Here's the magnifying glass (*holding up the magnifying glass*) so whenever you want to see something closer you use this magnifying glass. It even has a light so if you don't see properly then you just use the light. So far, are you following?

Group: Yes.

NC: Ok. Here's your Savlon – not Oros (*laughter*). I have this dichotomous key (*holding up the dichotomous key on the centre-fold of the miniSASS sheet*). This one you'd use when you are identifying your invertebrates, then your invertebrates explained here (*holding up the descriptions of the invertebrates on the miniSASS sheet*). You see them here as well at the back. Then you have our handbook (*holding up the 'Hands-On Stream and Pond Life' booklet produced by Sharenet*) on this handbook it explains everything about miniSASS, how to use this handbook. What else? Conducting a miniSASS, assessing the water quality... you can use this...ja, ok... before we do the miniSASS we must read this carefully...

LB: It's actually in there. The miniSASS sheet.

NC: Ok.

LB: All the information about miniSASS is on that sheet.

NC: Ja, then you have this sheet we're gonna use for our miniSASS. Here at the back we're gonna read this information first. We do the miniSASS. When we are done with the miniSASS then we score the invertebrates that we found. We count the total score and the number of groups that we found and the average score which will be our, our... that score will be our river category which may be largely modified or seriously, critically modified. Ok, I'll just read what the miniSASS is, then we go onto the field and then we do it. *(Reading)* "MiniSASS can be used to monitor the health of a river and measure the general quality of water in that river. It uses the composition of macroinvertebrates, the small animals that we find there in the stream ... living in the river based on the sensitivity of various animals to water quality" *(slight deviation from the original text)*. To me that sounds very complicated, but in my own understanding, I know that when you do a miniSASS you go there and you look for the small animals that are found in the water. Each animal is sensitive to a different amount of pollution, so those ones which we'll find there, probably they are tolerant to pollution. Mostly a good indicator of clean water is a Stonefly, but I doubt if we'll find any there. Mostly I think we'll find the, the... what's this? Ok, I think we'll find the Caddisflies mostly. I was reading the newsletter, the miniSASS newsletter and the animal of the month was discovered to be this Cased Caddisfly, so if ever you find it, please put it inside here in one of these boxes then maybe we can use this sheet to see what it is, since it will explain better. So I think we can now head to the stream.

LB: Can I ask that every group leader spends time to look at the sheet with your group? And perhaps ask the group leaders to allow your group members to read, take turns to read the sheet. Is that ok? Then we can really be familiar with the process before we go.

(New sound clip – Kevin Lakani's group)

KL: ... tell you whether the water is safe to drink or not. So let's just say maybe you happen to get a score which is 4 or 10, that doesn't tell you whether the water is safe to drink or not, but it actually tells you how polluted or how clean the water is, the river, that particular river is. So what we do, we have this thing here *(holding up the miniSASS sheet front page)*. Can you all see this? This is the thing that we're gonna be using....

(New sound clip – same group)

Who knows what are the invertebrates? Who can tell me what are the invertebrates?

Group member: The animals without backbone.

KL: Why the animals without backbone? Because they can be easily found and they're slow moving in water and those micro invertebrates that we're gonna be looking for, they actually have the different sensitive scores. So each micro invertebrate has got its own sensitive score. We've got Stoneflies, we've got Mayflies, we've got some Dragonflies with their different sensitive scores. So we actually score when we score the miniSASS according to those sensitive scores. Let's say maybe "mina" I'm 20 and Mbali is 7, so what they say here, they say the higher the score the more sensitive it is to pollution. Do we get that? The higher the score the more sensitive it is to pollution. If "mina" I'm 10 and Mbali is 20 who can we find to a very polluted river? (*group member points to Mbali*). If Mbali is 20 and I'm 10, in the very, very polluted water or river, who can be found?

Group member: You.

KL: Yes, because the higher the score, the more sensitive. So if Mbali is 20, she is more sensitive to water pollution than "mina", it doesn't mean you can only find me to a polluted river, you can find me to a clean river, but just because I'm not sensitive to pollution, you are gonna find me also in a clean or in a polluted one. Ok, so what we do here, we just look for these stuff here, we just scoop out the invertebrates and then we pour the water and the stuff in here (*pointing to the white tray*) and then we identify them using this (*pointing to the dichotomous key on the centre fold of the miniSASS sheet*). This is what we use to identify as uNduh explained, we start here, here it says here what you do, you just look at these from start. Shell, has it got a shell? If it has got a shell then you go down and then it's ok it says here "no shell" then you go there. Has it got legs "yes" then you go down, so this is what we use to identify and then once we find these you see here there's a worm, flat worms, leeches and all. Let's say maybe we get 5 different invertebrates here, so what we do if we found worms we tick number 3, if we found bugs and beetles we tick here and then we found a true fly we tick here. That's 3 right?

(New sound clip – Ayanda Lipheyana's group looking at the tray of invertebrate specimen)

Group members talking together: Maybe if it's that it has legs then, it's this one here "nantsi"... it has legs ... those small things, the small things are legs ... may I borrow the ... so it's a true fly?

Group member mumbling something about a worm.

AL: No this is not a worm.

Group member: So it's a true fly?

AL: Ja

(New sound clip, same group)

Group members together: 4., ja, it's 4.2 something, so that's sort of like ...

AL: Look at the rocky type, you are not there.

Group: So rocky type ... it's around here... so it is less than 5. ... so it is *(2 group members reading together)* "seriously, critically modified" that's in a very poor condition. Ja, hey *(whistling)*, let's move away! So now it's dangerous to drink.

AL: Very, very, very dangerous

Group member: Very dangerous.

Group member: That's at the end. That's when you need the government to come and clean *(laughter)*.

Group member: But then you'll be destroying these animals.

Group member still calculating: ... divide it by 7 ...

Group member: Why do you divide it by 7?

Group member: Cause you find the average score

Group member: So it gives you?

Group member: 4.2 something

Group member: Calculate Genevieve.

AL: The other things is that crab is the one that you can find in all kinds of conditions you can find it in clean water, dirty ... it can adapt

(00034 New sound clip same group)

Group member: He *(Ayanda)* was guiding us to see this is what you can find. The people that took time to go deep into, you know, understanding the environment, because by using this score sheet it is just easy, you pick it up and it's on the sheet. So I think to have time to analyse, to take time to

understand where you're living.... You're gonna come up with some dangerous situation because you are very neglectful person (someone agreeing – ja), you know you end up...

Group member: That way even though you could like notice like 5 over there you could already know that water you can't drink.

Group member: So there's a need for people to take time to focus on each and every facet of our life, it's very important. Look how he we found it's very dangerous this water, very dangerous, not just

AL: Now you understand that in polluted water what invertebrates you expect to find?

Group member: Yes, yes, ja

AL: We all understand that now? What did you find interesting during the course of the miniSASS here?

Group member responds in isiZulu. Need translation.

00036 New sound clip same group isiZulu discussion about low oxygen conditions. Translate.

... When water is still, moving slowly there's no oxygen, so those red worms they can make their own oxygen, they perform anaerobic respiration.

Group members: Hey!

Group member: Now I understand.

(New sound clip same group discussion about mistaking a Mayfly for a Stonefly)

Group member: So the one tail was broken?

AL: Ja, it happens that ... like ... Mayfly they have like weak legs.

Group member: Ok, so they break easily?

AL: Ja, yes their tails they break easily, so ...

Group member: See this one here in the middle it always breaks first (referring to the picture)

Group member: Ja...

Group member: So that means in doing this exercise of identifying you need to be very careful.

AL: Yes, you need to be very, very careful.

Group member: All of us would say, ja it's this one, it's this one

Group member: Hai, it wasn't a stonefly, no, no, no ...

Group member: How did you know?

Group member: The feathers, the gills...

AL: Ja, the Stonefly does not have the gills.

Group member: Ja

Group member: Ok.

AL: So ja, and the other Mayflies have the gills.

Group member: Ja, that's how you should recognize it.

AL: It has hairs on the abdomen.

Group member: It's a little bit bigger.

Appendix 5

Goals of this workshop:

- Talking and thinking together about the functions and practices of the MSEP over the last 3 years and highlighting the aspects that work well i.e. emerging outcomes and impacts that have created value amongst those intended to benefit (evaluation outcome). In the process identifying the key activities and practices that we do as an MSEP community of practice. Possible criteria for evaluation (based on the AI RCE evaluations): Coordination and networking; activities and their effects; transformation and sustainability; strategic areas and linkages; value creation assessment.
- Talking together about what it is that makes these aspects work well and applying these lessons learnt to aspects that don't work well currently (developmental outcome)
- Learning the art of thinking positively about our challenges and as MSEP participants and identifying ways in which we can address the causal mechanisms that hinder success for the MSEP (capacity building outcome)

8h00 Registration and welcome

8h30 The "Discover" stage

This is "The MSEP Journey", developing a picture of how the MSEP evolved.

To set the stage Liz Taylor: Presentation on the history of the MSEP project (the roots that we might not all be aware of) (30 min's)

Activity: Participants work in groups of 5. Walk around the room looking at photos taken during activities over the last three years. Groups write comments/memories/information/knowledge/experiences that relate to the photo on a numbered note pad that links to the A3 photo page. Responses are collated by facilitators on the A3 page for viewing and discussion (1.5 hours)

10h00 TEA

10h30 The Dream stage

Activity: During this stage participants still in their small groups imagine a perfect MSEP and develop a short skit that demonstrates their vision for an ideal organisation. The skits are filmed and can be used to develop a mission statement/vision for MSEP. (1 hour)

11h30 The Design stage

During this stage we think about what we are lacking that we need in order to achieve the dream that we have just acted out.

Activity: Positive Icebergs (this is the transformation/sustainability component).

The group identifies one component of the dream that they are going to analyse using the Iceberg approach. In doing this we 'unpack' what needs to change for us to achieve the ideal in terms of people's thinking/habits and the systems that underpin our actions.

13h00 Lunch

14h00 The Destiny stage

During this stage we consider how we can we achieve and sustain this? The premise on which this activity operates is that people are key to the success of the MSEP. We now identify the people according to their strengths/talents/experience/interest who are going to do what we identified needs to be done to sustain our DREAM.

Activity: Participants are asked to write down “what am I good at that can help the MSEP become better and more effective” and share this in the small group. Next step they identify the strengths of people in their group and affirm in what way they can strengthen the work of the organisation. The day ends with participants sharing in a big circle what was shared in the small group and the names and commitments of individuals recorded on the white board with time lines where applicable.

Appendix 6

Group 1: Hlonipho Zondo [actor/enviro champ], Sthe Nkomo [enviro champ] , Zongile Ngubane [enviro champ], Mbali Sithole [enviro club learner], Sandra Ndlovu [enviro club learner].

Group 2: Ayanda Lipheyana [enviro champ], Fresh Ngubo [actor/enviro champ], Mandisa Shelembe [enviro club learner].

Group 3: Thandanani Luvuno [actor/enviro champ], Kevin Lakani [enviro clubs mentor], Sanele Dlamini [enviro club learner], Minenhle Dube [enviro club learner].

Group 4: Lindo Sithole [enviro club learner], Nqobile Zondie [enviro club learner], Moses Kilozo [enviro champ], Zwelithini Hlela [potential enviro champ who had a big problem of sewage spilling around and under his own home].

THE DISCOVER STAGE

[Group 4] Can I ask you to hold this [referring to the voice recorder] to capture what people are saying during the time you look at this [the photos]? Lindo explaining the Iceberg Conversation: The Iceberg Conversation relates to the story around the pollution that's been happening; the events that have led to the pollution so that you can try and solve the problem - basically a way of explaining the problem. **[Photo 2]**This is Midmar Dam shown by the arrow where there was a sewage leakage affecting the dam water causing water pollution, leaving an effect on the animals of the dam, which also causes air pollution as the sewerage pipe smells .Mpophomeni has some illegal dumping as shown in the image. As there is dumping throughout the township. The people of the area are forcing material down the pipe causing it to have a leakage. There has to be an explanation of this situation with everything that is happening here. Something needs to be done to help this situation

Please may I stop everyone as I put an iceberg icon on the page without any explanation? So I will explain it. I will just show you this example of the iceberg. Please help me to translate. An iceberg is the symptom of the problem, not the cause, most of the iceberg is under the sea as only we see the tip of the iceberg, there is a lot more under the sea that a ship can bump up against. So that is why this is such a suitable metaphor, saying that there a lot of things under the problem that we can't see, that are the things we should try solve, so you do not have to do the iceberg for every photo, just mention a thought of the problems underlying the sea of the problem you are talking about. Please help me translate.

[Louine] I will make an example of this photo showing the dirty top part only but not showing what is actually underneath this dirt. As symptoms they show the problem like with flu you cough first and

know that you have flu which will lead you to go to hospital or the doctor. So the iceberg is the top part which is the issue or event.

If you imagine the “event” is the uMtunzima stream being full of litter you can know that this has been happening for a long period of time. Why is this happening? There has been no recycling depot in the area for example in Mpophomeni. There is no bio bag system; there is no land fill site for building rubble and service delivery is not adequate. Where we see the municipality is not able to pick up the rubbish every week as they promise. Then what in our thinking is causing this problem? We think that rivers wash waste away, we think that if the water comes it will take the waste away from our lives. We usually think that bread bags are waste but as the enviro clubs have learnt, bread bags can be made into skipping ropes, these bags can be used to make ropes for hanging gardens. Bread bags can be woven into carpets for your bathrooms; they don’t have to be “waste” if you think about it, think about bread bags differently. You won’t have to throw them away in the river. You don’t have to use the iceberg for every photo, but feel free to include this in your discussion.

[Thandanani]: Here we are talking about the community, not us! Knowing that things are not as good as they seem. We know that a river is not there to wash away waste and knowing that after 18 years, Midmar Dam would be turning around costing more money. We also know that bread bags are not waste, knowing that they have a good usage.

[Louine] It is not you causing the problem but knowing it is real as we are trying to address the problem. As people responding to this problem, we have to understand what it is ... something in people’s thinking that is making them do that. I’m not saying as the MSEP we are doing this and that. I’m saying as the MSEP we are trying to fix it and as like a doctor giving medicine to a sickness needs to understand what is causing it - so that is why we looking at this. We are not taking this from a personal point of view but as actors for the environment as ‘Agents of Change’. We can understand and decide how we can respond to this. So does that answer your concern?

[Thandanani]: So do we need to put ourselves in that situation?

[Louine] Yes, but you need to imagine you are that person who doesn’t understand how things work. In order to understand why this is a problem. It may be that a small percentage of the residents of Mpophomeni understand that bread bags are not waste, but we see a lot of bread bags being thrown away. So obviously there must still be that thinking going on peoples mind, and for you to be a doctor you need to understand what the cause of that thing is.

[Louine]: I’m going to give short time per board, don’t speak too much ... try keep it short like subheadings so on.

[Group discussions around the pictures start].

This is Group 1: [Hlonipho Zondo [actor/enviro champ], Sthe Nkomo [enviro champ] , Zongile Ngubane [enviro champ], Mbali Sithole [enviro club learner], Sandra Ndlovu [enviro club learner] sharing their work (hold it close so we can hear). I choose **Photo number 11** showing plumbers and an Enviro Champ discussing about a spilling manhole discussing as **Group 1** about refuse dump in Howick and also how it is collected by the municipality, saying it only comes once a week. **[Sanele Ngubane]** How many times the solid waste truck comes around Howick? **[Answer]** One truck alternates between wards the whole week. That is a problem because how can people be encouraged to minimize solid waste dumping when there is only one truck? A potential solution: plumbers need to install bigger pipes and secondly Enviro-champs must monitor who is dumping into manholes so that they can report that particular person. This is because a person dumping into a manhole needs to be asked immediately the underlying reasons for their dumping. This is the only way to solve this problem and understanding what people are thinking. There should also be a person who will write articles that can be published in the local newspaper. Liz said that there were people who used to complain. Also that there should be volunteer people raising awareness about this in areas like Mpophomeni also collecting the viewpoints of ordinary citizens about this like illegal dumping and burning. Also that implementing this won't be easy at all knowing that they might get rejections from people about his but however what they need to do is work hard on this. Example of Lindo who faced difficulties on promoting this idea in his township from the local residents is mentioned. The hard part is implementing.

This is actually Group 2: [Ayanda Lipheyana [enviro champ], Fresh Ngubo [actor/enviro champ], Mandisa Shelembe [enviro club learner].

[Mandisa] We had to calculate some results and give measurements using a form of identification the miniSASS. **[Photo 1]** This is an image used by group showing testing of the clarity of the sewerage water in Shiyabazali outside of Howick. **[Photo 2]** Another image we see is of an overflowing manhole affecting the water leading into Midmar dam. Sanele Ngubani gives an account of how fed up the community members can get, who resort to the use of vulgar language when talking to outsiders who are trying to understand the problem of spilling manholes. **[Sanele Ngubane]** We need to understand that people are different and some are rude naturally. However we can also help rude people understand by informing them of all the consequences of their actions. For example tell them if they dump waste into the manhole/ river this water will end up in the dam which is a primary source of drinking water. Explain that, a person may say there is no water crisis because there is water coming out of their tap, but we need to help them understand that the costs involved in treating that water is high. Furthermore you can also relate it to the fish that they eat which can come from the dam. If the dam is polluted, fish species may diminish which will affect

food security. Even when you go to town what are you going to buy there if the supply is negatively affected. The revenue is also negatively affected due to costs of water purification. People need to be taught step by step about the water crisis because as long as they have water coming from the tap they will not be aware of the water crisis.

Conversation in isiZulu in the background of social grants which are given to the people but however some make bad usage of the money saying it is not theirs however not knowing what impact it has on us tax payers and of uMngeni Valley animals as people will hunt them and say it not their animals.

[Photo 5] we can see miniSASS analysis being conducted at Mashengeni. What are some of the causes of ongoing river pollution? What makes this thing to continue? It is the lack of education and the ignorance in the person to not show interest in any of this just as long they are still enjoying the free basics of life? The issue of alien invasive plants is that they take a lot of water and space clashing with the local plants. **[Photo 7]** The identification of these plants along uMtinzima stream.

[GROUP PRESENTATIONS OF DISCUSSION START]

[Louine]: Share with us the whole group. You should all be accountable for your deeds, wow this is such a big group. Please feel free to speak in any language of your choice not to use Chinese if you can avoid it. Can you hold the machine while you talking?

Greetings to you all, I hope you know my name because you can see it on my stomach. **We are Group 1: [Hlonipho Zondo [actor/enviro champ], Sthe Nkomo [enviro champ] , Zongile Ngubane [enviro champ], Mbali Sithole [enviro club learner], Sandra Ndlovu [enviro club learner].**

The photo we first choose was **Photo 1** on that photo we can see Nhlonipho and Fresh using the clarifying pipe to see if the water was dirty. We see that the water in the photo was polluted so we came up with some solutions resulting like educating the youth about pollution. The next was **Photo number 12**. We see people walking near a spilling manhole where one [Andrea Kolbe] was doing her research on environmental problems so the solution we can up with was to tell people not to put things like condoms, baby diapers in their toilets which they flush it. Then we choose **Photo number 11** where the plumbers from the municipality were discussing together with the Enviro Champs the problems about the spilling manhole. The potential solution is to buy bigger pipes, report people who dump in the manhole and educate them on what they must flush or put down their toilets. **Photo number 14** is of a local man who told other people of a dumpsite near his yard which was affecting him and his family. The solutions were that the municipality garbage collectors must come more than once a week and Enviro Champs must teach the people how to reuse, reduce, recycle in order to decrease this problem. **Photo number 17** is of enthusiastic people came together to see the

waste water treatment works in Howick. The solutions are that the municipality workers must check if the water is clean before it is released to the river. **Photo number 19** Kevin was doing miniSASS on a polluted waterfall. Going to **Photo number 20** was of water polluted by the municipality where Enviro Champs should fix the manhole near them and the rivers. Another solution is that a young people should write articles about this, reporting to the local newspaper on the progress made by the people on this issue.

[Louine] Thanks very much, that was wonderful I would like them (*referring to the Enviro Champ and Actor in the team*) to say one thing anything about the exercise (*up to this point the learner from the Enviro Club was presenting and the Enviro Champs were quiet*).

I will talk about **Photo number 1**: We were investigating the water quality status but I found that the quality was poor because the rubber inside the clarity tube was not visible for a long time. Furthermore the manner in which water flows even the residents of Shiyabazali have made this site a dumping site, which means that this water that goes to the water fall carries the solid waste from Shiyabazali which will land up in Durban because it is hard to clean and collect the solid waste at the bottom of the waterfall. Additionally I foresee a problem since the water is treated with chlorine, the limited capacity of uMngeni tanks will result in a situation similar to Henley dam which is always polluted. We go to **Photo number 20** where we see a dirty dam leaving it without any fish - they wouldn't survive. Also that with the dam being dirty nearby people would get certain diseases from this. What do the algae do? **[Liz]** The algae in the water is the example of eutrophication in the initial stages as this is a small body of water as more nutrients come into the water as a result of sewage poo, which brings more nutrients in the water which feeds the plants in the water increasing their growth and start covering that area and they take a lot of oxygen out of the water so insects that need oxygen cannot survive here. The water can also become toxic so it is dangerous for cattle and humans to consume that water. The water has to go through a lot of treatment before it can be consumed properly for example the Hartbeespoort Dam as talked about this morning is covered with green slime and also areas of Midmar Dam also have this slime as seen in many aerial photographs. So that is what we are trying to combat in our role. Thank you. **Photo number 4** shows an overflowing manhole. **[Mbali]** Before joining this club I showed no interest in doing this action not knowing that this stream in Mpophomeni leads to Midmar dam. As Enviro Champs we did a film about the water wastage in the Howick area to show the people about this issue of water wastage as they showed no interest in this. Only they cared about getting the water, nothing else about it. **[Sandra]** I would like to add another **Photo number 5** where we went to the beginning of uMthunzima stream where we saw clean and purified water and even saw stoneflies but however

when we went down the stream the water was starting to get dirty and polluted. As members of the club we took other people to the source of the stream where they saw the clean waters.

Group 2: [Ayanda Lipheyana [enviro champ], Fresh Ngubo [actor/enviro champ], Mandisa Shelembe [enviro club learner]. Basically what I have found in **Photo number 5** is that there is a conduction of miniSASS at the source of the stream. We found that water was clean and checked that it is drinkable. **Photo number 6** I see that in order to see stoneflies you must have clean water. It seems that group 1 has taken all the points (laughing). **Photos 1-4** are a combination as you see with **Photo 1** is of a test to see how clean the water but you see that they dirty caused by the polluting of the residents who carry on still seeing it is already dirty, where in **Photo 2** I saw a burst sewage pipe leading in to Midmar Dam to our source of drinkable water. Also we see that people don't seem to care but still drink this water. **Photo 3** is the process of the blocked sewerage pipe being cleaned where **Photo 4** is a fixed manhole with bits of the overflow residue around it. **Photos 10 & 12** are of Mr Cele when he was explaining and showing his burst sewage pipe on how it is affecting him and his family with also the huge amount of dumped garbage by his house from the residents who don't seem to care about it. I did a follow up on Baba Cele. I also saw alien trees brought by the sewages which take a lot of water affecting our water supply.

Greetings from **Group 3:** [Thandanani Luvuno [actor/enviro champ], Kevin Lakani [enviro clubs mentor], Sanele Dlamini [enviro club learner], Minenhle Dube [enviro club learner]. As **Group 3** we started with **Photo 20** where we saw the process of eutrophication changing the eco system. If Midmar Dam is becoming more and more eutrophied it will make the female fishes infertile decreasing the fish rate of the dam and water pollution caused by the sewage at **Photo 3** the solution we need is education for the people about this whole situation and to have more active Enviro Champs. We are now going to **Photo 21** which is of environment education where the enviro educators teaching the people at Mpophomeni library why the wetland was destructed and the stream was very polluted as we saw a link about this also we see towards the bottom of Mhlanga stream in Mpophomeni the water is white due to the spilling manhole. **Photo 22** we see activists struggling for a clean Mpophomeni with people like Baba Cele. Baba Cele is sharing about the illegal dumping in his street and the ongoing spilling of the manholes in front of his house for over a year now. We all went there and saw and smelled what was happening. This is very important for us to really understand the problem. We looked at **Photo 5** and saw the activists "active people" hiking towards the uMtunzima stream source noticing the polluted other side of the stream and **Photo 6** seeing of a stonefly. And also all of this is due to lack of education to the people and a lack of

intolerance about this. We do “education in the community” to bring people to the awareness that “this will affect me” and that one cannot remain apathetic about this issue. Through education we ‘combat ignorance’. We do miniSASS regularly and should continue doing so. People (in Mpophomeni) doing research asking “why?” is very important. “We are all researchers” and “community science is the best transformation”. **Photo 17** is of water purification. **Photo 1** is of Nhlonipho and Fresh testing the quality of water to check its purification. **Photo 13** was a process of plumbers cleaning a blocked sewage coming out with various objects like papers, condoms etc. They don’t have an easy job. It’s smelly and hard work and they are very committed to helping when they are called. **Photo 10** is of Baba Cele who expresses his concerns and gets listened to by the counsellors and a solution is, to improve service delivery. **Photo 11** is collective of different stakeholders meeting to find a solution on this very important issue that the community is facing. In **Photo 12** we see Dr Jim Taylor who was running away of all the pollution in Mpophomeni. The suggestion of this issue to be taught in schools in the subject of life orientation as it will have an impact on the young. **Photo 13** is about the invasive alien plantation suggesting that they should be destroyed. The group the day before were humiliated by a local resident regarding this issue also the club members were bullied by some officials [Lindo’s story of house owner of the house where the club fixed the broken plumbing being drunk and very rude about the club having “made things worse not better”]. There seems to be a repetition of the same issue affecting the area of Howick. Also that an emphasis on education on this issue should be done.

A solution to contact the Department of Agriculture should be done about Mpophomeni on the illegal dumpsites - like planting of vegetables as the soil is very rich.

Group 4: [Lindo Sithole [enviro club learner], Nqobile Zondie [enviro club learner], Moses Kilozi [enviro champ], Zwelithini Hlela [potential enviro champ]. Greetings from the group which it called “Together we can do More”. So we are going to start with **photo 13** of alien plants. These plants take a lot of space where they overcrowd the indigenous plants of that area and also these plants multiple quickly as a result the best solution is to destroy these plants. **Photo 20** is about algae which is able to supply nutrients to the river. **[Correction by someone in the audience]** The algae cover the surface of the water, using a lot of oxygen and causing a lack of oxygen to animals that live in that river. The excessive growth of algae is the result of phosphates entering the stream, which can be found in human and animal manure. It doesn’t give food to the animals or plants. **[Refer to the information about eutrophication on the white board]**. There was a scientific explanation from a group member [Sanele Ngubane – UKZN MSc student]. **Photo 6** of stoneflies from a miniSASS from the clean source-part of the stream. **Photo 18** was Kevin doing a miniSASS at Shelter Falls. A

miniSASS is a process of going into a lake or stream where different tests are done on the species of that stream and they put upon a chart. **Photo 10** is of three men Baba Cele, Ayanda & Andile talking about problems that they see in the area they live in which is Mpophomeni . **Photo 12** is a mixture of land and sewage pollution, if you look clearly at the photo that this pollution is close to them which might affect their health and daily living so let's say if maybe you had a garden you wouldn't have the appetite to eat the food from your garden this and **Photo 2** is a sewage leak which travels to Midmar which it affects a lot of things on its way like people who rely on Midmar for their daily living. **[Moses]:** I would comment **Photo 3** where Thandanani is standing like a boss but doesn't give any help [laughter] and **Photo 12** the sewage also affects the people's garden with it going through making mess everywhere as the municipality didn't do anything also that the water goes inside the house making everything wet [referring to Zwilithini's personal experience].

[Kevin] Speaking of polluted rivers or waters I grew up in rural areas, we used to go to the rivers and we would call that algae "ingubo yamasele" the blanket for the frogs. When you tell people that the water is polluted from the algae caused by nutrients people will tell you that algae is the habitat for the frogs, so I get confused but I understood it the way you explained it to me and even in the scientific way but it is still not easy to tell people about the cause of algae. The reason why I say this is that you find eggs of frogs in the algae confusing the people resulting in them calling it the habitat of frogs.

[Sanele Ngubane] Ya, I also grow up in a rural area where we had a problem of the stream having a lot of algae as there was less dilution of water and higher concentration as where we saw a decreased rate of fishes as they seem to use this dirty water. There is a difference between algae and 'bio-films' but we won't get in to that which will confuse you a lot. There is some green stuff which is not algae but 'bio-films' "ingubo yamasele" and this is usually attached to plants or rocks in streams and algae is on the surface and usually floats.

[Sanele Ngubane] Great, but it is the amount of algae that's important. If walk down the stream and see that it is clear but you see algae on the edges of the stream with green patches growing in the river but most of it is clear you can see the bottom, smell the water and do a mini sass and assume this is a healthy stream. But if you walk down there and see green everywhere, that is not natural, something else is happening to the stream. **[Liz]** Like Midmar Dam it was built to capture clean water without too many nutrients, so the authorities planned it twenty or thirty years ago to be a clean water source. Now we have noticed that some algae is starting to grow at the one section, that is an indication to the authorities that something is happening in the dam, but the people who might live near there might not notice that it is a bad thing but the authorities will with the algae and toxic bloom .

THE DREAM STAGE:

Group 4: We should start an eco-programme whereby we indicate educational projects on environmental issues and awareness. We should educate people through community dialogues, debating on different issues but before debating on these issues you can't do anything without research. Secondly as Liz was here she told us about War Rooms where counsellors from different wards have discussions on different topics also we suggest that in each and every ward there should be an environmental ambassador who will tell the people about different issues. Thirdly video and storytelling and usage of the media in order to pass on that information. The information which needs to be passed must be tackled by the community. In a war room we tackle different issues but the information discussed doesn't get across to other people on that War Room to make awareness as we making a way in order to solve it. I am now going to speak about the three components Eco Champs , Enviro Clubs and Actors from the three components we need communication because without it we cannot do anything. Secondly, we need mutual respect because if we don't respect each other what is the reason we still doing that certain project? Thirdly, community education it is no use having that certain knowledge and not sharing it with others. You cannot borrow information as it needs to be spread out somehow and somewhere. Loyalty if I dedicate all my time to make a difference but as others don't do that will cause me to lose interest in what I am doing. We need to have fun to attract youngsters in joining our club. But we did mention something which is a goal I trust that when the group was formed it had its goals maybe they not fully met by now. A goal has to be reached and make a difference in people's lives.. A critical question/concern: What would success mean for the MSEP? What actually is the goal of MSEP? How do we as people involved in the MSEP define our goal and success? I want to add something about sanitation as health is not a thing we can put upon the government. It is an action we as people must take. We must not be called Enviro Champs but 'Enviro Lawyers'. This is an interesting concept. Mutual respect goes along with communication.

We as **Group 3** touched a lot on the Enviro Champs, Eco Clubs and street theatre. We also have a few questions that we need answers from other groups. Firstly as Enviro Champs we thought War Rooms should be emphasised and that the champs should get together and visit schools raising awareness occasionally. The visits must include drama presentations as it will keep the youth interested in this as the youth don't seem to enjoy talks like adults. The emphasis of community dialogue through street theatre. An idea of using the popular shows to show people that message. We have two questions 1) How can we include the environment department in our local government? Because there is no raised issue on environment 2) How can the local government absorb the street theatre? As only this was vaguely used by the district municipality. The

community information should be raised. This workshop here is to see what people really want. It is their houses, it not someone in top management, as we want to see how this works in your everyday life. But working on this very hard. This project relies on money and contacts as more people should approach their local counsellors. What is the goal as it seems unknown at this moment? As many people say nothing has been done by the project as they still see spilling manholes in Mpophomeni but the awareness in the people is a positive thing as it is a building step.

[Liz]: The Titanic was the big ship sailing on the sea with people who were proud of the biggest modern ship and also being rich. They were going so fast but the people at the top saw an iceberg way before and realised that they will hit it and then went to the people downstairs partying and told them to stop. The engines but it were going too fast, the energy was too fast and they tried everything to stop it approaching the iceberg. In the modern world many people seem to show no interest in projects like this, as they are “partying”, buying cars living a good life as there seem to be a few people warning them but they don’t listened either. Now we are trying to turn the engines back and try stop the polluting that’s happening and yet people tell us we are failing. The thing is that the people don’t see the iceberg as they still underneath having a party. Our job is to get the people to come up from down there and say hey that’s an iceberg as they are more and they tend to focus on the modern lifestyle.

Okay this is **Group 2** reporting on their dream. As group 2 we just have 3 dreams. Our first dream is to see projects like Enviro Champs stay longer since we have noticed that there are not as many Enviro Champs as we like. To also to make them stay is to offer them rewards at the end of the year and also try find more funding where they can be accommodated. Our second dream is the project to get more members growing and active communication to encourage us to get involved a lot and also communication with the local residents and municipality whence when people face problems they could tell the MSEP members who would contact the municipality on their behalf. Our other dream if we introduce kids this idea at an early age and tell people more earlier as more tend to be busy and the encouragement of MSEP members to attend community meetings then try advertise or speak about the project during those meetings and the recruitment of Mpophomeni as the area has high unemployment rate in order to have food. The third dream is to see the number of spilling manholes and dumping decrease this could be achieved through communication with the municipality to erect a building waste material depot in Mpophomeni and also that the municipality provide the residents with some toilet paper which will decrease the overflowing manholes as many use newspapers and at many more towards the schools as the manholes near them are the most often blocked. The issue of dumping can be decreased by municipality providing refuse bags as before as this is our main dream. Also want to comment on the issue of toilet paper as girls tend to

carry toilet paper a lot but no boys. So I ask of teachings to the gents of the importance of carrying toilet paper. I think we spoke about it when I spoke to one group about toilet paper as it was the main factor in this issue. We thought that most household have breadwinners who also heavily rely on the social grants so they don't have the money for toilet paper so this will have impact on the child not carrying toilet paper to school. This issue of sanitation cannot be put to blame on the government nor the municipality but on the person who does things without thinking. Like the idea of having many children in order to get more money but that won't be enough to look after them.

The issue of toilet paper in homes and schools not being available: The issue should be that toilet papers must be placed in classes in schools, and if the schools are recycling they will afford to buy toilet paper with that money. The issue of water born sewerages in a country which is water insecure, is currently being discussed by the group on how in fact it is affecting our local streams.

The issue of Enviro Champs to be put into school governing bodies as to portray this message across as this will encourage learners to take action. Also members must try and stop corruption in these schools because money may be allocated for toilet paper but it might end on the staff's pockets. We need a solution. Also if Enviro Champs don't make it in to the SGB we need to make friends with teachers, like Thandanani is doing as we see in Mpophomeni High School.

Local businesses can get involved in donating some toilet papers and sanitary pads. **[Sesethu]** Thandanani also mentioned local businesses, I suggest that these businesses should be buying machinery to produce these tissues in this area which will employ the local residents . We heard on the I radio that there a few co-operatives available knowing that if we do this idea there will be enough toilet paper for a long time.

Group 1's Dreams are about more environment classes for environment clubs, the issue of mobile phones for Enviro Champs in order to increase communication amongst members and the community at large. More educational workshops should be conducted educating both MSEP members and the community. And also the making of competition of recyclable material likes ropes. MSEP should attract new fresh blood in their team and train them to help Zongile out as her job is very demanding.

Has everybody finished dreaming now?

Appendix 7

30 July 2014

To whom it may concern

Ms. Louine Boothway – student number g93l4904 – is currently registered with Rhodes University for the years 2013-2014 to work towards earning a Master's degree in Education (Environmental Education).

Ms. Boothway is doing an evaluative case study of a citizen science project, the Mpophomeni Sanitation Education Project (MSEP) based in the Mpophomeni Township and Howick. Her specific interest lies in the nature of the learning that takes place in the MSEP Community of Practice and emerging knowledge that result from citizens participating in environmental monitoring, data collection and community education components of the project.

The third aspect of her study looks at possible changes in water and sanitation practices that result from citizens' engagement in the project. This requires insight into the generative, systemic mechanisms that influence the process of change on various levels. Your knowledge and insights in this regard would strengthen her study and provide invaluable input with regards to systemic challenges.

The evaluative orientation of her study allows for the potential improvement of the project through the use of the method of Appreciative Inquiry with a view to the potential replication and upscaling of this project. Initiated 3 years ago with substantial start-up funding from the uMgungundlovu District Municipality the MSEP is widely viewed as one of the most innovative successful grassroots projects to engage citizens in actively participating in the improvement of their environment and community.

We therefore request that you kindly consider granting her an interview at your earliest convenience. Your assistance in this regard would be greatly appreciated.

Best regards

Dr. Ingrid Schudel

Environmental Learning and Research Centre

Senior lecturer

Appendix 8

Ngingu (Louine Boothway) ngenza ucwaningo ngeMpophomeni Sanitation Education Project phecelelezi (MSEP) njengengxenywe ymsebenzi wami mayelana nemfundo ephakeme (Masters degree) Kumkhakha we- Environmental Education ngaphansi kweNyuvesi yaseRhodes. Ngiphinde ngibe ngumphathi wama Eco-School Enviro Club nawo ayinxenywe ye(MSEP). Phecelelezi ngiyilunga le(MSEP). Nginetshisekelo yokubona (MSEP) iqhubekela phambili iphumelela. Nginethemba lokuthi ucwae neningo lwami luzoba ekutheni bayiqonde kabanzi(project) kanye nezinhloso ze MSEP noshitsho oluzobakhona

Imibuzo yocwaningo lwami ithi.

Ngabe umphakathi uzzibandakanya kanjani ngokufundisa ngamanzi kanye nokuvivekwa nokushitsha indlela amanzi asetshenziswa ngayo kanye nokuvivekwa.

Okumele kwenziwe ukuze kutholakale ulwazi mayelana nemibuzo engenhle. Ngizoba nemithingi (interviewer) neqoqwana labantu kulabo abayingxenywe MSEP. Nggiyobe ngibuza umuntu ngamunye imibuzo. Uma kubuzwa imibuzo kunemiyalelo eyobe ilandelwa.

*Amagama alaba abayobe bebuzwa imibuzo ngeke adalulwe kuyaqinisekiswa lokho;

*Uma ezizwa engakhululekile oyobe e (interviewer) unelungelo lokungaqhubeki ne-interviewer;

*Abayobe bebuzwa imibuzo(interviewer) banelungelo lokubuzwa imibuzo ngolimi lwebele;

*Imiphumela yocwaningo kanye namanye amaphepha ahlobene ne Msep kuyobe kutholakala kunoma ubani kusukela ngo Meyi 2015 ;

*Ukuthulwa kocwaningo kungahlelwa uma sseluphelile ucwaningo.

Ngiyayiqonda inhloso yocwaningo futhi ngiyazibophezela ukudlulisela ulwazi enginalo ngesikhathi ngibuzwa imibuzo(interview) kulandelwa imiyalelo engenhle.

Name of interviewer:.....

Signature.....

Name of researcher.....

Signature.....

I (Louine Boothway) am undertaking a study of the Mpophomeni Sanitation Education Project (MSEP) as part of my work towards reading for a Masters degree in Environmental Education through Rhodes University. At the same time, as the coordinator of the Eco-Schools Enviro Clubs component of the MSEP, I am also a participant in the MSEP and thus have an interest in seeing the sustained success of this project. I therefore hope that the results of my research would be able to contribute in some way to a better understanding of the projects activities and outputs as well as an appreciation for the social and ecological changes that it is bringing about and can potentially bring about.

My research question is:

HOW IS CITIZEN PARTICIPATION IN A COMMUNITY-ENGAGED WATER AND SANITATION EDUCATION PROJECT INFLUENCING LEARNING, KNOWLEDGE PRODUCTION AND CHANGED WATER AND SANITATION PRACTICES?

In order to generate data to explore the above question I need to conduct interviews with a small sample of people participating in the project. With a view to the planned interviews the following guidelines apply:

- The anonymity of the interviewees will be guaranteed;
- At any stage during the interview or post-interview, should an interviewee wish to withdraw their participation or input their wish would be respected with immediate effect;
- Interviewees can chose to conduct the interview in their mother tongue or in English;
- A copy of the research results and related academic papers will be given to the project and may be accessed by anyone interested (available from May 2015).
- A presentation on the research findings can also be arranged upon completion of the study.

I understand the purpose of the proposed research study and give my consent to provide the researcher with information through an **interview**/focus group discussion/observation according to the guidelines outlined above.

Name of interviewee:

Signature:

Name of researcher:

Signature:

Date:

Re: Permission to show your face - Message (HTML)

File Message

Ignore X Meeting
Junk Delete Reply Reply All Forward More
Delete Respond Quick Steps Move OneNote Actions Mark Unread Categorize Follow Up Translate Find Related Select Zoom

From: Hallam Payne <hallampayne@gmail.com>
To: Louine Boothway
Cc:
Subject: Re: Permission to show your face

Hi Louine,

Yes, I'm very happy for you to use that photo.

I wouldn't mind a copy of the picture when you have time, but there's no rush.

Hope you're keeping well.

Good luck with the submission,
Hallam

--

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Appendix 9



Appendix 10

[Title] The following short film has been put together by Grade 10 pupils from Mpophomeni Township in The KwaZulu-Natal region, South Africa. Mpophomeni: Born. Bread. Buttered.

[Words on the screen]“Walking to school with the smell of sewage thick in the air, stepping over puddles of raw sewage, it doesn’t put you in a good mindset. And the level of sanitation and hygiene in the schools is not good, there are always blocked toilets” Pens Malinga, Mpophomeni residents & Enviro Champs co-ordinator. [Words on the screen] The residents of Mpophomeni Township are facing a massive crisis. Schools in the Mpophomeni Township do not have the resources and services to maintain their toilet facilities... and as a result many are unknowingly contributing to a serious water-quality crisis that threatens the water supply of an entire province! [Article from The Witness flashed across the screen titled “Sewage seeps into Midmar” and “Threat to Midmar”]. [Words on the screen] We the students of Mpophomeni, want to educate our town about this serious crisis. [Footage of waste water with solid waste in a wetland near a manhole. Young student in school uniform standing on the manhole, talking and pointing in the direction of Midmar Dam]. Midmar Dam is 2 km away from this manhole. Animals drink from this manhole and they eat this grass [footage of chickens walking in the wetland and a cow grazing near a polluted stream] and then they go back at home and people eat them. So that’s how people get germs because of this manhole. If this doesn’t get clean it goes into Midmar and it affects the clean water in Midmar. [Map showing the proximity of the township to Midmar Dam]. It’s because people put the wrong things in the toilet [footage of a used sanitary pad on the edge of the spilling manhole] like you see paper, socks and everything.[Photo of a group of young people on the edge of a spilling manhole with clipboards having a discussion with a person standing on an ‘island’ in the middle of the stream of waste water flowing from the manhole. Photo of a used condom lying in the grass. Photo of a learner standing next to a very polluted stream taking a photo]. Not the toilets the bins!!

[Woman – resident of Mpophomeni – being interviewed, speaking in isiZulu]. Our babies get diseases from that leakage and also our animals that we live with swim there and come back with cholera. Even us we are old we also get that sickness all the time. We also get blocked noses, rash and runny stomach. The smell is very bad. We would be happy if some people in high places, will come and solve our problem, because this place is disgusting. They always come but they don’t do anything about the manhole. They don’t come and fix this manhole. It’s been 9 months now. This manhole stinks!

End of part 1.

Appendix 11

MPOPHOMENI DRAMA GROUPSCRIPT(POPCYD ENVIRONMENTAL GROUP)

_Actor 1

My name is Snehlanhla Zuma.I am student at Mpophomeni high school. At the school I am involve in debating ,popcyd environmental group which is coordinated by Miss TP Sibiyi.I sing and debate at the school choire.We are now present doing a drama with popcyd enviro group.

-Actor 2

My is Thobani Nkala today we will be performing an awareness drama about toilet blockage where we wil be telling people what go to the toilet and what does not go inside the toilet.Poop,toilet paper and urine only the 3 that goes to the toilet, stones and other stuff do not go to the toilet.

Actor 3

My iname is Nqobile Dlamina.I am a learner at Mpophomeni High school. I am the member of Popcyd enviro group. We help each other and we take care of the environment. We do drama about toilet blockage to stop toilet blockage and what causes toilet blockage.

Actor 4

My name is Skhumbuzo Makhathini.I am doing grade 10 at Mpophomeni High school. I am the member of Popcyd enviro club. We take care of nature. We practice perm culture garden and clean toilet. We do all these things to keep the environment clean so people can live in a health clean environment because unhealthy environment cause diseases. I appreciate the oppportunity

Actor 5

My name is Pink Phungula.I am a learner at Mpophomeni H igh school.I am the director of the drama team.I am also involve with eco friendly group.

Drama start

-Ooh it time to go school and it the morning. Let me check my time table. Can I go to school look like this?Eish toilet is calling me. Aibo! What will I warp myself with? My mother and father got paid yesterday but there is no toilet paper let me use a newspaper but toilet will block but I don't have a choice and I don't care. Let me use many father's newspaper (Isolwze).Yoh the newspaper got stuick in the toilet. My father will see.

Father: The night was short.

(Phone ring)

Father: Hallow bass. How are you sir? I am fine thank you sit down. You want me at work now now? I am going to be right there now bass. Thank you sit down. Ooh Mehlemamba wants me at work now. Where is my newspaper? Let me use man's room. Ayi ayi ayi! What is this I see with my eyes? Mamlangeni, Cijimpi, Ntombizodwa and what is this I see with my eyes in the toilet?

Ntombizodwa: it a pent horse

Father: It no pent horse this is my newspaper. Mamlangeni I told you that I don't want children with big heads and they will do as they please. Where were you Cijimpi? We all come from this side and you come from the other side.

Cvijimpi: I was watching TV

Father: Who put my newspaper in the toiletr?

Cijimpi: It is Ntombizodwa

Ntombizodwa: It wasn't me dad

Father: MaMlangeni talk these things of yours who put my newspaper in the toilet?

MaMlangeni: Cijimpi who put your father's newspaper in the toilet? You know exactly that your father like reading newspaper.

Cijimpi: It wasn't me mum. Let me come next to you.

MaMlangeni: You both causing troubles between me and your father.

Ntombizodwa: I wouldn't do such a thing.

Father: Who put my newspaper in the toilet? Talk talk

(Cijimpi and Ntombizodwa pointing each other)

Cijimpi: It her.

Ntombizodwa: It him.

Father: Who put newspaper in the toilet?

Cijimpi: It wasn't me dad. I am telling the truth

MaMlangeni: There is a bad smell here.

(All hold their nose and sniffing)

Father: I am going to work.

Cijimpi: Yes dad.

Father: When I come back from work I want to find everything in a good manner. Do you hear me MaMlangeni?

MaMlaneni: I am the one who suppose to clean father? I don't understand

Father: Why did I marry you?

Mamlangeni: Father you married me to be your wife not toilet cleaner.

Father: It your things that put the newspapers in the toilet. Who put my newspaper here (pointing the toilet)?

MaMlangeni: Let go my children you father is now angry. (They all walk away from their father)

Father: Stop there and come back to me. You see now I am going to work. Mamlangeni I am giving you my blackberry.

MaMlangeni: I am sorry father.

Ntombizodwa: I will take it dad.

Father: Don't give it to anyone phone. This phone belongs to bass. Bass would kill me if you loose that phone.

Ntombizodwa: Owk father

Father: When I come back I want see everything clean. Do you hear me Cijimpi?

Cijimpi: Can I take the phone?

Father: Shut up you rude now. Mamlangeni look me in the eyes and listen carefull when I come back I want to find everything clean. Do we understand each other?

MaMlangeni: Yes father.

Father: Go away I don't want to see you. Today time is running so fast. Let me rush and take a shower and go to work before Ill be late.

Learner 1: I am late and I am getting dress in the street there is nothing I can do.

Learner 2: I can see you acting like a girl but you are a boy.

Learner 3 :Howzit guys? What are you up to? You too you like this now? Owk let stop talking about that today it Friday let bank all the classes. It Friday in the morning and first period make crazy. Let go baby.

Learner 1: I can't bank class. No I can't

Learner 3: Let go my brother join me.

Learner 2: You should go with friend not me.

Learner3: I don't care

Learner3: Now you playing in toilet? How are you? My head is spinning and it a history period now. I can't write long note.

Learner4: You can't

Learner3: Let's smoke some cigarette

Learner4: Let me check cigarette for you.

Learner3: My brother my head is spinning and I need a smoke. There is that sound in my head and I don't know what is it.

Learner4: There is your cigarette. What is happening in the class?

Learner3: It boring and there is that annoying gay. I told them to join me and bank but they don't want. They want to attend history lesson. I don't understand anything the teacher is saying.

Learner4: Let make of how we can leave the school. I can't be here today.

Learner3: I have the plan and I have lot of plans actual I have a dictionary of plans. Let destroy the toilet.

Learner4: That is a problem where we will release ourselves?

Learner3: Go and get some stones and we make this gay vandalize the toilet.

Learner4: I can't do that

Learner3: I know you can my brother. You my boss go and get stones.

Learner1: What are you doing with me?

Learner3: Take these bricks and put them in the toilet and you better be fast. Do it fast time is not in our side. I will beat you if you keep wasting my time.

Learner2: What going on here and that too much noise?

Learner1: Please help me

Learner2: Don't hold gay. Why are putting stones in the toilet? Are you crazy?

Learner3: I don't know what is happening now. Who is boss in this school?

Learner4: It you my friend you the boss.

Learner2: You the boss where? Maybe you the boss to those who you smoke with dagga.

Learner3: Don't test me. I will beat you right now. Go away.

Learner2: I will tell the teacher.

Learner3: I don't care.

Learner5: Hello girl

Learner6: I am good and you.

Learner7: I am not feeling it just that bad smell from the toilet and I am feeling dizzy.

Learner8/Sihle: Good morning girls

Learner5 and Learner 6: We are fine and how are you?

Sihle: I am fine.

Learner5: The problem is that bad smell from the toilet. Let try and talk with principal because I can't even concentrate and study.

Sihle: But he will shut at us

Learner5: At least he will help us.

Learner 5, 6 and 7: Knock knock knock

Principal: Destroy the door if you want. Come in

Learner 5, 6 and 7: Good morning Sir

Principal: Oh it? How are?

Learner 5, 6 and 7: We are fine.

Learner 5: Sir we are here to inform you about the toilet problem we have here at school. Boy's toilet has blocked and there is a very bad smell and it too much for us. As learners we are affected because we can end getting sick and we can't attend classes when we sick

Principal: So why are telling me and what I am so suppose to do?

Learner 5: We are asking you to phone municipality people and plumbers so they can fix the problem and we continue with classes.

Principal: You want me to phone municipality? There is another thing you want?

Learner 5, 6 and 7: Yes Sir

Learner6: Sir when is last time you visited boy's toilet?

Principal: I don't remember my child but it when I was new in this school.

Learner6: Sir where do you release yourself?

Pcincepal: At the teacher's toilet.

Leaner6: Sir that should end because it 50/50 if that doesn't wee will use teacher's toilet.

Pcincepal: That is true my child when it comes to a toilet we all equal. There is another opinion you have?

Lerner7: Sir I have an opinion

Pcincepal: What opinion?

Lerner7: What about we form a youth group here at school that can take care of nature

Principal: They will look after toilet?

Lerner7: Yes Sir and vandalism of toilet can be stopped

Principal: Hey my boy Sihle. You came here when you was very you. Your brought you here and you were always getting zero today it the first time you say something with a sense. Thank you my boy.

Lerner7: Thank you Sir

Principal: There is another thing you want to say?

Leaner 5, 6 and 7: No Sir. Thank you

Principal: Thank you learners.

Principal: Let me phone municipality (Hallow, hallow is it baba Maduna? Yes it me Mr. Nkala at Qeda Ukoma High school. I am reporting toilet blockage. Yes I will appreciate if you can come today. Thank you Sir Bye) since I have contacted plumbers let me go check toilet for my self.

Sne: What a beautiful place here. This place it so beautiful. I didn't know that here in the township there is nice, beautiful place like this

Linda: Hallow Sne

Sne: How are you friend?

Linda: I am fine

Sne: I am standing here talking alone appreciating the beautiful of this place.

Linda: I noticed you when I was coming and it look like you were crazy

Group: Hallow girls

Sne and Linda: Hy

Sne: I was explaining to Linda about the beauty of a wetland.

Linda: Thah do you agree with them when they saying it is place is beautiful?

Thah: I don't see the beauty of this place maybe they joking

Sne: Look at this place Thah. Take your time and take a good look.

Thah: I don't see anything

Linda: Take good look guys this place is no good

Zama: For now this place is bad because it polluted but when it clean it will be so beautiful.

Mzo: I am taking with a gorgeous looking this place it so badly

Mbali: This place stores water, we find different types of grass in this place for thatching like ilala

Linda: Listen Thah this place is like a spongy it hold polluted water and pass clean water

Mzo and Thah: Now we understand the magic of this place

Learner 5, 6, 7: Hy guys? What are you doing here?

V: This place store water when there is too much rain

Father: Hallow my childrens. What are up to?

Childrens: We appreciating the beauty of this place

MaMlaneni: I thought there was a fight because to you school children fighting has become a habit.

Children: We are not fighting we chatting about this wetland

MaMlangeni: What about a wetland?

Father: Oh wesland

Ntomizodwa: No dad it not a wesland it a wetland

Father: Keep the noise down you Ntombizodwa

Father: Can you please tell us more about the role of this wetland?

Sne: Someone said this place is like a spongy it holds polluted water and passes clean water.

All Children: It holds polluted water and passes clean water.

Thah: I didn't know but know I am untouchable

Sne: It is called natural filter.

Sne: They call it natural filter because it holds polluted water and passes clean water

All Children: It holds polluted water and passes clean water.

Father: Hallow principal. You was my teacher

Principal: Yes and you was dom

Principal: I greet you all. Toady I have good news. Toilet blockage will be fixed. Secondly this wetland will be taken care by Umngeni, DUCT and Umngungundlovu has agreed to take care of this place and they will fence it. Lastly during the course of cleaning this place there will be job opportunities for Mpphomeni community. (Everyone making noise as signs of happiness) All we need as a community is to hold each others hand. What they say in English?

All: Together we can do more

Appendix 12

Determining the nature of learning in the MSEP Community of Practice - A closer look at what makes the MSEP a Community of Practice.	
Category: Joint Enterprise = Code: JE. A negotiated response to the situation /issue i.e. the conceptualising and implementation of an agreed upon course of action. This criteria refers to GOALS shared by members of the CoP.	
Respondents included the Project Manager [PM]; Actors [A]; Enviro Champs [EC]; School Enviro Club members [SEC].	
Example of referencing data source: Interview 02 [Actor], page 2, line 38 = Int. 02[A].2/38.	
Response	Source
... they asked us not to toy-toy about service delivery ...	Int.01[PM].2/40.
I think the best thing is that people are at the moment really willing to get on with each other and work with each other to the best of their ability.	Int. 01[PM].3/77,78.
... the way that we run these workshops that it's very open in allowing them to bring their experiences to the picture.	Int.01[PM].4/107-108.
So I suppose I can be proud that I take people seriously where they are at and don't assume that they're deliberately sort of scuppering the project you know?	Int.01[PM].4/124-126.
I think I've spoken a lot about the human relations which to me seemed to be the most important thing since it is a human relations type of project – it's a community project.	Int.01[PM].4/128,129.
I think I'm very grateful that there are people picking up on what we're doing and that we're invited to give lectures at the university or to share with students that are doing their honours and masters, what's happening so that we can deepen our understanding of what's happening through research ...	Int.01[PM].5/136-139.
They seem to have a mutual respect of what each other's jobs are.	Int.01[PM].5/158,159.
It's a very open space where people can come together and share ideas in a non-threatening way. Whether it is stated upfront or whether it's an understood thing in the meeting that we're here to share and grow we're not here to bring up our own problems and point fingers and expect somebody else to do the work because each person that comes to the meeting has got their own lives their own set of problems their own situation in their own job that we might not understand.	Int.01[PM].6/192-196.
I think that's up to the community to start pushing in that direction through their channels ...	Int.01[PM].9/291,292.
... the project contributed more knowledge to Mpophomeni people because now they know what is right and wrong for the environment, especially for water.	Int.02[A].1/18-20.

Since the MSEP started there are many changes regarding the spillage of manholes and the community is well educated about what is supposed to be put in the toilet.	Int.02[A],p.1/28,29.
... I think if I can stop acting, my knowledge will not be wider anymore.	Int.03[A].1/29.
I once worked with counsellors to solve illegal dumping and Liz helped when I was doing a petition for cleaning the street and I gave it to Don Mtshali at the municipality and the street was cleaned.	Int.04[EC].2/41-43.
Working together is one of the success factors of the MSEP.	Int.05[EC].2/38,39.
The drama, workshops and meetings have contributed much information to me. The knowledge I have now makes it easy for me when I am trying to make people understand about water pollution and sanitation problems in Mpophomeni.	Int.05[EC].3/74-76.
I think respect and dedication for the work we doing are the success factors of the MSEP.	Int.06[SEC].1/29.
It's good to join the MSEP because you learn a lot of things and when you explain to people they do understand	Int.08[EC].4/109,110.
I am eager to learn more.	Int.09[EC].2/57.
What would be very boring actually is not to have any fun on that project and MSEP is quite a very fun project and quite a very teaching project at the same time so I think that's what makes it very very successful, because I don't think that you can enjoy something whereby you get to be serious all the time.	Int.10[SEC].4/113-116.
So ja, I think that's what made it most successful, the people I was working with.	Int.10[SEC].4/130,131.
... my club members I tell them at each and every meeting at school that what we claim to do, we mustn't only claim to do it at the fieldtrips but we have to also apply it at home even at our close communities. They have to see what we are about ...	Int.10[SEC].9/289-291.

Determining the nature of learning in the MSEP Community of Practice - A closer look at what makes the MSEP a Community of Practice.	
Category: Mutual Engagement = Code: ME. Working together and doing things together including awareness of complementary competences. ME refers to ACTIVITIES not goals and this might distinguish ME from JE. E.g. "To make them understand" (JE) we talk to people about what not to throw down the toilet (ME).	
Respondents included the Project Manager [PM]; Actors [A]; Enviro Champs [EC]; School Enviro Club members [SEC].	
Example of referencing data source: Interview 02 [Actor], page 2, line 38 = Int. 02[A].2/38.	
Response	Source
... we had this idea quite a long time ago that it would be nice for people who lived in the community to be Enviro Champs – people who could watch what was going on in the community ...	Int.01[PM].1/24,25.
It's very obvious and visual and in your face so but I think that it is an area that the Enviro Champs themselves need to address with their own councillors and put pressure on the uMngeni Municipality and jack up the service delivery ...	Int.01[PM.9/284-286.
... so they phone the plumbers ...	Int.01[PM].13/407.
... people were employed although is not that much, to teach the community how they can engage in decreasing the rate of spilling manholes,	Int.02[A].1/15,16.
Sometimes acting or demonstration is the better way of teaching people. By doing the toilet play some people understand now exactly what they have to put in the toilet while before they didn't know what causes blockage of manholes.	Int.02[A].3/82-84.
School children are the good example because are the ones who teach their parents at home about the importance of water and sanitation. School children received the information from us through drama.	Int.02[A].4/103-105.
I am contributing by passing the information on to the community through drama ...	Int.03[A],p.1/28.
I think the contribution of Enviro Champs makes the MSEP success.	Int.03[A].1/31.
Some people didn't know that when they flush the toilet they use 8-9 litre of water, through drama they know.	Int.03[A].2/67,68.
As an Enviro Champ I report the spilling manholes, water leaks ...	Int.04[EC].1/6.

To report spillage of water and sanitation issues and to conduct petitions.	Int.04[EC].2/55.
[One thing you know now] To communicate with councillors and plumbers.	Int.04[EC].2/67.
I think the Umthobo Enviro Club. They are applying what they've learnt through conversation when they're teaching other kids and their parents.	Int.04[EC].3/79,80.
My role as an Enviro Champ is to look after nature and environment. Especially spilling manholes and illegal dumping and to protect the nature we have before we lose it.	Int.05[EC].1/6,7.
The drama is the most meaningful learning experience to me because when they were acting the toilet play I did give my full attention to understand and I did understand what they were teaching us.	Int.06[SEC].2/51,52.
My role is to take care of the community and work together with different people, keeping Mpophomeni clean and taking care of the environment, also trying to control things that affect the environment.	Int.07[SEC].1/6-8.
Yes the Enviro Champs and Thandanani, they are applying what they learned from MSEP now they are teaching us. My school mates now know that if they are going to the toilet only toilet papers are welcome in toilet, no other papers.	Int.07[SEC].3/96-98.
Being an Enviro Champ makes our township clean because we report spilling manholes, water leakages and illegal dump sites.	Int.08[EC].1/6,7.
We do clean up campaigns along the street.	Int.08[EC].1/8,9.
My job includes phone calls and writing down the information. I also go with plumbers when they go to fix a problem. They usually find sanitary pads and towels. Sometimes you will find that one manhole has been fixed and after 4 hours it will spill again.	Int.08[EC].4/103-105.
Like children from Qhumukile Lower Primary and Sifise Esihle Primary, they know the number to call when they see the spilling manhole and my children also know the number and people tend to report the spilling manhole, they don't wait for me report if they see a spilling manhole. Even my eldest does report the spilling manhole and she will tell me that she reported the manhole.	Int.08[EC].4/131-134.
Every day 3 times a day I check water released from Umngeni Water works if it's clean and I record the score. The score of the dirty water is	Int.09[EC].1/7,8.

less than 4.		
Yes I do teach the people.	Int.09[EC].2/39.	
... the biggest problem that we are dealing with is water wastage.	Int.10[SEC],p.1/6,7.	
I make sure that our club members as the Injoloba Eco Wonders know fully on the problem that we are facing and we also try to find out ways on how to fix that problem.	Int.10[SEC].1/11-13.	
... we are about to be on a new chapter of our project and it's called Healthy Living so that is where we ensure that people and the environment is safe for people to live around in it.	Int.10[SEC].1/27-29.	JE stewardship as a goal
... what that project does is that it does not only fall under Mpophomeni, but it makes sure that the areas that are around Howick keep their rivers, streams, ja they make sure that their rivers are clean.	Int.10[SEC].2/40-42.	JE rather
... at the MSEP project there are a few experts for example in the drama part Thandanani is there.	Int.10[SEC].9/271.	

Determining the nature of learning in the MSEP Community of Practice - A closer look at what makes the MSEP a Community of Practice.	
Category: Shared Repertoire = Code: SR. Members of the CoP use the same concepts, actions, discourses, historical events, artefacts. This criteria has to do with the CONTENT and STRUCTURE of the activities i.e. concepts, themes, language (specific terms) and tools used consciously or unconsciously by members of the CoP.	
Respondents included the Project Manager [PM]; Actors [A]; Enviro Champs [EC]; School Enviro Club members [SEC].	
Example of referencing data source: Interview 02 [Actor], page 2, line 38 = Int. 02[A].2/38.	
Response	Source
When I say to them you know "what's the problem and why do you have so many blockages?" they say it's because the people are not educated.	Int.01[PM].5/150-152.
And, ja, the municipality officials that's a difficult one ...	Int.01[PM].5/165.
... for the last 30,40,50 years the scientists have been measuring pollution and measuring pollution and measuring pollution and it's getting worse and worse and worse – why? They're putting this information out there, but nothing is getting better so somewhere the scientists are not really getting on top of the picture.	Int.01[PM].8/248-251.

<p>... because uMngeni Municipality is quite difficult to work with we haven't really addressed that issue, but obviously in the community's mind it is a big issue.</p>	<p>Int.01[PM].9/282-284.</p>
<p>That it's not functioning well and that it's polluting Midmar Dam and that Midmar is part of the uMngeni Catchment and the uMngeni river itself from source to mouth is the most important river in the whole of KwaZulu-Natal providing something like 100 billion litres of water per day (I'll get the figures right but it's a huge amount of potable water) so, the uMngeni Catchment itself is very important. Midmar Dam was built where it was built because it was in a clean area of KwaZulu-Natal and then they take water in a silver pipe to Pietermaritzburg and Durban so we need to keep that clean for future drinking water and it's just a very interesting and complex system at play ...</p>	<p>Int.01[PM].10/322-329.</p>
<p>... some people that are involved from the outside other stakeholders don't really understand the big picture either people don't really realise how much pollution is coming out of Mpophomeni ...</p>	<p>Int.01[PM].10/331-333.</p>
<p>... the local municipality and the district municipality make a lot of promises and they say that they are going to fix things and that they are very committed to fixing the problems but actually they're not really and I can see that the plumbers are caught in a system that's not really supporting them.</p>	<p>Int.01[PM].11/353-356.</p>
<p>For example outside Baba Cele's house there was vandals which threw rocks down the manholes which is a misuse of the system but then they still haven't fixed it and it's been over a year now that it's been flowing fully and strongly into the uMthinzima stream and that is going straight into Midmar.</p>	<p>Int.01[PM].11/356-359.</p>
<p>I saw many, many more areas that are just saturated with raw sewage that I can take people to, 15 or 20 sites in Mpophomeni. It's absolutely disgusting and so we've been working on this project for 3 years now and really there've been promises and promises and promises and I think it is in the pipeline that that Royal Haskoning have got the funding and have got the go-ahead but still nothing is happening.</p>	<p>Int.01[PM].12/376-380.</p>
<p>Ok so I think that some of the good examples are that people are more aware of spilling manholes so they've learnt that, what a spilling manhole is and what it looks like and that it can actually be fixed by the plumbers ...</p>	<p>Int.01[PM].13/405-407.</p>

<p>... I just think that in their [MSEP participants] conversation about water and rivers one can tell that they've got a much bigger picture of what's going on and they find that much more important that they water supplies are kept clean so there's a much greater awareness about water and water health.</p>	<p>Int.01[PM].13/419-422.</p>
<p>And the rate of spilling manholes has changed or decreased since the project has started.</p>	<p>Int.02[A].1/20,21.</p>
<p>I think since drama is a demonstration and people do understand everything presented to them by action that is the reason drama works well.</p>	<p>Int.02[A].1/31-33.</p>
<p>MSEP makes people happy especially plumbers, they always appreciate the contribution of MSEP. When you phoned them about water leaks and manhole problems they come, it's like they were waiting for your call and they will thank you for letting them know about the problem.</p>	<p>Int.02[A].2/43-45.</p>
<p>Most of the community now is aware of how important nature is. They know that if they pollute water they will be affected in the future and if they cut trees will decrease amount of oxygen that we receive from trees.</p>	<p>Int.02[A].2/61-63.</p>
<p>Before I never knew anything about testing water but now I have a full knowledge of how to test water to see whether it is in a drinkable condition or not.</p>	<p>Int.02[A].3/74,75.</p>
<p>... when I joined the MSEP is that I learnt new things about manholes and water especially that the uMthinzima stream goes directly into Midmar dam,</p>	<p>Int.03[A].1/14-16.</p>
<p>Since we started to visit schools and acting in schools the spillages of manholes is not the same as before. The community and school children are more educated</p>	<p>Int.03[A].1/23,24.</p>
<p>Before, most were spilling now they have been taught about what must be put in the toilet and manholes are not spilling as before and they are aware that they inhale germs from spilling manholes. Spillage of manholes has decreased.</p>	<p>Int.03[A].2/48-51.</p>
<p>I think teaching through drama is meaningful learning to me because people always understand what we are trying to express to them.</p>	<p>Int.03[A].2/54,55.</p>
<p>The first good thing that happen there was a reduction of spilling manholes in my area.</p>	<p>Int.04[EC].1/14,15.</p>
<p>Most of the things that makes me happy is that some of the things are not happening as before, like dumping site reduction, occurrence of spillage manholes has decreased.</p>	<p>Int.04[EC].1/21,22.</p>

I would like to remember MiniSASS and tell people about it. MiniSASS works well because everything is practical.	Int.04[EC].1/25,26.
Through drama and Enviro Champs, the community is well educated and they are taking action about solving manhole spillage.	Int.04[EC].2/47,48.
There are many ways of learning. Drama is the meaningful learning to me.	Int.04[EC].2/52.
The things that made me happy when the project began is that the project made the Mpophomeni community realize how spilling manholes pollute our rivers. We started to pay more attention to how we can stop the spilling of manholes. The project delivered more information about how we can report the spilling manholes or contact the right people for the fixing of spilling manholes.	Int.05[EC].1/14-18.
It did make me happy to see that there will be a way of solving problems like water pollution and illegal dumping.	Int.05[EC].1/21,22.
I am happy with the work I do because since the project started things have changed from bad to good. The spilling of manholes is slightly decreasing. Now if I see a spilling manhole I report it and the plumbers they come to fix it. That makes me happy. Also the number of illegal dumping is decreasing which is good.	Int.05[EC].1/28-31.
Through workshops and drama I've learned a lot, especially when the drama tells us how we are supposed to behave around the environment.	Int.05[EC].2/61,62.
When I think of the MSEP I see the change and Mpophomeni becoming better than other places in terms of taking care of water and the environment as a whole	Int.06[SEC].1/14,15.
I knew how to plant a tree but now I know, MSEP has taught me lot about water pollution, illegal dumping and air pollution. I also learnt to teach people about the environment and I am good at that.	Int.06[SEC].2/57,58.
I think the community is improving in terms of taking care of environment and they make MSEP's work easy.	Int.07[SEC].1/29,30.
My siblings used to swim in the dirty river, they urinated and defecated in the river after a while their bodies will experience rash. I taught them that defecating and urinating in the river is not good for the animals living in the river. Since then they stopped. I also used to dump rubbish in the water, because I have a lot of information now I don't do that anymore.	Int.07[SEC].2/51-54.

Plumbers come immediately after we report the problem. If they didn't make it in time they will come and fix the problem later.	Int.08[EC].1/7,8.
... before the MSEP there were no Enviro Champs. Manholes used to spill for quite a long time because no-one reported it to the plumbers and the plumbers had no idea that there is a manhole spilling somewhere and children will get sick when they play near that manhole.	Int.08[EC].1/18-20.
I feel that people who started the project did a good job because since the project started there is change.	Int.08[EC].1/25,26.
... they [Enviro Champs] are well educated in terms of water pollution and spilling manholes and how to deal with water leakages, spilling manholes and illegal dumping.	Int.08[EC].2/41,42.
The way I think has changed because in past I had a lack of information about water pollution and the sanitation problem. Now when I see a spilling manhole even if it is not in my area, I just report it and give plumbers directions so they can come and fix the problem.	Int.08[EC].3/79-82.
Sometimes we use newspaper in the toilet because we had no idea that newspaper is not good for the toilet. Now I know what must go into the toilet and that if we carry on wasting water in the near future water will be insufficient.	Int.08[EC].4/110-112.
I learnt a lot in the project. I used to wash with dirty water and had no idea that it is dangerous.	Int.09[EC].2/35.
They are some are still using that water but the rate of using that water has decreased.	Int.09[EC].2/41.
I think they did a good thing because they widen my knowledge about water and I am well educated about water. Something that comes to my mind is that one day I will have more knowledge about water.	Int.09[EC].2/53-55.
I think drama works very well because through drama I understand easily and I believe most people understand through drama.	Int.09[EC].3/72,73.

Appendix 13

Determining the nature of learning in the MSEP Community of Practice - A closer look at the components of learning in a Community of Practice.	
<p>Category: Learning Community = Code: LC. This criteria refers to "learning as belonging ... talking about the social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence" (Wenger, 1998, p. 5).</p>	
<p>Respondents included the Project Manager [PM]; Actors [A]; Enviro Champs [EC]; School Enviro Club members [SEC].</p>	
<p>Example of referencing data source: Interview 02 [Actor], page 2, line 38 = Int. 02[A].2/38.</p>	
Response	Source
So I think the fact that Groundtruth takes us seriously and that we have Mahomed working on the concentration of the sludge and the clarity tube and that we've got the university supporting us. That also is a very positive thing	Int.01[PM].4/131-133.
It's supported by well-respected scientists as well.	Int.01[PM].4/134-135.
I mean uMngeni Valley people Wayne, Jim, Mark Graham even Mark Dent that he attended our meeting and gave us positive feedback. All those people give it a kind of substance that's real. It encourages me to keep going.	Int.01[PM].5/141-143.
So it seems as if the plumbers are very happy with what we're doing so when I ask them for advice or feedback, they just say "no it's all great, it's great" ...	Int.01[PM].5/153-155.
Also the counsellors are satisfied about what the project is doing ...	Int.02[A].2/45,46.
The plumbers always get satisfied and appreciate what the MSEP does. When I reported the spilling manhole they always appreciated it for making their work easy.	Int.03[A].2/35,36.
Yes, I strongly believe they are satisfied especially plumbers, because when they are invited to workshops they come and appreciate the work of MSEP.	Int.04[EC].2/34,35.
My neighbours are happy about the job MSEP is doing and the other members of the community when we are discussing about healthy environment and health living and keeping nature safe.	Int.05[EC].2/43,44.
People from the community and teachers from school usually say MSEP is doing good job and we must continue doing what we do until the project spreads all over country.	Int.06[SEC].1/33,34.
My aunt always says environment is the key and is the reason we have access to clean water and MSEP must continue with the good work it is doing.	Int.07[SEC].2/34,35.

<p>The deputy mayor saw me when I was checking the manholes and he asked me what I am doing and I told him that I am checking this manhole and I have to report it as it is spilling directly into the stream. He told me that we are doing a good job because many people don't know about that manhole.</p>	<p>Int.08[EC].2/46-49.</p>
<p>Yes they are people I know and I get well with them, especially the plumbers. When they pass by my home they will stop and I will tell them if there is a problem. They will attend to the problem when they're done where they were going to. I go with the plumbers to discuss the cause of the blockage.</p>	<p>Int.08[EC].2/55-58.</p>
<p>Yes, it affected my neighbours because they are happy with the job we are doing. One of my neighbours had a broken pipe and they did fix it.</p>	<p>Int.09[EC].3/78,79.</p>
<p>People used to ask what I am doing and why I am doing it. I just tell them and they would say I am doing a good job and would like to do it so they can learn more about water.</p>	<p>Int.09[EC].3/77,78.</p>
<p>Even at school, well recently we lost our principal and he was quite interested in the process of the club, he was the one who made sure that you know, even we asked for an office but he tried to make sure that we got one...</p>	<p>Int.10[SEC].5/138-140.</p>
<p>Well last year well at school we have a stream and there's a bridge on top of it this stream was very, very dirty, so we took our sport time to try and clean it and that gave us a lot of feedback from our school teachers saying that they didn't think that we had noticed that our school is in a very, very very bad position so ja seeing you do something, that gave them the courage to praise us. That gave them the words to praise us.</p>	<p>Int.10[SEC].5/150-154.</p>
<p>Even Mark Dent came to us and said that the presentation was quite a very, very, very, very teaching one.</p>	<p>Int.10[SEC].7/212,213.</p>
<p>So although a tiny bit of that 16 million budget would be really, really useful to spend on educating people, they don't. The funding goes for things that you can see: concrete, pipes, dig up, lay down and because you can say well "I laid 200 metres of pipes and there it is", but if you say I educated 200 people, you can't kind of measure the outcome. So sadly, although everybody that you interview says that education is the most important, they don't put the money there.</p>	<p>Int.11[PM][ECC].2/52-57.</p>

Name Code /
Coordinates

Thandanani Luvuno

TL1

-29,56633

30,192396

TL2

-29,56552

30,19193

TL3

-29,56494

30,18888

TL4

-29,56124

30,18634

TL5

-29,55971

30,18533


D.3.01.

History of the miniSASS tool

[LC]

South Africa has been a world leader in biomonitoring techniques using macroinvertebrates. The most successful of these is the South African Scoring System version5 (SASS5). miniSASS is based on SASS and also uses the presence of macroinvertebrates to indicate the "health of a river". Where SASS5 contains over 90 different macroinvertebrate classes, miniSASS only has 13 different classes, allowing for simpler identification and understanding. miniSASS has been found to provide similar indications of "river health" status as the more comprehensive SASS5 assessment, thereby providing a good means of generating useful biomonitoring data. The original miniSASS (version 1) was developed/based on approximately 2000 SASS4 data records, whilst this updated miniSASS (version 2) is based on over 6000 SASS5 records. This makes miniSASS v2 more robust as a useful water quality monitoring tool & more widely applicable in Southern Africa.

D.5B.01.

	D.9B.01.
Overview map of MSEP Enviro Champs Monitored Manholes.	D.10A.01.
Map of manholes monitored by Enviro Champ, Baba Cele.	D.10B.01.

<p align="center">Determining the nature of learning in the MSEP Community of Practice - A closer look at the components of learning in a Community of Practice.</p>	
<p>Category: Learning Identity = Code: LI. This criteria refers to "learning as becoming ... how learning changes who we are and creates personal histories of becoming in the context of our communities" (Wenger, 1998, p. 5).</p>	
<p>Respondents included the Project Manager [PM]; Actors [A]; Enviro Champs [EC]; School Enviro Club members [SEC].</p>	
<p>Example of referencing data source: Interview 02 [Actor], page 2, line 38 = Int. 02[A], 2/38.</p>	
<p>Response</p>	<p>Source</p>
<p>I think I play a big role in terms of teaching people about the importance of nature and environment to make them understand that if they affect nature in a bad manner and if they not protect natural resources like water in the near future they are the ones who will suffer</p>	<p>Int.02[A].1/6-8.</p>

I contribute as an actor because it how I teach people through drama and I am proud of that and give 100% commitment through dedication when we're practicing, that's what keeps the drama team going on forward.	Int.02[A].1,2/33-35.
Yes, being a member of MSEP has changed the way I think, because now I am well educated and I have been teaching the community.	Int.02[A].2/60,61.
Before, I used to dump rubbish in water and in drains when the rubbish truck didn't show up. Since I joined MSEP I don't do that anymore and I am encouraging people not dump rubbish where it's not supposed to be dumped.	Int.02[A].2/63-66.
I am an actor. My role is to pass on information or teaching through acting especially in schools, and to learn more from the Enviro Champs	Int.03[A].1/6,7.
... before I joined MSEP I had little knowledge about sanitation and water, but MSEP has broadened my knowledge and I am passing that knowledge to the members of the community.	Int.03[A].1/25,26.
Yes being member of MSEP has changed my way of thinking ...	Int.03[A].2/48.
I sometimes go to the municipality offices and teach people water related issues and dumping issues etc	Int.04[EC].1/6,7.
I am proud of taking care of manholes and rivers.	Int.04[EC].1/27.
[Success factors of the MSEP] The involvement of Enviro Clubs from different schools from Mpophomeni. School children take knowledge and pass it back to their parents and siblings.	Int.04[EC].1/29,30.
Before I joined MSEP I didn't care about river issues and now I care a lot.	Int.04[EC].2/49.
I am proud of teaching other people about keeping the environment healthy.	Int.05[EC].2/37,38.
MSEP has changed the way I think before I did care about dumping illegal and spilling manholes but not that much, after MSEP began my thinking changed. I care a lot about illegal dumping and spilling manholes.	Int.05[EC].2/55-57.
My role is to teach new kids from Umthombo and the ones who recently joined the enviro club about the importance of environment ...	Int.06[SEC].1/6,7.
The work I do makes me happy because it has built my self-esteem. Now I can speak freely in front of many people teaching them about the environment.	Int.06[SEC].1/21,22.
There is not much that I am, but passing the knowledge I have to the people makes me proud.	Int.06[SEC].1/26,27.

Yes MSEP has changed the way I think and my role in life. Before I joined MSEP I didn't know about environment. I used to throw papers everywhere and put everything in the toilet without thinking about what will happen but I don't do that anymore.	Int.06[SEC].2/46-48.
I am one of those people who used to put soil water in the toilet but now I am practising what I teach people ...	Int.06[SEC].3/84,85.
I would like to see myself as a hero for the work I've done to serve the community about the environment and how people are taking care of the environment.	Int.07[SEC].1/24,25.
I never thought that the environment is important but now I know and I would like to be an environmental teacher. Teaching people about the importance of the environment and making the information accessible to everyone.	Int.07[SEC].2/54-57.
Before I didn't know how to do miniSASS but now I can do it perfect. I couldn't speak in front of people but now I am not shy anymore. I can speak freely in front of many people. MSEP has boosted my self-esteem.	Int.07[SEC].3/67-69.
I also go to Ethembeni Shelter to do the gardening and knitting for the orphanage. We also practise permaculture at Khethi's place so we can have vegetables.	Int.08[EC].1/9,10.
When I washed in the past I would let the water flow without closing the tap and waste water, but now when I wash I put the water in a bucket or in the washing dish and close the tap.	Int.08[EC].3/89,90.
I am doing this because I am not employed and I want to keep myself busy and with everything I do I want other people to benefit from what I am doing, for example at Ethembeni the garden is for people who live there and orphanage and at Khethi's place the garden is for the members, we are not selling it. The garden is for all of us so we can have something on the table.	Int.08[EC].5/136-139.
Yes, it has changed the way I think because in past I had no idea that dirty water can be dangerous. In the past people used to wash there since I've joined the MSEP they stopped, because I taught them.	Int.09[EC].3/95-97.
Well certainly I got to meet a lot of people and when you meet a lot of people you get that surety that you yourself can be ... you know, you can go further than you think go can go so ja, you meet a lot of different kind of people, so ja, that's was the best thing that ever happened to me.	Int.10[SEC].2/34-36.

<p>Well, I am a matriculant, so time is what's really not on my side ... but I like to spend time with them so I think my time is more valuable to them actually so that what I'm happy about contributing it.</p>	<p>Int.10[SEC].3/74-76.</p>
<p>Well that play, it was my first time doing plays since primary, well it rose to me some happiness from which I couldn't describe cause I get to be part of the person whose making a difference on the environment so ja that gave me a lot of power in order for me to perform and make sure that I do very well. So ja, that play is one of which I think I will never forget in my life.</p>	<p>Int.10[SEC].4/120-123.</p>
<p>Ja, well if I'm exactly doing my job as I should be doing it that would really make a difference to me and ja, I think it has done I have noticed a few things in my community. A few years back if I wasn't part of that project I wouldn't have noticed and I wouldn't have cared about it that's what changed me.</p>	<p>Int.10[SEC].6/169-172.</p>
<p>... besides school the club is my second priority, so that's why I make sure that at every single meeting I'm there to see how things go and to see if we're having success on that meeting or what ...</p>	<p>Int.10[SEC].6/191-193.</p>
<p>Well when I started the club I was much of a very, quite shy person I still am right now but not much cause it has taught me to work with many people, people from many backgrounds so that's quite ... to shy away. So ja, it has helped me with my personality.</p>	<p>Int.10[SEC].7/197-199.</p>
<p>[Words on the screen] We the students of Mpophomeni, want to educate our town about this serious crisis. [Footage of waste water with solid waste in a wetland near a manhole]</p>	<p>D.2.01/11,12.</p>
<div style="border: 1px solid red; padding: 5px;"> <p>Observation Details</p> <p>Date: 07 Sep 2013 (L)</p> <p>Username: lakani</p> <p>Organisation type: NGO</p> <p>Organisation name: WESSA</p> <p>Comments/notes: Limitations, Cattle farm, Fertilisers, Sewerage, flooding and Alien vegetation.</p> </div>	<p>D.4A.01.</p>

As the general public, we can play a part in making a difference to managing freshwater resources in a community. miniSASS has the potential to be a powerful 'red flag' indicator for the identification of aquatic pollution sources. By using miniSASS we can actively take an interest and management in the health of freshwater bodies in our community. Your interest and knowledge can be enhanced by adopting a local river in your community and monitoring it over time, identifying sources of pollution and taking local action to make a difference. You could also encourage more members of the community to take positive action towards monitoring and conserving water.

D.5B.01.

EnviroChamp Monitored Manholes

- Ayanda Lipheyana
- Baba Cele
- Bonisile Mnguni
- Fresh Ngubo
- Mbali Dlomo
- Nhlonipho Zondo
- Sthe Nkomo
- Thandanani Luvuno

[LI]

D.10A.01.



D.10B.01.

**Determining the nature of learning in the MSEP Community of Practice -
A closer look at the components of learning in a Community of Practice.**

Category: Learning Meaning = Code: LM. This criteria refers to "learning as experience ... talking about our (changing) ability – individually and collectively – to experience our life and the world as meaningful" (Wenger, 1998, p. 5). Making connections between what we see and what we've learnt and what we do/what happens in the world around us.

Respondents included the Project Manager [PM]; Actors [A]; Enviro Champs [EC]; School Enviro Club members [SEC].

Example of referencing data source: Interview 02 [Actor], page 2, line 38 = Int. 02[A].2/38.

Response	Source
They're producing the information so Graham Jewitt is now interested in the social aspect, ok, so there are people involved here and working with people is more difficult than measuring the number of e.coli.	Int.01[PM].8/251-253.
In the past I didn't know that the river stream needs to be protected and living organisms in water need to be protected too.	Int.06[SEC].3/71,72.
The work I do leads to a healthier life for all of us when I am trying to make people understand about the environmental issues.	Int.07[SEC].1/22-24.
If people do take care of the environment I will tell people and future generations that I was the member of the MSEP project that brought the change to the Mpopohomeni community.	Int.07[SEC],p.1/25-27.
I was happy to get more information about alien invasive plants and to know that they destroy our indigenous plants and they consume too much water.	Int.07[SEC].2/43,44.
I also learnt a lot about water research (MiniSASS). Water research keeps us aware that if we keep polluting water in the near future there will be no access to clean water and the future generations will suffer because of our actions	Int.07[SEC].2/62-64.

I didn't know that the water we are drinking come from the river and by carrying on polluting the rivers we are limiting our chance of getting clean water.	Int.07[SEC].3/80,81.
We went at Emashingeni from the source of uMthinzima stream. At the source we found stonefly, the indication of clean water, but as we go down the stream there was dumping in the river and we couldn't find the stonefly showing that water was now dirty and it was not safe to drink that water. People should stop dumping in the river.	Int.07[SEC].3/84-87.
It makes me happy that I do my job properly and spillings and leakage problems have decreased.	Int.08[EC].1/32.
Yes I learnt a lot when we went to the Howick Waste Water Works. I did understand how manure comes from the faeces and how they treat grey water.	Int.08[EC].3/85,86.
I think they will do a proper treatment when I report to Liz ... she will phone them.	Int.09[EC].1/15.
I think at Howick Water Works sometimes they release water when they have treated it properly and sometimes without doing proper treatment.	Int.09[EC].2/67,68.
I didn't know that animals need to be respected and they need their habitats.	Int.09[EC].4/119.
Ja, you did hear booing, well let me just say in life you cannot just experience the good things you just have to have the negative things in order for you to have the power to succeed.	Int.10[SEC].3/85,86.
... I also tell them [learners at Injoloba High School] that the environment best describes your personality so I think that motivates them.	Int.10[SEC].4/107,108.
What I would say my knowledge I didn't know that people would just develop a very heartless reaction towards water. Water it's sort of like life to many of us, some people just don't care about how the water is wasted so I would say that it's very very harmful and very bad towards the environment.	Int.10[SEC].8/235-238.
What came out of that quite clearly was that it was basically the infrastructure that was a problem. There were at least 6 or 7 manholes probably more, that could not be fixed by the plumbers and they didn't even go near them, they didn't even try and fix them, and then there were some others that they did try to fix but it was a bit hopeless.	Int.11[PM][ECC].2/38-42.

<p>And so what came out of that study was, well first of all uMgungundlovu thought that it was what people were throwing down the toilet that was causing all the blockages because every time the plumbers did have a successful freeing of the system it was household waste that came out. Plastic, nappies, knives and forks and rags and panties and things that come out of households, but there were these ones that just absolutely couldn't be fixed. So they realised that the whole of Mpophomeni needed an upgrade</p>	<p>Int.11[PM][ECC].2/41-47.</p>
<p>And then they decided that our funding should stop because they had discovered what the problem was, it was the infrastructure and so they didn't tell us in so many words, but they did not renew the funding and I think they'd got their answer and it's quite common with a lot of programmes around the country, unfortunately, the education part comes second.</p>	<p>Int.11[PM][ECC].2/49-52.</p>
<p>...it became quite obvious to him and Ayanda that we needed to name each of the manholes, because Ayanda was summarising the stuff and what was happening was, S'the Nkomo would report a spillage because it was sort of in his area and then Ayanda was walking past so he would report it because he's the manager of the Enviro Champs and then Thandanani also walked past and he's everywhere, so he would report it and they might even have had it on each of their sheets – the same one. And the plumbers got phoned by 3 people all about the same one, so we needed to streamline the system from a reporting point of view, but also we want to know exactly which manhole spills all the time and exactly which manhole is totally blocked and leaks underground all the time. Where is it? What is its GPS coordinates? And has it been fixed?</p>	<p>Int.11[PM][ECC].2,3/65-73.</p>

<p>And, so if we can have this information over a number of months, we could eventually work out, for example how many manholes spill continuously, just never stop? What is the average time that it takes for the plumbers to come and fix the thing? Is it half a day, a day, 2 days? And, how long does it take them to fix it? And, how long after they fixed it does it start spilling again, because that number appears on our spreadsheet and then you can tell when it starts to spill again. And also looking at the whole map, which area is causing the most trouble? Is it S'the Nkomo's 6 manholes, or Mbali's 6 manholes? Where is the problem? And, also very importantly, there a column for writing down what comes out of the manhole, so you could say 90% of the time it's household waste, but 1% of the time it's builder's rubble, whereas at the moment maybe everybody's saying "ha, it's builder's rubble all the time", but there's no facts and figures to prove that</p>	<p>D.11[PM][ECC].3/77-87.</p>
<p>AL: I did assume that each Enviro Champ is looking out of 5 manholes ... on their different reporting sheet. LB: And so what did you find, what was presenting the challenge? AL: The challenge is that that assumption is not always correct</p>	<p>D.11[PM][ECC].6/189-192..</p>
<p>A person who knows that I am an Enviro Champ, wanted me to report the manhole. Then I went to the map that Mahomed made us for, made it for us, then I noticed that the manhole belongs to S'the – it was SN1. Then I phoned S'the, let him know that his manhole is spilling he told me that he didn't know that it's happening then he phoned the plumbers. On the next day the person phoned me and appreciating that the manhole's been fixed</p>	<p>D.11[PM][ECC].7/206-210.</p>
<p>... but when I was filling up the spreadsheet I noticed that most of the manholes that were fixed on the same day were the ones that have household waste problems. The one that has infrastructure took too long sometimes they do not got fixed, yes</p>	<p>D.11[PM][ECC].8/269-271.</p>
<p>It happens like, when I was filling the spreadsheet yesterday I noticed that there are some manholes that had cows waste, household waste and the vandalism; cause most of the cases the combination of household/building material or household and vandalism</p>	<p>D.11[PM][ECC].10/335-337.</p>

<p>And I'm gonna be very excited when we can produce some tables and maps out of this lot.</p>	<p>D.11[PM][ECC].11/341.</p>
<p>Ok, all I'm saying is that the new reporting sheet it shows exactly which manhole is spilling and how often they get spilling, cause on Kethi Luvuno's reporting sheet he will write like "on the 21st the manhole is spilling and it was getting fixed maybe on the 22nd". On the 5th and then he reports again, the manhole is been spilling and fixed on the 26th but on this new reporting sheet it shows that it's two manholes not one. The one it gets fixed and when it gets fixed the neighbour of that one starts spilling</p>	<p>D.11[PM][ECC].11/364-369.</p>
<p>[Words on the screen] "Walking to school with the smell of sewage thick in the air, stepping over puddles of raw sewage, it doesn't put you in a good mindset. And the level of sanitation and hygiene in the schools is not good, there are always blocked toilets" Pens Malinga, Mpophomeni residents & Enviro Champs co-ordinator.</p>	<p>D.2.01/3-6.</p>
<p>Young student in school uniform standing on the manhole, talking and pointing in the direction of Midmar Dam: "Midmar Dam is 2 km away from this manhole. Animals drink from this manhole and they eat this grass [footage of chickens walking in the wetland and a cow grazing near a polluted stream] and then they go back at home and people eat them. So that's how people get germs because of this manhole. If this doesn't get clean it goes into Midmar and it affects the clean water in Midmar. [Map showing the proximity of the township to Midmar Dam]. It's because people put the wrong things in the toilet [footage of a used sanitary pad on the edge of the spilling manhole] like you see paper, socks and everything".</p>	<p>D.2.01/13-20.</p>
<p>[Photo of a group of young people on the edge of a spilling manhole with clipboards having a discussion with a person standing on an 'island' in the middle of the stream of waste water flowing from the manhole. Photo of a used condom lying in the grass. Photo of a learner standing next to a very polluted stream taking a photo]. Not the toilets the bins!!</p>	<p>D.2.01/20-24.</p>
<p>[Woman – resident of Mpophomeni – being interviewed, speaking in isiZulu. Our babies get diseases from that leakage and also our animals that we live with, swim there and come back with cholera. Even us we are old we also get that sickness all the time. We also get blocked noses, rash and runny stomach. The smell is very bad.</p>	<p>D.2.01/25-28.</p>

We would be happy if some people in high places, will come and solve our problem, because this place is disgusting. They always come but they don't do anything about the manhole. They don't come and fix this manhole. It's been 9 months now. This manhole stinks!

D.2.01/28-31.

Groups	Present
Flat worms	No
Worms	No
Leeches	No
Crabs/Shimps	No
Stoneflies	Yes
Minnow mayflies	Yes
Other mayflies	No
Damselflies	Yes
Dragonflies	No
Bugs/beetles	No
Caddisflies	Yes
True flies	No
Snails	No
Average score:	8.75 
	Natural

D.4A.01.

Interpretation of the minISAS score: Although an ideal sample site has rocky, sandy, and vegetation habitats, not all habitats are always present at a site. If your river does not have rocky habitats use the sandy type category above to interpret your scores.

Ecological category (Condition)	River category	
	Sandy Type	Rocky Type
Unmodified (NATURAL condition)	> 6.9	> 7.9
Largely natural/few modifications (GOOD condition)	5.8 to 6.9	6.8 to 7.9
Moderately modified (FAIR condition)	4.9 to 5.8	6.1 to 6.8
Largely modified (POOR condition)	4.3 to 4.9	5.1 to 6.1
Seriously/critically modified (VERY POOR condition)	< 4.3	< 5.1

D.5A.01

Method

The best sites are those with rocks in moving water. Not all sites have rocks (rocky type rivers), but may be largely sandy (sandy type rivers).

1. Whilst holding a small net in the current, **disturb** the stones, vegetation, sand etc. with your feet or hands.
2. You can also lift stones out of the current and **pick** insects off gently with your fingers or forceps.
3. Do this for about **6 minutes** whilst ranging across the river to **different habitats** (biotopes).
4. Rinse the net and turn the contents into a plastic tray and **identify** each group using the identification guide (see insert: you could start with the dichotomous key and then use the identification guide for more information).
5. **Mark** the identified insects off on the identification guide.
6. Fill in the site information and **add up** the sensitivity scores to determine the average score (see scoring sheet on back page).

D.5A.01.

What is the importance of water quality monitoring and management in South Africa?

[LM]



Fresh water is essential for most life on earth. It is also used in all spheres of human life, namely agriculture, industry, biodiversity conservation, sanitation and hydration. However due to the amount of rainfall that South Africa receives, it is classified as a water stressed country. This means that if we do not monitor, manage and conserve our current water resources, we will be placing them and the population under tremendous stress in future!

D.5B.01.

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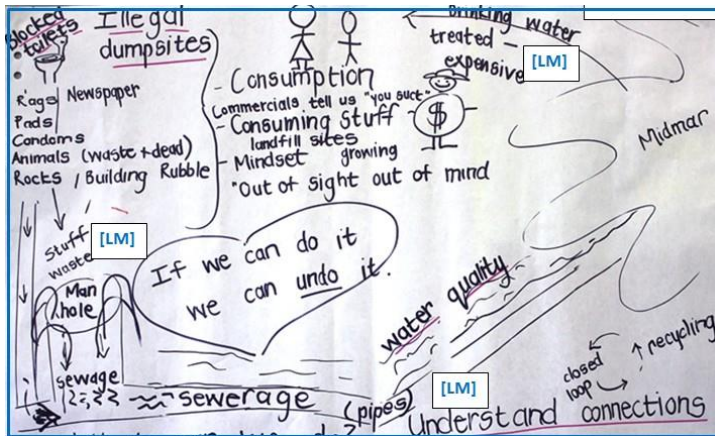
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1 March 2014 Iceberg Conversation with the PopCyd Enviro Friendly Club

D.6.01.

Event/s:
 Blocked toilets, illegal dumps, dirty water in Mpophomeni.
 Pattern/Trends:
 5/6 toilets block/week.
 Takes 3 weeks to fix.
 Plumbers fix toilets over weekends.
 Systemic Structures:
 Male culture
 "you are gay if you don't vandalise the toilet", no toilet paper learners use stones, grass etc.
 Learners throw papers, plastic, pads down the toilet.
 Mental models:
 Priorities/values: people choose airtime, coke, burgers, doritos instead of paying for toilet paper.
 Ignorance/Habit: Rural person "I don't use this, what is this? Give me newspaper".

D.6.01.



D.7.01.

Zandile: Grandmother you must not use the newspaper in the toilet.

Grandmother: It a bad lucky for MaMlangeni, now you ordering me? I don't have money for toilet Papers and newspapers are too strong (easily available). You full of English (you are telling me what to do now that you're educated – 'full of English').

Zandile: Don't be angry grandmother. Newspapers causes manhole blockage.

Grandmother: I understand my granddaughter. Please take that thing for me (toilet paper). (convinced now)

Zandile: Yes grandmother. I am looking it (I'll get some

D.8.02/48-55.

DESCRIPTION OF SITE 3
1M FROM THE STREAM, MTHINZIMA STREAM BRIDGE

GRADE A, B, C	TALLY	TOTAL
C- Extremely Polluted		
TYPES OF LITTER		
Sweet wraps		5
Plastic Packets		
Crisp Wrappers		
Cans		5
Plastic bags		5
Fruit peels/skin		2
OTHERS		
Fast Food Packing		5
Cigarettes butt		5
Match sticks		
Disposable Nappies		5
Sanitary Towels		5
Dog Poohs		2
Aerosols		2
DISTANCE FROM THE NEAREST WETLAND	~ 5m	
CAN YOU SMELL THE POLLUTION	There is a stench around the stream	
Comments: If Mthinzima is polluted, it carries all the dirt to the Midmar Dam. The dam supplies water to local municipalities.		

D.9A.01.



D.9B.01.

Determining the nature of learning in the MSEP Community of Practice - A closer look at the components of learning in a Community of Practice.

Category: Learning Practice = Code: LP. This criteria refers to "learning as doing ... talking about the shared historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action" (Wenger, 1998, p. 5). Shared understandings and strategies that help us to keep working together. E.g. the things that we do together like meetings, training days, fieldtrips, workshops, and social gatherings.

Respondents included the Project Manager [PM]; Actors [A]; Enviro Champs [EC]; School Enviro Club members [SEC].

Example of referencing data source: Interview 02 [Actor], page 2, line 38 = Int. 02[A].2/38.

Response	Source
The thing that I do remember is the warmth and friendliness of the people that I work with and the willingness to put themselves out over weekends or after hours or on a Sunday to meet with me or plan a project or talk about it or that sort of thing.	Int.01[PM].3/84-86.
He tries his best in his role as the Enviro Champs coordinator and he also has extra input, he wants to draw graphs, he wants to assess the data that's coming through. So that's exciting and pleasing.	Int. 01[PM].3/90-92.
I like the way that the drama team take it upon themselves to book plays when and where they like at last they seem to be a bit more independent and not phoning me for lifts all the time ...	Int.01[PM].3/92-94.

<p>the training as well seems to be working really, really well ... people seem to put in more than I can possibly imagine on the day. They want to stay longer and they bring such richness to the experience as well.</p>	<p>Int. 01[PM].3,4/98-104.</p>
<p>They also work very well with the Enviro Champs and there doesn't seem to be any clashes and the Enviro Champs are very respectful of them so that seems to work well.</p>	<p>Int.01[PM].5/155-157.</p>
<p>All people from different walks of life just came together for a common purpose to deal with the problem of water pollution and illegal dumping in Mpophomeni and Howick and we were able to have a long meeting of 3 or 4 hours talking about different issues with different people contributing to the conversation and there was a spirit of sharing and learning and solving problems and respecting each other's point of view and I just thought it was really, really positive and I just think this is the only way to go forward really ...</p>	<p>Int.01[PM].6/186-191.</p>
<p>... so for example on the 28th of February Hlonipho whose one of the actors when he was walking along the road, noticed a spilling manhole, now he wouldn't have normally done anything about it because he's not an Enviro Champ per se, he's an actor and he decided to phone me and tell me about it and used up his own airtime money to phone me and then he , I said, "well look I'm not there and I don't know where the manhole is that you're talking about maybe phone Ayanda". So he phoned Ayanda Lipheyana and Ayanda phoned the plumbers straight away and within the day by that afternoon it was fixed.</p>	<p>Int.01[PM].13/407-413.</p>
<p>Continuous workshops or having small groups of people and school children being taught by the Enviro Champs and through drama about water pollution and land pollution makes MSEP going forward</p>	<p>Int.02[A].2/37-39.</p>
<p>Yes there are other people involved in MSEP I share ideas with, like Enviro Champs and we get on well on each other.</p>	<p>Int.02[A].2/53,54.</p>
<p>When we were having meetings discussing about water pollution and last year we had field trip to uMngeni water works with the Enviro Champs.</p>	<p>Int.02[A].2/55,56.</p>
<p>We had a field trip from Mpophomeni pumping station to uMngeni Water Works. We were learning about the process of separating water and sanitation until the water is ready or clean to be released in the river.</p>	<p>Int.02[A].3/91-93.</p>

I think everything works well because information comes in many ways like through drama, workshops, field trips etc.	Int.03[A].1/26-28.
Yes there are other people involve in the MSEP I know and we get well on each other. We work together with them when we asking cages for certain areas where rubbish can be dumped and protected from cows and goats. We also did a MiniSASS together.	Int.03[A].2/42-44.
I was taught at WESSA on a field trip.	Int.03[A].3/76.
I think what makes everything works well is that the local municipality people and the community get on very well. They are in these issues together.	Int.04[EC].1/22-24.
I know other people involved in the MSEP and get on well with them.	Int.04[EC].2/41.
It works well to work together including Enviro Champs, actors and community and then we make sure that we keep nature safe.	Int.05[EC].2/34,35.
To have meetings and workshops on different occasions makes the MSEP work well.	Int.05[EC].2/37.
The Enviro Club works well because we respect each other and we don't criticise others' opinions, working together and giving each other the opportunity	Int.06[SEC].1/24-26.
We were at WESSA last year having a debate about water related issues.I did gain a lot of knowledge and I was able to pass it to other children from school.	Int.06[SEC].3/75,76.
[Good memories about the project] I think of the Enviro Champs and the Enviro Club working together. The Enviro Champs teach us so we can teach others and lead by example.	Int.07[SEC].1/15,16.
I remember when we hike from the source of Umthinzima stream. I was really inspired by aunt Liz teaching us about alien invasive plants.	Int.07[SEC].2/41-43.
Well when you begin something, when you start to form something, it's not exactly everyone who will understand what you are doing, even you yourself sometimes question yourself "what am I exactly doing?" So ja, you just have to be patient because everything will fall into place as time goes. So I would say that patience has driven us to where we are today.	Int.10[SEC].2/50-53.
Well a difference cannot occur as from now, but I feel as time goes by there will be a huge difference if only people could get educated and stuff.	Int.10[SEC].2/66-67.

Well a memory I think for me I think it was that time that we (sort of like the extended family as you said) got together and we went to Shiyazi to identify the problems they face from which they face there and we went to uMngeni Valley to discuss the problems from which we saw that the people we facing. So ja that's quite a memory for me.

Int.10[SEC].5,6/163-166.

Zandile : Yes so you can take care of other people and nature.

D.8.04/110.

Themes/Codes: A/1:Representation; B/2:Knowledge arena; C/3:Actors;D/4:Disciplinarity; E/5:Agenda; F/6:Context; G/7:Knowledge archive; H/8:Complexity; I/9:Ethics; J/10:Responsibility.																						
		Codes A-J: Knowledge as an open, diverse, social-ecological embodied system.										Codes 1-10: Knowledge as closed, uniform social-ecological disembodied system.										Integrated
Extract	Source	A	B	C	D	E	F	G	H	I	J	1	2	3	4	5	6	7	8	9	10	
So if I get phone calls from Department of Water Affairs or the university or whoever who might be interested I feel it's part of my role to go out of my way to meet those people and involve them and see what they can contribute as well.	Int.01.01/15-17			x																		
Ok, so we had this idea quite a long time ago that it would be nice for people who lived in the community to be Enviro Champs – people who could watch what was going on in the community...	Int.01.01/24,25.						x															
...they agreed with everything we put in that and they didn't change anything – except that they asked us not to toy-toy about service delivery (laughing) ja, which was understandable. So I was pleased that they were willing to put money into a project of their own where they knew things were not working well...	Int.01.02/39-42.						x															

<p>...I have a mental picture of the Enviro Champs being very diligent with monitoring the sewage spillages and filling in the forms carefully and then being gathered at the end of the month and then a comprehensive report being written up that allows anybody that's interested from uMgungundlovu Municipality to any researchers or uMngeni Water or any other stakeholders would be able to see clearly what's going on.</p>	<p>Int.01.02,03/67-72.</p>																												
<p>I think the best thing is that people are at the moment really willing to get on with each other and work with each other to the best of their ability.</p>	<p>Int.01.03/76,77.</p>																												
<p>You sort of think "oh, I'm dealing with illiterate people from Shiyabazali – they don't know anything", yet they're full of their own knowledge and experiences and traditions and way of life and we really, really need to connect with that. It's so easy to just brush it over and think we know more and so I think it works well the way that we run these workshops that it's very open in allowing them to bring their experiences to the picture.</p>	<p>Int.01.04/103-107</p>																												
<p>I think I've spoken a lot about the human relations which to me seemed to be the most important thing since it is a human relations type of project – it's a community project.</p>	<p>Int.01.04/127,128.</p>																												

<p>But there are the scientific measurements and the scientific support and the miniSASS and the people that we work with. So I think the fact that Groundtruth takes us seriously and that we have Mahomed working on the concentration of the sludge and the clarity tube and that we've got the university supporting us. That also is a very positive thing.</p>	<p>Int.01.04/128-132.</p>																												
<p>It's not that we're just this crazy fringe group of people that are just lovey dovey in the townships you know. It's supported by well-respected scientists as well</p>	<p>Int. 01.04/132-133.</p>																												
<p>Yes, I think I'm very grateful that there are people picking up on what we're doing and that we're invited to give lectures at the university or to share with students that are doing their honours and masters, what's happening so that we can deepen our understanding of what's happening through research...</p>	<p>Int. 01.04,05/134-137.</p>																												
<p>I mean uMngeni Valley people Wayne, Jim, Mark Graham even Mark Dent that he attended our meeting and gave us positive feedback. All those people give it a kind of substance that's real.</p>	<p>Int.01.05/139-141.</p>																												

Well I suppose my best memory because it's a recent memory is our meeting that we had on the 24th of February in the library, because there were all sorts of different people that came together: people that were in charge like Don Mtshali and other kind of role players that are higher up. Maybe, very well educated people university lecturers, professors that type of thing all the way through to community members and residents of Mpophomeni Zongile from Shiyabazali who doesn't speak English and is illiterate. All people from different walks of life just came together for a common purpose to deal with the problem of water pollution and illegal dumping in Mpophomeni and Howick and we were able to have a long meeting of 3 or 4 hours talking about different issues with different people contributing to the conversation and there was a spirit of sharing and learning and solving problems and respecting each other's point of view and I just thought it was really, really positive and I just think this is the only way to go forward really ... is a very open space where people can come together and share ideas in a non-threatening way.

Int.01.06/179-190

x

x

Whether it is stated upfront or whether it's an understood thing in the meeting that we're here to share and grow we're not here to bring up our own problems and point fingers and expect somebody else to do the work because each person that comes to the meeting has got their own lives their own set of problems their own situation in their own job that we might not understand. So we can't start shouting at Don Mtshali and tell him that he's not doing his work properly because he's within another system in the municipality and he's got his own constraints, his own bosses whether it's work related or personally related or part of his nature or character – we don't know. So the only way that he'd be able to come out of himself is if we're kind and open to him. Otherwise people just close down and refuse to share.

Int.01.06/190-199.

x

<p>You want to be happy in your life, so how's that going to happen? And there's certain things that you can do which are kind of self-orientated like playing a sport or going hiking or doing your own thing ... travelling, going on holiday ... it's kind of just about yourself or you can decide to spend your life working with other people getting involved in the community and there are certain community levels that one can be involved in I mean you can join the Lions or the Rotary or something like that but I think that working with people at a grassroots level is what I'm very comfortable with so I would prefer to go and visit Zongile at Shiyabazali, would prefer to drive to the library in Mpophomeni on a Wednesday morning than go and have my nails done or go and spend my money on buying something for myself you know.</p>	<p>Int.01.07/209-217.</p>																								
<p>So my role in the community I would like to see myself as somebody that is more involved – that's why I live in Africa and not in Europe I suppose is that there's more opportunity here to get involved in the community and things like poverty alleviation or human suffering or those kind of things I am interested in...</p>	<p>Int.01.07/220-223.</p>																								

<p>Well that would be anybody that is interested in participating whether they participate from a work point of view or from an intellectual point of view (it's not geographically bound?) no, no not geographically bound so I mean Mark Dent's input, even Graham Jewitt who is a professor at the university he is very interested because he knows that for the last 30,40,50 years the scientists have been measuring pollution and measuring pollution and measuring pollution and it's getting worse and worse and worse – why?</p>	<p>Int.08/243-248.</p>																				
<p>They're putting this information out there, but nothing is getting better so somewhere the scientists are not really getting on top of the picture.</p>	<p>Int.01.08/248,249.</p>																<p>x</p>				
<p>They're producing the information so Graham Jewitt [UKZN Hydrology professor] is now interested in the social aspect, ok, so there are people involved here and working with people is more difficult than measuring the number of e.coli.</p>	<p>Int.08/249-251.</p>		<p>x</p>		<p>x</p>																
<p>...uMngeni Municipality is quite difficult to work with we haven't really addressed that issue, but obviously in the community's mind it is a big issue. It's very obvious and visual and in your face so but I think that it is an area that the Enviro Champs themselves need to address with their own councillors and put pressure on the uMngeni Municipality and jack up the service delivery...</p>	<p>Int.01.09/280-284.</p>		<p>x</p>		<p>x</p>																

<p>I think what my role is with the Enviro Champs and community members and the drama teams and people that we meet is to form a sort of contextual picture of why we are so passionate about this particular issue – the Mpophomeni sanitation system. That it's not functioning well and that it's polluting Midmar Dam and that Midmar is part of the uMngeni Catchment and the uMngeni river itself from source to mouth is the most important river in the whole of KwaZulu-Natal providing something like 100 billion litres of water per day (I'll get the figures right but it's a huge amount of potable water) so, the uMngeni Catchment itself is very important.</p>	<p>Int.01.10/317-323.</p>																												
<p>...it's just a very interesting and complex system at play and it's I see myself as helping to give that picture to the Enviro Champs or to the drama team so that when they do their work they're more educated about the bigger picture and also some people that are involved from the outside other stakeholders don't really understand the big picture either people don't really realise how much pollution is coming out of Mpophomeni...</p>	<p>Int.01.10/326-330.</p>																												
<p>So ja , I suppose I just see my contribution as being somebody who might just keep the bigger picture in mind all the time...</p>	<p>Int.01.10/334-335.</p>																												

<p>...I thought that the whole Mpophomeni sanitation infrastructure was mainly impacted by people misusing the toilets (throwing the wrong thing down the toilet) I thought that was 90% of the problem and I suppose this could link back to that other question here about what have I learnt, what is the most meaningful learning experience, that comes in there as well that the actual infrastructure itself was really, really badly laid down. People say that the pipes are too small and others say “no they’re not, they’re the right size”, but I think they are too small and the gradient is definitely a problem...</p>	<p>Int.01.11/343-349.</p>						x																						
<p>...and the kind of what I have also learnt is that the local municipality and the district municipality make a lot of promises and they say that they are going to fix things and that they are very committed to fixing the problems but actually they’re not really and I can see that the plumbers are caught in a system that’s not really supporting them.</p>	<p>Int.01.11/349-353.</p>							x																					

<p>For example outside Baba Cele’s house there was vandals which threw rocks down the manholes which is a misuse of the system but then they still haven’t fixed it and it’s been over a year now that it’s been flowing fully and strongly into the uMthinzima stream and that is going straight into Midmar. Now if they were committed to fixing it, they would have got there and fixed it. They’ve dug it up and it’s now an open pit that a child could drown in and unless I go to the newspaper nothing’s really done about it and I can’t get hold of Riaz, he’s very difficult to get hold of so from being lulled into a sort of false sense of “yes they’re going to do things and yes they’re listening to us” to actually discovering that they don’t really jump around and how to deal with that is a bit of a challenge as well.</p>	<p>Int.01.11/353-361.</p>																												
<p>It’s grown as a dawning realisation through the Enviro Champs reporting, so they report that a manhole was cleared by the plumbers on a certain day and less than a day later, or maybe a day later or maybe two hours later it’s spilling again and the engineers have said that if the pipes and the gradient were correct that would have all been swept away. It’s absolutely impossible for something to block again after two hours if the pipes are big enough and the gradient is correct.</p>	<p>Int.01.11/364-368.</p>	<p>x</p>																											
<p>They’ve said, I mean I’ve spoken to high level engineers that their specialization is in sewerage and they’ve said that every other system in the world (water-borne sewerage) would sweep that stuff straight through the pipes, so I mean there’s a serious problem.</p>	<p>Int.01.11,12/368-371.</p>																												

<p>I've just spent (a week ago) with the Department of Water Affairs a lady from the Dept of Water Affairs came to look for more projects and I saw many, many more areas that are just saturated with raw sewage that I can take people to - 15 or 20 sites in Mpophomeni...</p>	<p>Int.01.12/371-374.</p>																												
<p>...it's absolutely disgusting and so we've been working on this project for 3 years now and really there've been promises and promises and promises and I think it is in the pipeline that (he, he, excuse the pun) that Royal Haskoning have got the funding and have got the go-ahead but still nothing is happening.</p>	<p>Int.01.12/374-377.</p>																												
<p>What we heard yesterday is that they have the go-ahead but they don't have the funding. Oh (the municipality haven't come up with the money yet) oh, ok so they've got the go-ahead but they haven't got the actual money (so they're waiting, they've been waiting for a while, ja) so that is frustrating that 1 year, 2 years, 3 years doesn't seem to be a problem.</p>	<p>Int.01.12/378-381.</p>																												

<p>...look there are experts that are interested in the MSEP project. I don't know how involved they are. I can go to them and ask them for advice. All sorts of different experts from uMngeni Water Gordon Boraine, Royal Nzuzo who's in charge of repairs of the pipes so they all know their jobs very well and but they don't contact me ever about anything so ja and then there are other experts like Mark Graham with his miniSASS and Mohammed with calibrating the clarity meter and how that relates to sludge and the nitrogen and phosphorous content they know more about that than I do. So there's lots of experts that we can call on if we need to but they're not actually fully involved on a weekly basis.</p>	<p>Int.01.12/388-395.</p>																					
<p>... people are more aware of spilling manholes so they've learnt that, what a spilling manhole is and what it looks like and that it can actually be fixed by the plumbers so they phone the plumbers...</p>	<p>Int.01.12,1 3/402- 404.</p>																					

<p>...so for example on the 28th of February Hlonipho whose one of the actors when he was walking along the road, noticed a spilling manhole, now he wouldn't have normally done anything about it because he's not an Enviro Champ per se, he's an actor and he decided to phone me and tell me about it and used up his own airtime money to phone me and then he , I said, "well look I'm not there and I don't know where the manhole is that you're talking about maybe phone Ayanda". So he phoned Ayanda Lipheyana and Ayanda phoned the plumbers straight away and within the day by that afternoon it was fixed. So the time that it takes for the plumbers to get to the manholes is much shorter ...</p>	<p>Int.01.13/404-411.</p>																												
<p>...I just think that in their conversation about water and rivers one can tell that they've got a much bigger picture of what's going on and they find that much more important that their water supplies are kept clean so there's a much greater awareness about water and water health.</p>	<p>Int.01.13/415-418.</p>																												
<p>I think I play a big role in terms of teaching people about the importance of nature and environment to make them understand that if they affect nature in a bad manner and if they not protect natural resources like water in the near future they are the ones who will suffer.</p>	<p>Int.02.01/6-8.</p>																												
<p>The first thing I remember that happened in the community, people were employed although is not that much, to teach the community how they can engage in decreasing the rate of spilling manholes.</p>	<p>Int.02.01/15,16.</p>																												

<p>I joined the project along the way but I think the project contributed more knowledge to Mpophomeni people because now they know what is right and wrong for the environment, especially for water. And the rate of spilling manholes has changed or decreased since the project has started.</p>	<p>Int.02.01/18-21.</p>																												
<p>I think since drama is a demonstration and people do understand everything presented to them by action that is the reason drama works well.</p>	<p>Int.02.01/ 31-33.</p>	<p>x</p>																											
<p>I contribute as an actor because it how I teach people through drama and I am proud of that and give 100% commitment through dedication when we're practicing...</p>	<p>Int.02.01, 02/33,34.</p>		<p>x</p>																										
<p>Continuous workshops or having small groups of people and school children being taught by the Enviro Champs and through drama about water pollution and land pollution makes MSEP going forward, and giving people pamphlets so they can read for themselves.</p>	<p>Int.02.02/37- 39.</p>	<p>x</p>																											
<p>Most of the community now is aware of how important nature is. They know that if they pollute water they will be affected in the future and if they cut trees will decrease amount of oxygen that we receive from trees.</p>	<p>Int.02.02/ 61-63.</p>							<p>x</p>																					

<p>Before, I used to dump rubbish in water and in drains when the rubbish truck didn't show up. Since I joined MSEP I don't do that anymore and I am encouraging people not dump rubbish where it's not supposed to be dumped. With a lack of knowledge, before I joined MSEP, I once put a dead dog in water in order to avoid the bad smell but now I know that by doing that I am polluting the very scarce natural resource</p>	<p>Int.02.02,03/63-67.</p>																												
<p>Before I never knew anything about testing water but now I have a full knowledge of how to test water to see whether it is in a drinkable condition or not (MiniSASS).</p>	<p>Int.02.03/73-74.</p>			x																									
<p>Sometimes acting or demonstration is the better way of teaching people. By doing the toilet play some people understand now exactly what they have to put in the toilet while before they didn't know what causes blockage of manholes.</p>	<p>Int.02.03/81-83.</p>	x																											
<p>We were learning about the process of separating water and sanitation until the water is ready or clean to be released in the river. We also did MiniSASS at WESSA. These are two things that I didn't know but now I fully understand them.</p>	<p>Int.02.03/90-93.</p>			x																									
<p>School children are the good example because are the ones who teach their parents at home about the importance of water and sanitation.</p>	<p>Int.02.03/102,103.</p>				x																								
<p>School children received the information from us through drama.</p>	<p>Int.02.03/103,104.</p>	x																											

I am an actor. My role is to pass on information or teaching through acting especially in schools, and to learn more from the Enviro Champs.	Int.03.01/ 6,7.	x																											
The first good thing that comes to my mind when I joined the MSEP is that I learnt new things about manholes and water especially that the uMthinzima stream goes directly into Midmar dam.	Int.03.01/ 14-16.							x																					
Since we started to visit schools and acting in schools the spillages of manholes is not the same as before. The community and school children are more educated. I would like to remember that before I joined MSEP I had little knowledge about sanitation and water, but MSEP has broadened my knowledge and I am passing that knowledge to the members of the community.	Int.03.01/23-26.						x																						
I think everything works well because information comes in many ways like through drama, workshops, field trips etc. I am contributing by passing the information on to the community through drama...	Int.03.01/ 26-28.	x																											
The plumbers always get satisfied and appreciate what the MSEP does. When I reported the spilling manhole they always appreciated it for making their work easy.	Int.03.02/ 35,36.						x																						
Yes being member of MSEP has changed my way of thinking and of the community too. Before, most were spilling now they have been taught about what must be put in the toilet and manholes are not spilling as before and they are aware that they inhale germs from spilling manholes. Spillage of manholes has decreased.	Int.03.02/48-51.						x																						

<p>I have learnt more about water especially MiniSASS where we check the state of water. Now I know that when there is a stonefly in water that means the water is clean and in a good condition.</p>	<p>Int.03.02/ 58,59.</p>																																	
<p>Some people didn't know that when they flush the toilet they use 8-9 litre of water, through drama they know.</p>	<p>Int.03.03/ 66,67.</p>	<p>x</p>																																
<p>As an Enviro Champ I report the spilling manholes, water leaks and sometimes go to the municipality offices and teach people water related issues and dumping issues.</p>	<p>Int.04.01/ 6,7.</p>		<p>x</p>																															
<p>The first good thing that happen there was a reduction of spilling manholes in my area.</p>	<p>Int.04.01/ 14,15.</p>				<p>x</p>																													
<p>I think what makes everything works well is that the local municipality people and the community get on very well. They are in these issues together.</p>	<p>Int.04.01/ 22-24.</p>		<p>x</p>																															
<p>I once worked with counsellors to solve illegal dumping and Liz helped when I was doing a petition for cleaning the street and I gave it to Don Mtshali at the municipality and the street was cleaned.</p>	<p>Int.04.02/ 41-43.</p>				<p>x</p>																													
<p>Yes the MSEP changed my way of thinking and of the community too. Through drama and Enviro Champs, the community is well educated and they are taking action about solving manhole spillage. Before I joined MSEP I didn't care about river issues and now I care a lot.</p>	<p>Int.04.02/47- 49.</p>								<p>x</p>																									

<p>The people who started the project contributed so much and what they did made me happy because at my age seeing nature affected the way it was affected especially animals living in the water because of spilling manholes going directly to the river stream. It did make me happy to see that there will be a way of solving problems like water pollution and illegal dumping.</p>	<p>Int.05.01/19-22.</p>																												
<p>I am happy with the work I do because since the project started things have changed from bad to good. The spilling of manholes is slightly decreasing. Now if I see a spilling manhole I report it and the plumbers they come to fix it. That makes me happy. Also the number of illegal dumping is decreasing which is good.</p>	<p>Int.05.01/28-31.</p>																												
<p>I would like remember that water we use now was protected and the organisms using water as a habitat will able to survive if we continue with the work we do.</p>	<p>Int.05.01/ 32,33.</p>																												
<p>I care a lot about illegal dumping and spilling manholes. MSEP opened my eyes and other members of the community through MSEP their thinking has changed and they are happy with the work MSEP is doing.</p>	<p>Int.05.02/ 56-58.</p>																												
<p>Through workshops and drama I've learned a lot, especially when the drama tells us how we are supposed to behave around the environment.</p>	<p>Int.05.02/ 61,62.</p>	<p>x</p>																											
<p>I didn't know that if rubbish is not collected we have a right to report the matter to waste management at the municipality offices.</p>	<p>Int.05.02/ 65,66.</p>						<p>x</p>																						

<p>My siblings used to swim in the dirty river, they urinated and defecated in the river after a while their bodies will experience rash. I taught them that defecating and urinating in the river is not good for the animals living in the river. Since then they stopped. I also used to dump rubbish in the water, because I have a lot of information now I don't do that anymore. I never thought that the environment is important but now I know and I would like to be an environmental teacher.</p>	<p>Int.07.02/51-55.</p>																												
<p>I didn't know that the water we are drinking come from the river and by carrying on polluting the rivers we are limiting our chance of getting clean water.</p>	<p>Int.07.03/80,81.</p>																												
<p>It was a fieldtrip. We went at Emashingeni from the source of uMthinzima stream. At the source we found stonefly, the indication of clean water, but as we go down the stream there was dumping in the river and we couldn't find the stonefly showing that water was now dirty and it was not safe to drink that water. People should stop dumping in the river.</p>	<p>Int.07.03/84-87.</p>																												
<p>Being an Enviro Champ makes our township clean because we report spilling manholes, water leakages and illegal dump sites. Plumbers come immediately after we report the problem. If they didn't make it in time they will come and fix the problem later.</p>	<p>Int.08.01/6-8.</p>																												
<p>We do clean up campaigns along the street. I also go to Ethembeni Shelter to do the gardening and knitting for the orphanage. We also practise permaculture at Khethi's place so we can have vegetables. We are not selling vegetables it is for our families.</p>	<p>Int.08.01/8-11.</p>																												

<p>It makes me happy that I do my job properly and spillings and leakage problems have decreased. That is a good sign. I can tell my grandchildren in 2010 Mpophomeni was very dirty and in 2012 MSEP was introduced and the township started being clean.</p>	<p>Int.08.01,02/ 32-34.</p>																				
<p>The way I think has changed because in past I had a lack of information about water pollution and the sanitation problem. Now when I see a spilling manhole even if it is not in my area, I just report it and give plumbers directions so they can come and fix the problem.</p>	<p>Int.08.03/79- 82.</p>																				
<p>When I washed in the past I would let the water flow without closing the tap and waste water, but now when I wash I put the water in a bucket or in the washing dish and close the tap.</p>	<p>Int.08.03/ 89,90.</p>																				
<p>Every day 3 times a day I check water released from Umngeni Water works if it's clean and I record the score. The score of the dirty water is less than 4.</p>	<p>Int.09.01/ 7,8.</p>			x		x														x	
<p>I use a turbidity tube to check. There is something in the tube, I push it away until I don't see it then it will indicate the score of water.</p>	<p>Int.09.01/ 10,11.</p>	x		x																	
<p>I think they will do a proper treatment when I report to Liz ... she will phone them.</p>	<p>Int.09.01/ 15.</p>					x															

<p>Did you used to use the water from Howick Water Works before? Yes Now since you know that the water is dirty do you teach people? Yes I do teach the people. When water is clean do people still use it or they don't use it anymore? They are some are still using that water but the rate of using that water has decreased. What do they use that water for? For washing clothes. Does it smell? It always smells but when it's dirty it smells very bad</p>	<p>Int.09.02/36-45.</p>	<p>x</p>																			
<p>Water is always changing 8h00, 12h00 and17h00 the water is never the same. You can find that morning water is dirty and afternoon water will not be the same and 17h00 water will not be the same.</p>	<p>Int.09.02/63-65.</p>	<p>x</p>																			
<p>I think at Howick Water Works sometimes they release water when they have treated it properly and sometimes without doing proper treatment.</p>	<p>Int.09.02/67,68.</p>					<p>x</p>															
<p>It is a good memory for me because we saw problems. If people can start to fix the problem the stream can be clean.</p>	<p>Int.09.03/90,91.</p>					<p>x</p>															

<p>At Injoloba Eco Wonders Club I am the chairperson, so the biggest problem that we are dealing with is water wastage.</p>	<p>Int.10.01/ 6,7.</p>					x																
<p>Well in the process of addressing that issue I make sure that our club members as the Injoloba Eco Wonders know fully on the problem that we are facing and we also try to find out ways on how to fix that problem.</p>	<p>Int.10.01/ 11-13.</p>						x															
<p>Well what I would like myself to remember is that the difference that we made in the process of being MSEP and being under it. So ja, the difference is what I want to remember actually.</p>	<p>Int.10.02/ 63,64.</p>								x													
<p>Well that play, it was my first time doing plays since primary, well it rose to me some happiness from which I couldn't describe cause I get to be part of the person whose making a difference on the environment so ja that gave me a lot of power in order for me to perform and make sure that I do very well. So ja, that play is one of which I think I will never forget in my life.</p>	<p>Int.10.04/119-122.</p>	x																				
<p>...most of my club members I tell them at each and every meeting at school that what we claim to do, we mustn't only claim to do it at the fieldtrips but we have to also apply it at home even at our close communities.</p>	<p>Int.10.09/ 288-290.</p>								x													
<p>...it started off with funding from uMgungundlovu District Municipality to try to find out exactly what was going on in Mpophomeni, first of all and secondly as an education programme so those two things ran side by side...</p>	<p>Int.11.01/5-7.</p>				x																	

<p>...they said should be previously unemployed people that are more like, stay at home and they could then monitor not only spilling manholes but other environmental issues around their house.</p>	<p>Int.11.01/ 9-11.</p>																												
<p>So I started that off and I decided that you obviously had to have the person's name on the sheet, their cell phone number, their house number and street name and a kind of rough table that they could write down when the manhole started spilling and when the plumbers came to fix it and comments.</p>	<p>Int.11.01/15-18.</p>																												
<p>We realised quite soon that it needed some kind of designation, like where the person was. And in those days each person used to watch only like 1 manhole, so we gave the GPS coordinates of their house or the spilling manhole that they watched.</p>	<p>Int.11.01/25-27.</p>																												
<p>...for about two years with Pens Malinga gathering the information and Andile Vilakazi and they would take those forms and then type up into a kind of landscape page, the summaries and we used those summaries to put into our end of year reports that we needed to hand in and it had photographs of the Enviro Champs, it had all their information, cell phone number, name, GPS coordinates of the house or the manhole...</p>	<p>Int.11.01/29-33.</p>																												
<p>And what came out of that first kind of spreadsheet and report (it wasn't actually an excel spreadsheet) it was more just like a summary sheet with words on it.</p>	<p>Int.11.02/ 34,35.</p>																												

<p>What came out of that quite clearly was that it was basically the infrastructure that was a problem.</p>	<p>Int.11.02/ 35,36.</p>						x																						
<p>And so what came out of that study was, well first of all uMgungundlovu thought that it was what people were throwing down the toilet that was causing all the blockages because every time the plumbers did have a successful freeing of the system it was household waste that came out. Plastic, nappies, knives and forks and rags and panties and things that come out of households, but there were these ones that just absolutely couldn't be fixed. So they realised that the whole of Mpophomeni needed an upgrade</p>	<p>Int.11.02/39-44.</p>						x																						
<p>So he was sitting in a lot of the meetings and looking at what we were talking about and it became quite obvious to him and Ayanda that we needed to name each of the manholes.</p>	<p>Int.11.02/ 60-62.</p>						x																						
<p>And the plumbers got phoned by 3 people all about the same one, so we needed to streamline the system from a reporting point of view, but also we want to know exactly which manhole spills all the time and exactly which manhole is totally blocked and leaks underground all the time. Where is it? What is its GPS coordinates? And has it been fixed?</p>	<p>Int.11.02,03/66-70.</p>						x																						

<p>And, so if we can have this information over a number of months, we could eventually work out, for example how many manholes spill continuously, just never stop? What is the average time that it takes for the plumbers to come and fix the thing? Is it half a day, a day, 2 days? And, how long does it take them to fix it? And, how long after they fixed it does it start spilling again, because that number appears on our spreadsheet and then you can tell when it starts to spill again. And also looking at the whole map, which area is causing the most trouble? Is it S'the Nkomo's 6 manholes, or Mbali's 6 manholes? Where is the problem? And, also very importantly, there a column for writing down what comes out of the manhole, so you could say 90% of the time it's household waste, but 1% of the time it's builder's rubble, whereas at the moment maybe everybody's saying "ha, it's builder's rubble all the time", but there's no facts and figures to prove that.</p>	<p>Int.11.03/73-84.</p>																								
<p>So Mahomed came up with this thing called a pivot table, which can give us all these answers.</p>	<p>Int.11.03/83,84.</p>																								

<p>But you see the difference between an ordinary spreadsheet that adds up numbers across and down, the pivot table is that a pivot table you can put different things against different things and then you can 'turn' the answers. So you can say which manholes had household waste coming out of them mostly and it will go 'bshhbb' and it will pull out information. Or you could say "what was the average length of time that it took for the plumbers to get to the manholes?" and then it will go 'bshhb' or you can say ... which area has the most spillings or whatever.</p>	<p>Int.11.04/101-107.</p>	<p>[11 pink vertical bars]</p>	<p>[16 light green vertical bars]</p> <p style="text-align: right;">x</p>	<p>[grey background]</p>
<p>LT: But you see, I don't think Mahomed thought of that... Mahomed didn't think of that when he set this up, so he hasn't written it into its brain to do that, so it can't do it. LB: Because this is ... these then are the most powerful some of the most powerful bits of data that you want to highlight [referring to data of the manholes that spill on an ongoing basis], are the very hotspots that haven't been fixed.</p>	<p>Int.11.04/118-122.</p>	<p>[11 pink vertical bars]</p> <p style="text-align: right;">x</p>	<p>[16 light green vertical bars]</p>	<p>[grey background]</p>
<p>So BC3 is the absolute hotspot .</p>	<p>Int.11.04/123.</p>	<p>[11 pink vertical bars]</p> <p style="text-align: right;">x</p>	<p>[16 light green vertical bars]</p>	<p>[grey background]</p>

<p>AL: Before it was look like ... LT: You see like that, it didn't have any ... so that's 2012. May 2012 and then you can also see how many days, but here's one that was continuously spilling, from even from those times. AL: The manholes doesn't have names. LT: They haven't got names or GPS numbers or anything....</p>	<p>Int.11.04/128-132.</p>																												
<p>It's almost also important history that's lost, we want to know ... because we might want to comment on the sustainability of the project from the participants' point of view.</p>	<p>Int.11.05/136-138.</p>																												
<p>Dolly we stopped hers because she was only looking after one manhole and it never ever got fixed (LB: ja) so every month she would just report "it's broken, it's broken, well, it's leaking, it's leaking, it's leaking" for 2 years and she got paid R200 a month. So we took her off the list (LB: yes) but that would be important to have here. From 20 ... in fact November 2011 until now, nothing has happened, it stayed the same (LB: ja) so that's 3 years.</p>	<p>Int.11.05/146-150.</p>																												

<p>Dolly is the one down by the stream (LB: ok) where the road does a corner like that, and we often go and look over the edge and look into the stream (LB: ok). It's right down ... (LB: I remember now) the 'Ebumdeni' (AL: Ebumnandeni) ja, ja and we often say that's where the child that was sick used to live. LB: And so that's close to the uMthinizima stream? LT: Ja AL: Yes LT: Very close, very close.</p>	<p>Int.11.05/154-161.</p>																									
<p>Then I decided, let me do some tables and graphs cause most of people hate reading, they just prefer to see numbers and graphs.</p>	<p>Int.11.06/176,177.</p>	<p>x</p>																								
<p>...he would say "out of 10 manholes 7 were reported spilling but it could have been doubling up that this one and that one were reporting on the same one..."</p>	<p>Int.11.06/192,193.</p>																									
<p>...but they don't ever name it or say which one it was...</p>	<p>Int.11.06/197.</p>																									
<p>AL: Now it works very well, cause for example on the 26th of July a guy phoned me telling me there's a spillage somewhere and he give me direction of the spillage. LT: Just an ordinary community member.</p>	<p>Int.11.06,07/200-202.</p>																									

<p>A person who knows that I am an Enviro Champ, then he wanted me to report the manhole. Then I went to the map that Mahomed made us for, made it for us, then I noticed that the manhole belongs to S'the – it was SN1. Then I phoned S'the, let him know that his manhole is spilling he told me that he didn't know that it's happening then he phoned the plumbers. On the next day the person phoned me and appreciating that the manhole's been fixed.</p>	<p>Int.11.07/203-207.</p>																				
<p>LT: And the plumbers came and it was Sunday. They phoned them on Sunday morning, by Sunday afternoon 4 o'clock it was fixed.</p>	<p>Int.11.07/208,209.</p>																				
<p>Yes, but we are still have some challenges when we have to fill up the sheet like sometimes we find we have the map of the Mpophomeni manholes but not all of them (LT: yes!). Sometimes you find that the Enviro Champs reported the manhole that is not on the map.</p>	<p>Int.11.07/213-216.</p>																				
<p>Yes, cause I once on the 21st of June I went along the stream I was actually going to see the manholes of Bonisile BM4 and BM5 and I noticed that along the stream is a manhole which is near the one which I manage, that we didn't see it on the time we were doing the spreadsheet cause I saw it has been spilling recently cause there was (LT: grey patch) around it.</p>	<p>Int.11.07/221-224.</p>																				
<p>But then it should also be able to be pinned onto the map (LT: ja; AL: yes) because if it's just on the spreadsheet you can't continue monitoring it, it can't ... it's not available as a reference for the people on the ground.</p>	<p>Int.11.07/229-231.</p>																				

<p>you're now working with people in the community who are ...now working with maps and linking what they're seeing on the map to what they're seeing on the ground and filling in those forms.</p>	<p>Int.11.08/ 239-241.</p>																												
<p>Ja, I see there's a progress because most of the Enviro Champs now they know how to fill up the reporting sheet and they understand how to deal with the map, cause in most cases they know all the roads of Mpophomeni and they go around, ja.</p>	<p>Int.11.08/250 -252.</p>																												
<p>Yes, but when I was filling up the spreadsheet I noticed that most of the manholes that were fixed on the same day were the ones that have household waste problems. The one that has infrastructure took too long sometimes they do not got fixed, yes.</p>	<p>Int.11.08/266 -268.</p>																												
<p>I will say that just because a person is illiterate doesn't mean to say that they are worse at noticing what's going on so you might get a well-educated person that knows about tables and graphs but they just don't do their job properly or they're bored or they don't notice things.</p>	<p>Int.11.09/276 -278.</p>																												
<p>He went there and he took the pictures when the plumbers were fixing and he already, he even told me that the one of the plumbers came from Pietermaritzburg (LT: oh!) to help the Mpophomeni plumbers.</p>	<p>Int.11.09,10/ 301-303.</p>	<p>x</p>																											

<p>But I usually told them that when they said that something has happened, when they reported the manhole and when they came and see that it's been fixed, they can try phone the plumber that they phoned earlier and ask what happened, what was the problem, those things (LB: ja) how long does it took to fix.</p>	<p>Int.11.10/320-323.</p>	<p>x</p>																											
<p>... when the one is spilling, the plumbers will fix it and maybe a week later the other one will spill, so something like that has been occurring, but I think now it's for ... today it's ... I think it's 35 days both of them are not spilling and today I was talking with Lulama he said, he also noticed that.</p>	<p>Int.11.11/356-358.</p>																												
<p>...on this new reporting sheet it shows that it's two manholes not one. The one it gets fixed and when it gets fixed the neighbour of that one starts spilling.</p>	<p>Int.11.11/365-367.</p>																												
<p>....but now we've got real facts ...</p>	<p>Int.11.12/391.</p>																												
<p>Remember Kethi Luvuno's monitoring forms here</p>	<p>D.1.</p>																												
<p>[Title] The following short film has been put together by Grade 10 pupils from Mpophomeni Township in The KwaZulu-Natal region, South Africa. Mpophomeni.</p>	<p>D.2.01/1, 2.</p>	<p>x</p>		<p>x</p>			<p>x</p>																						

<p>[Words on the screen] “Walking to school with the smell of sewage thick in the air, stepping over puddles of raw sewage, it doesn’t put you in a good mindset. And the level of sanitation and hygiene in the schools is not good, there are always blocked toilets” Pens Malinga, Mpophomeni residents & Enviro Champs co-ordinator.</p>	D.2.01/4-7.																												
<p>[Words on the screen] The residents of Mpophomeni Township are facing a massive crisis. Schools in the Mpophomeni Township do not have the resources and services to maintain their toilet facilities... and as a result many are unknowingly contributing to a serious water-quality crisis that threatens the water supply of an entire province.</p>	D.2.01/7-10.																												
<p>[Words on the screen] We the students of Mpophomeni, want to educate our town about this serious crisis.</p>	D.2.01/12, 13.																												
<p>[Footage of waste water with solid waste in a wetland near a manhole]. Young student in school uniform standing on the manhole, talking and pointing in the direction of Midmar Dam.</p>	D.2.01/12, 13-15.			x		x																							
<p>Midmar Dam is 2 km away from this manhole.</p>	D.2.01/15					x						x																	
<p>Animals drink from this manhole and they eat this grass [footage of chickens walking in the wetland and a cow grazing near a polluted stream] and then they go back at home and people eat them. So that’s how people get germs because of this manhole.</p>	D.2.01/15-18.	x																											

<p>If this doesn't get clean it goes into Midmar and it affects the clean water in Midmar.</p>	<p>D.2.01/18 ,19.</p>						x																			
<p>It's because people put the wrong things in the toilet [footage of a used sanitary pad on the edge of the spilling manhole] like you see paper, socks and everything.[Photo of a group of young people on the edge of a spilling manhole with clipboards having a discussion with a person standing on an 'island' in the middle of the stream of waste water flowing from the manhole. Photo of a used condom lying in the grass. Photo of a learner standing next to a very polluted stream taking a photo]. Not the toilets the bins!!</p>	<p>D.2.01/20-25.</p>								x																	
<p>[Woman – resident of Mpophomeni – being interviewed, speaking in isiZulu.</p>	<p>D.2.01/26</p>	x		x																						
<p>Our babies get diseases from that leakage and also our animals that we live with, swim there and come back with cholera. Even us we are old we also get that sickness all the time. We also get blocked noses, rash and runny stomach.</p>	<p>D.2.01/26-29.</p>	x					x																			
<p>We would be happy if some people in high places, will come and solve our problem, because this place is disgusting. They always come but they don't do anything about the manhole. They don't come and fix this manhole. It's been 9 months now.</p>	<p>D.2.01,02/29-31.</p>																									

Name: Thandanani Luvuno.	D.3.01.				X			X												
Code: TL1	D.3.01.				X			X												
Coordinates: -29,56633/30,192396	D.3.01.											X								
TL5: -29,55971/30,18533	D.3.01.											X								

Groups	Present
Flat worms	No
Worms	Yes
Leeches	No
Crabs/Shimps	Yes
Stoneflies	No
Minnnow mayflies	No
Other mayflies	No
Damselflies	Yes
Dragonflies	No
Bugs/beetles	Yes
Caddisflies	No
True flies	No
Snails	No

Average score: 4.25
Very Poor

D.4.01,02.						X					X							X			X
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SITE INFORMATION TABLE			Date (dd/mm/yr):
River name:			Collectors name:
Site name:			School/organisation:
GPS co-ordinate Lat:	Long:	Comments/notes: e.g. weather, insects.	
Site description: e.g. downstream of industry Stream plants, level of flow etc			
pH: Water temp: Dissolved oxygen: Water clarity/turbidity: www.waterbugs.org <small>GPS co-ordinate in degrees, minutes, seconds (e.g. 36°32'31"N / 32°10'57"E) OR in decimal degrees (e.g. 36.54194°N/32.18217°E). If you don't have a GPS, register to upload your results at www.waterbugs.org. Find your site on the map, click to upload your result and it saves the co-ordinates for you!</small>			

Equipment list

- net
- white container / tray / ice-cream box
- pencil
- magnifying glass (optional)
- shoes/gumboots
- Hand wash / soap

[A]

How to make your own net

Take any piece of wire, for example an old clothes hanger, and bend it



[C]

D.5A.01																						
D.5A.01																						
D.5A.01	x																					
D.5A.01																						

For more information or to put your results on the miniSASS map
[visit the website www.minisass.org!](http://www.minisass.org)

History of the miniSASS tool

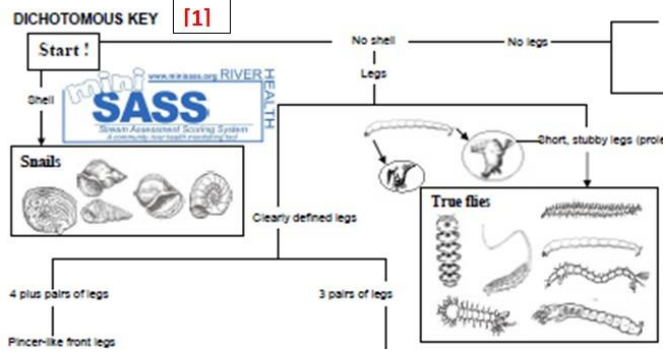
South Africa has been a world leader in biomonitoring techniques using macroinvertebrates. The most successful of these is the South African Scoring System version 5 (SASS5). miniSASS is based on SASS and also uses the presence of macroinvertebrates to indicate the "health of a river". Where SASS5 contains over 90 different macroinvertebrate classes, miniSASS only has 13 different classes, allowing for simpler identification and understanding. miniSASS has been found to provide similar indications of "river health" status as the more comprehensive SASS5 assessment, thereby providing a good means of generating useful biomonitoring data. The original miniSASS (version 1) was developed based on approximately 2000 SASS4 data records, whilst this updated miniSASS (version 2) is based on over 6000 SASS5 records. This makes miniSASS v2 more robust as a useful water quality monitoring tool & more widely applicable in Southern Africa.

hydration. However due to the amount of rainfall that South Africa receives, it is classified as a water stressed country. This means that if we do not monitor, manage and conserve our current water resources, we will be placing them and the population under tremendous stress in future!





D.5A.01																										
D.5B.01.																										
D.5B.01.																										

River safety: take special care in polluted waters. Beware of dangerous animals (crocs/hippos!) and fast flowing waters. Wear protective gear when necessary and wash your hands regularly with soap and clean water wherever possible!!

Upload your results to the miniSASS map on the website www.minisass.org to contribute to a developing picture of river quality in South Africa.
 (or send your results to results@minisass.org)
 For queries or comments email info@minisass.org
 miniSASS is also available from Share-Net
www.sharenet.org.za PO Box 394, Howick, 3290. Tel (033) 3303931



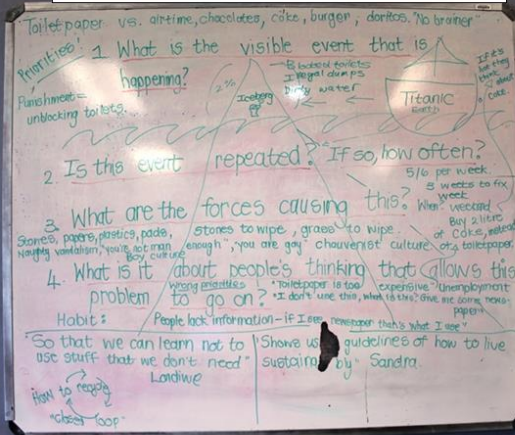
D5B.01.									X												
D5B.01.																			X		
D5C.01.										X											

<p>Stoneflies</p>  <p>The nymphs of adult stone flies usually have two long tails and three pairs of legs each having two claws at the tip. A characteristic feature of stonefly nymphs are the tufts of gills on the side of the body as well as gills between the two tails. Wing pads on the thorax are often dark and obvious. Some species run across the substrate very efficiently and are potent predators on other invertebrates. Other species are smaller and feed on plant material. Most live in well oxygenated, clean water.</p>	<p>Dragonflies</p>  <p>Dragonflies are robust creatures that are stout and have a large head and protruding eyes. Some have short legs whilst others have long legs. They do not have tails, but swim using 'jet propulsion' by forcefully ejecting water from the abdomen. Dragonfly nymphs are usually the largest organisms found in a sample and are the most powerful invertebrate predators in the water.</p>
<p>Caddisflies</p> 	<p>Bugs and Beetles</p> 

[1]

D.5D.01										x									
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1 March 2014 Iceberg Conversation with the PopCyd Enviro Friendly Club.



Event/s:
Blocked toilets, illegal dumps, dirty water.

Pattern/Trends:
5/6 toilets block/week. Takes 3 weeks to fix. Plumbers fix toilets over weekends.

Systemic Structures:
Male chauvinist culture
"you are gay if you don't vandalise the toilet", no toilet paper
learners use stones, grass etc.
Learners throw papers, plastic, pads down the toilet.

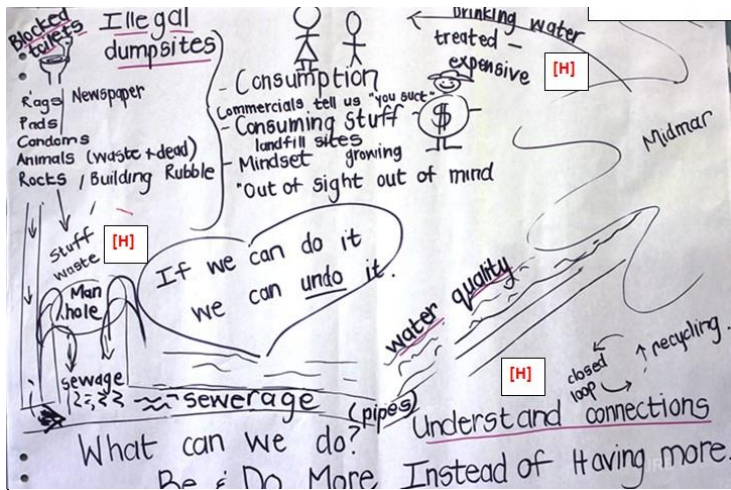
Mental models:
Wrong priorities: people choose airtime, coke, burger, doritos instead of paying for toilet paper.
Ignorance: Rural person "I don't use this, what is this? Give me newspaper".

D.6.01

X

X

X



D.7.01.

X

<p>How Damaged Sanitation Can Lead To Diseases (In Zulu & English) written and performed by Pop Cyd Enviro Friendly Group (Mpophomeni High’s Environmental Club).</p>	D.8.01/1,2	x		x																					
<p>Narrator: It is in the early morning and it hot. Zandile, Tezana and Zodwa they meet together on their way to school. They all attend at Phaphamani High School.</p>	D.8.01/3,4.			x																					
<p>We should do it not for us but for our environment.</p>	D.8.01/15								x																
<p>Our government want every school to be taught about sanitation. Now sanitation is what we call toilets, you know where we all take our waste to in fact not every waste but waste from our stomach.</p>	D.8.01/31-33.				x																				
<p>Annita: Okay you use the information at home, so we can decrease the high rate of blockage toilets And our infrastructure. So go home and tell your mothers, grandparents and uncles.</p>	D.8.02/35-36.																								
<p>Zandile: Grandmother you must not use the newspaper in the toilet. Grandmother: It a bad lucky for MaMlangeni, now you ordering me? I don’t have money for toilet Papers and newspapers are too strong (easily available). You full of English [you are telling me what to do now that you’re educated – full of English].</p>	D.8.02/48-51.	x		x					x																

<p>Zandile: Don't be angry grandmother. Newspapers causes manhole blockage. Grandmother: I understand my granddaughter. Please take that thing for me (toilet paper). [convinced now] Zandile: Yes grandmother. I am looking it [I'll get some]</p>	D.8.02/52-55.			x														x								
<p>Bongani: Your problem is that you the mamas baby too much. Sipho: You see now you taking me for granted (insult). Who is mamas baby? All boys: you Thami: Okay if you not mamas baby show us All boys: proof Bongani: put some stone here Sipho: That is waste, our own toilet come on be serious. Care for your environment. Sizwe: You just being a cheese boy. You don't know how real man lives Sipho: Okay I will show you Narrator (He did put the stones) Bongani: A real man does that</p>	D.8.02,03/60-70.	x		x																						
<p>Why does it matter of how we destroying nature .They don't know what they saying because nature it belong to all of us and it is our gift from God.</p>	D.8.03/96-98.																									
<p>Beny: Don't say that did you know that this things can causes diseases for an example Zinhle is sick because of the spillage manholes and dirty toilet.</p>	D.8.03/99,100.																									

Zandile : Yes so you can take care of other people and nature too.

D.8.04/11
0.

X

Narrator :(She realise that she the help from the mayor) on the following morning she woke up and organise to meet the mayor and the counsellor.

D.8.04/11
7,118.

X

D9A Pop Cgd Action Research Data poster (Youth Environmental Science Conference submission)

DESCRIPTION OF SITE 1
TAXI RANK 500 METRES FROM MTHINZIMA STREAM

GRADE A, B, C	TALLY	TOTAL
Plastic Bottles	15	15
Plastic Foodwraps	25	25
Cans		
Cardboard		
Drinking Straws		
Plastic Bottles	1	1
Chewing gum	2	2
Other	8	8
Fast Food Packaging	1	1
Cigarette butts	100	100
Match sticks	100	100
Broken Glass	2	2
Other	2	2

COMMENTS FROM THE NEAREST WETLAND:
CAN YOU SMELL THE POLLUTION?
Comments: We have done our litter survey and we have found that the rank is polluted, it's being used by everyone and there are food cafes, where they prepare and sell food. So we feel the rank is unhygienic.

DESCRIPTION OF SITE 2
400M FROM THE STREAM, MPOPHOMI CLINIC DRAIN

GRADE A, B, C	TALLY	TOTAL
Plastic Bottles	15	15
Plastic Foodwraps	25	25
Cans		
Cardboard		
Drinking Straws		
Plastic Bottles	1	1
Chewing gum	2	2
Other	8	8
Fast Food Packaging	1	1
Cigarette butts	100	100
Match sticks	100	100
Broken Glass	2	2
Other	2	2

COMMENTS FROM THE NEAREST WETLAND:
CAN YOU SMELL THE POLLUTION?
Comments: Patients that go to the clinic are affected by the terrible smell that comes from the drain.

DESCRIPTION OF SITE 3
13M FROM THE STREAM, MTHINZIMA STREAM BRIDGE

GRADE A, B, C	TALLY	TOTAL
Plastic Bottles	15	15
Plastic Foodwraps	25	25
Cans		
Cardboard		
Drinking Straws		
Plastic Bottles	1	1
Chewing gum	2	2
Other	8	8
Fast Food Packaging	1	1
Cigarette butts	100	100
Match sticks	100	100
Broken Glass	2	2
Other	2	2

COMMENTS FROM THE NEAREST WETLAND:
CAN YOU SMELL THE POLLUTION?
Comments: If Mthinzima is polluted, it carries all the dirt to the Midmar Dam. The dam supplies water to local municipalities.

Mpophomoni (Popcgd) Action Research DATA.

[1] Universally recognizable scientific language;
 [A] Multiple knowledge configurations
 [C] Diverse range of knowledge actors
 [F] Knowledge for a specific place.

D.9A.01.

X

X

X

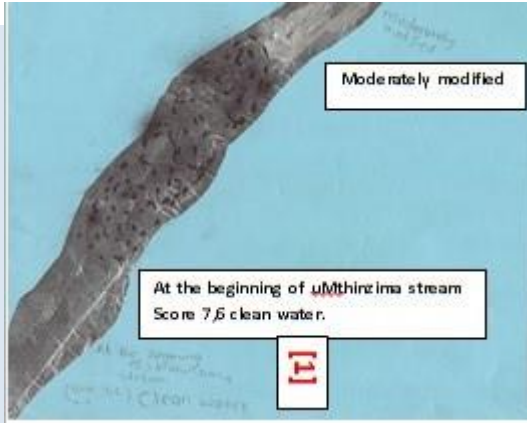
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D.9B.01.

X

D9B – Umthombo YESC poster [A]



D.9B.01.																												
D.9B.01.						x																						

<p>MPOPHOMENI DRAMA GROUP SCRIPT (POPCYD ENVIRONMENTAL GROUP) This play was written by the learners in the Pop Cyd Enviro Friendly Club, performed in front of the school and filmed for wider distribution</p>	D.11.01/1-3.	x																											
<p>My iname is Nqobile Dlamina.I am a learner at Mpophomeni High school. I am the member of Popcyd enviro group. We help each other and we take care of the environment. We do drama about toilet blockage to stop toilet blockage and what causes toilet blockage.</p>	D.11.01/14-16.						x																						
<p>Eish toilet is calling me. Aibo! What will I wipe myself with? My mother and father got paid yesterday but there is no toilet paper let me use a newspaper but toilet will block but I don't have a choice and I don't care. Let me use many father's newspaper. (Isolewze)</p>	D.11.01/27-29.							x																					
<p>Father:When I come back from work I want to find everything in a good manner.Do you hear me MaMlangeni? MaMlaneni:I am the one who suppose to clean father?I don't understand Father:Why did I marry you? Mamlangeni:Father you married me to be your wife not toilet cleaner. Father:It your things that put the newspapers in the toilet.Who put my newspaper here(pointing the toilet)? MaMlangeni:Let go my children you father is now angry.(They all walk away from their father)[</p>	D.11.03/61-68.	x																											

<p>Father: Shut up you rude now. MaMlangeni look me in the eyes and listen carefull when I come back I want to find everything clean. Do we understand each other? MaMlangeni: Yes father</p>	<p>D.11.03/78-80.</p>	<p>x</p>																			
<p>Learner3: I have the plan and I have lot of plans actual I have a dictionary of plans. Let destroy the toilet. Learner4: That is a problem where we will release ourselves? Learner3: Go and get some stones and we make this gay vandalize the toilet. Learner4: I can't do that Learner3: I know you can my brother. You my boss go and get stones. Learner1: What are you doing with me? Learner3: Take these bricks and put them in the toilet and you better be fast. Do it fast time is not in our side. I will beat you if you keep wasting my time</p>	<p>D.11.04/102-109.</p>	<p>x</p>																			
<p>Leaner6: Sir when is last time you visited boy's toilet? Pcincepal: I don't remember my child but it when I was new in this school. Leaner6: Sir where do you release yourself? Pcincepal: At the teacher's toilet. Leaner6: Sir that should end because it 50/50 if that doesn't work will use teacher's toilet. Pcincepal: That is true my child when it comes to a toilet we all equal</p>	<p>D.11.06/142-147.</p>									<p>x</p>											

Sne: They call it natural filter because it holds polluted water and passes clean water.	D.11.08/1 98.	x																								
All:Together we can do more.	D.11.08/2 07.					x																				
Transcription of miniSASS observation 22 June 2014 (The following groups did presentations after conducting a miniSASS in the uMngeni river. During the presentations they referred to a poster with a summary of their findings that they produced in their groups).	OBS.1.01/1-4.	x																								
Group member 1: ... findings during our miniSASS. We first started with the rocky type [habitat] we found shrimps, Minnow Mayflies, other Mayflies, Damselflies, bugs and beetles and True Flies. Our comment was because there's a lot of oxygen and the water is flowing very fast, it causes bubbles and in those bubbles oxygen is produced. Our total score was 35 and number of groups was 7 and our average score was 5 and the ecological category was critically modified.	OBS.1.01/6-10.										x															
Group member 3: In the edge type [habitat] we get shrimps and worms, also the red worms and the red worms also provide their own oxygen. Like the water doesn't move. They provide their own oxygen, they produce their own oxygen (another group member assists with prompts) they are adapted to live in low-oxygen conditions.	OBS.1.01/14-17.										x															

<p>Group member 4: We in the orange team wanted to know what is the problem. The first problem that we identified was sewage problem, as we were walking by we saw the sewage problem over there.</p>	<p>OBS.1.01/ 18-20.</p>						x																						
<p>Group member 4: I should say the reason that we didn't put it under human impact is because the sewage over there, we cannot say it was caused by humans, you know but we can say that the sewage problems can be solved by humans. It's why we didn't want to put it under human impact. LB: Really? If I had to ask you, how can you say that? What is it then caused by? If it's not caused by humans what is causing the sewage problem? Group member 4: Ok, maybe the pipes are too small so the sewage obviously is going to leak. LB: AAh, so it's the pipes not the people? Group member 4: Yes, we think so</p>	<p>OBS.1.02/50-57.</p>																				x								

<p>Audience member: I think what we should do, we should actually think of what people like Moses, Thandanani, Ayanda what are they doing? They actually deal with these problems so it's actually the municipality problem which is a very big challenge to us. So it's actually our job to actually like go to the people who, because this is actually human impact because it's from the municipality, it's the people who do those things and it's actually also their job to actually look at those things and fix those pipes. So you guys as the Enviro Club and Enviro Champs it's actually your job to go to those people. It's a human impact</p>	<p>OBS.1.03/64-70.</p>																												
<p>Group member 2: The total score was 47 and the number of groups were 9 and we divided and then the average score was 5.2 which means it's largely modified and in a poor condition.</p>	<p>OBS.1.03/ 82,83.</p>																												

Group member 1: We are the third group. So we made our findings approximately about 350 metres from the pump station. So we started off at the rocky type in which we found Flatworms, Shrimps, Dragonflies. Well, we found two types of Dragonflies. We first found one with a round body shape that was black in colour and then we found Bugs and Beetles and other Mayflies. Well we also found a Dragon nymph at the sandy type and also crabs. Well at the sandy type we had two places which contained sandy and vegetation places so our scores went like this and then we found 8 groups of animals for which we got the score of 49 and we divided it by 8 and we got 61.25 and that resulted in a fair condition which was moderately modified.

OBS.1.04/106-113.

x

x

We also found that it was shrimp season because all of a sudden you could find them which was a little bit confusing because we found mostly shrimp near the vegetation places so we thought that maybe it could be a breeding season for them or something which maybe could be open for discussion with the audience. Audience member: Most of them are green though.
LB: So what does that mean?
Audience member: There's probably a high amount of algae for them to live here so that's why there's so many.
LB: And where does algae come from?
Audience member: What do you mean?
LB: Why would there be algae? Is algae associated with a certain condition of a stream?
Audience member: Ja it can be if there's a high nutrient level then the algae grows quickly.
LB: And why would there be a high nutrient level?
Group leader: Because of the sewerage from the pump station there

OBS.1.05,05/115-118;122-131.

x

<p>LB: It's an ecological term that is used and I used it earlier to actually guide you about what you must go and do. The reason why I'm asking you not to use the word type is because on the miniSASS sheet it specifies "sandy type river", "rocky type river" and it guides you as to how you must interpret the score, but if you use the word "type" in, to describe the places where you found the insects, it's a bit problematic and confusing. "Habitat" is a better word to use, so when you're talking about finding insects in different "places" or "types of places" use the word "habitat". We found insects in the "sandy habitat" (echoed in the background by group member 1), in the "reeds habitat", in the open deep water habitat" and where the water flows fast over the rocks – the rapids, that "habitat"</p>	OBS.1.06/151-158.																									
<p>Group 1: Hlonipho Zondo [actor/enviro champ], Sthe Nkomo [enviro champ] , Zongile Ngubane [enviro champ], Mbali Sithole [enviro club learner], Sandra Ndlovu [enviro club learner]. Group 2: Ayanda Lipheyana [enviro champ], Fresh Ngubo [actor/enviro champ], Mandisa Shelembe [enviro club learner]</p>	OBS.2.01/4-7.																									
<p>Lindo explaining the Iceberg Conversation: The Iceberg Conversation relates to the story around the pollution that's been happening; the events that have led to the pollution so that you can try and solve the problem - basically a way of explaining the problem.</p>	OBS.2.01/5-8.																									

<p>[Photo 2]This is Midmar Dam shown by the arrow where there was a sewage leakage affecting the dam water causing water pollution, leaving an effect on the animals of the dam, which also causes air pollution as the sewerage pipe smells .Mpophomeni has some illegal dumping as shown in the image. As there is dumping throughout the township. The people of the area are forcing material down the pipe causing it to have a leakage. There has to be an explanation of this situation with everything that is happening here.</p>	<p>OBS.2.01/18-23.</p>																												
<p>Something needs to be done to help this situation.</p>	<p>OBS.2.01/ 23,24.</p>																												

<p>If you imagine the “event” is the uMtunzima stream being full of litter you can know that this has been happening for a long period of time. Why is this happening? There has been no recycling depot in the area for example in Mpophomeni. There is no bio bag system; there is no land fill site for building rubble and service delivery is not adequate. Where we see the municipality is not able to pick up the rubbish every week as they promise. Then what in our thinking is causing this problem? We think that rivers wash waste away, we think that if the water comes it will take the waste away from our lives. We usually think that bread bags are waste but as the enviro clubs have learnt, bread bags can be made into skipping ropes, these bags can be used to make ropes for hanging gardens. Bread bags can be woven into carpets for your bathrooms; they don’t have to be “waste” if you think about it, think about bread bags differently. You won’t have to throw them away in the river</p>	OBS.2.02/37-46.																									
<p>How many times the solid waste truck comes around Howick? [Answer] One truck alternates between wards the whole week. That is a problem because how can people be encouraged to minimize solid waste dumping when there is only one truck?</p>	OBS.2.03/74-76.																									

<p>A potential solution: plumbers need to install bigger pipes and secondly Enviro-champs must monitor who is dumping into manholes so that they can report that particular person. This is because a person dumping into a manhole needs to be asked immediately the underlying reasons for their dumping. This is the only way to solve this problem and understanding what people are thinking.</p>	<p>OBS.2.03/76-80.</p>															<p>x</p>			
<p>Also that there should be volunteer people raising awareness about this in areas like Mpophomeni also collecting the viewpoints of ordinary citizens about this like illegal dumping and burning.</p>	<p>OBS.2.03/82-84.</p>	<p>x</p>																	

<p>However we can also help rude people understand by informing them of all the consequences of their actions. For example tell them if they dump waste into the manhole/ river this water will end up in the dam which is a primary source of drinking water. Explain that, a person may say there is no water crisis because there is water coming out of their tap, but we need to help them understand that the costs involved in treating that water is high. Furthermore you can also relate it to the fish that they eat which can come from the dam. If the dam is polluted, fish species may diminish which will affect food security. Even when you go to town what are you going to buy there if the supply is negatively affected. The revenue is also negatively affected due to costs of water purification. People need to be taught step by step about the water crisis because as long as they have water coming from the tap they will not be aware of the water crisis</p>	OBS.2.03,04/97-106.																						
<p>The potential solution is to buy bigger pipes, report people who dump in the manhole and educate them on what they must flush or put down their toilets.</p>	OBS.2.04/123,124.																						
<p>The solutions were that the municipality garbage collectors must come more than once a week and Enviro Champs must teach the people how to reuse, reduce, recycle in order to decrease this problem.</p>	OBS.2.04/126-128.																						

The solutions are that the municipality workers must check if the water is clean before it is released to the river.	OBS.2.04/ 129-130.																												
Another solution is that a young people should write articles about this, reporting to the local newspaper on the progress made by the people on this issue.	05/132- 134.					x																							
I will talk about Photo number 1: We were investigating the water quality status but I found that the quality was poor because the rubber inside the clarity tube was not visible for a long time.	OBS.2.05/ 138,139.	x																											
The algae in the water is the example of eutrophication in the initial stages as this is a small body of water as more nutrients come into the water as a result of sewage poo, which brings more nutrients in the water which feeds the plants in the water increasing their growth and start covering that area and they take a lot of oxygen out of the water so insects that need oxygen cannot survive here. The water can also become toxic so it is dangerous for cattle and humans to consume that water. The water has to go through a lot of treatment before it can be consumed properly for example the Hartbeespoort Dam as talked about this morning is covered with green slime and also areas of Midmar Dam also have this slime as seen in many aerial photographs.	OBS.2.05/147-155.					x				x		x													x				
Photo 20 where we saw the process of eutrophication changing the eco system.	OBS.2.06/ 180.									x			x																

Photo 3 the solution we need is education for the people about this whole situation.	OBS.2.06/184.																								
Photo 22 we see activists struggling for a clean Mpophomeni with people like Baba Cele. Baba Cele is sharing about the illegal dumping in his street and the ongoing spilling of the manholes in front of his house for over a year now. We all went there and saw and smelled what was happening. This is very important for us to really understand the problem.	OBS.2.06/189-192.	x				x																			
And also all of this is due to lack of education to the people and a lack of intolerance about this. We do education in the community to bring people to the awareness that “this will affect me” and that one cannot remain apathetic about this issue.	OBS.2.06/194-196.						x																		
Through education we ‘combat ignorance’. We do miniSASS regularly and should continue doing so. People (in Mpophomeni) doing research asking “why?” is very important. We are all researchers and community science is the best transformation.	OBS.2.06/197-199.		x		x																				
Photo 13 was a process of plumbers cleaning a blocked sewage coming out with various objects like papers, condoms etc. They don’t have an easy job. It’s smelly and hard work and they are very committed to helping when they are called.	OBS.2.07/200-203.																								
Photo 10 is of Baba Cele who expresses his concerns and gets listened to by the counsellors and a solution is, to improve service delivery.	OBS.2.07/203,204.			x																					

<p>Greetings from the group which is called “Together we can do More”.</p>	<p>OBS.2.07/ 217,218.</p>																									
<p>Speaking of polluted rivers or waters I grew up in rural areas, we used to go to the rivers and we would call that algae “ingubo yamasele” the blanket for the frogs. When you tell people that the water is polluted from the algae caused by nutrients people will tell you that algae is the habitat for the frogs, so I get confused but I understood it the way you explained it to me and even in the scientific way but it is still not easy to tell people about the cause of algae. The reason why I say this is that you find eggs of frogs in the algae confusing the people resulting in them calling it the habitat of frogs.</p>	<p>OBS.2.08/239-245.</p>	<p>x</p>																								
<p>[Sanele Ngubane, UKZN MSc Hydrology student] There is a difference between algae and ‘bio-films’ but we won’t get in to that which will confuse you a lot. There is some green stuff which is not algae but ‘bio-films’ “ingubo yamasele “and this is usually attached to plants or rocks in streams and algae is on the surface and usually floats.</p>	<p>OBS.2.08/239-245.</p>	<p>x</p>	<p>x</p>			<p>x</p>																				
<p>[Sanele Ngubane] Great, but it is the amount of algae that’s important. If you walk down the stream and see that it is clear but you see algae on the edges of the stream with green patches growing in the river but most of it is clear you can see the bottom, smell the water and do a mini sass and assume this is a healthy stream. But if you walk down there and see green everywhere, that is not natural, something else is happening to the stream.</p>	<p>OBS.2.08/252-256.</p>			<p>x</p>		<p>x</p>																				

<p>We should educate people through community dialogues, debating on different issues but before debating on these issues you can't do anything without research.</p>	<p>OBS.2.08/ 264-266.</p>																												
<p>Liz was here she told us about War Rooms where counsellors from different wards have discussions on different topics also we suggest that in each and every ward there should be an environmental ambassador who will tell the people about different issues.</p>	<p>OBS.2.08,09/ 266-268.</p>	<p>x</p>																											
<p>The third dream is to see the number of spilling manholes and dumping decrease this could be achieved through communication with the municipality to erect a building waste material depot in Mpophomeni and also that the municipality provide the residents with some toilet paper which will decrease the overflowing manholes as many use newspapers and at many more towards the schools as the manholes near them are the most often blocked.</p>	<p>OBS.2.10/322-327.</p>																					<p>x</p>							
<p>The issue of dumping can be decreased by municipality providing refuse bags as before as this is our main dream.</p>	<p>OBS.2.10/ 327,328.</p>																					<p>x</p>							

<p>Also want to comment on the issue of toilet paper as girls tend to carry toilet paper a lot but no boys. So I ask of teachings to the gents of the importance of carrying toilet paper. I think we spoke about it when I spoke to one group about toilet paper as it was the main factor in this issue. We thought that most household have breadwinners who also heavily rely on the social grants so they don't have the money for toilet paper so this will have impact on the child not carrying toilet paper to school.</p>	OBS.2.10/328-333.																												
<p>Also members must try and stop corruption in these schools because money may be allocated for toilet paper but it might end on the staff's pockets.</p>	OBS.2.11/342,343.																												
<p>[Sesethu] Thandanani also mentioned local businesses; I suggest that these businesses should be buying machinery to produce these tissues in this area which will employ the local residents. We heard on the I radio that there a few co-operatives available knowing that if we do this idea there will be enough toilet paper for a long time .</p>	OBS.2.11/347-350.																												
<p>MiniSASS waterquality monitoring fieldtrip to the uMngeni river in the centre of Howick, 2 August 2014, with learners from the Injoloba Eco Wonders Environmental Club and learners from the Pietermaritzburg Refugees Environmental Club.</p>	OBS.3.01/1-4.																												

<p>NC: Ja, then you have this sheet we're gonna use for our miniSASS. Here at the back we're gonna read this information first. We do the miniSASS. When we are done with the miniSASS then we score the invertebrates that we found. We count the total score and the number of groups that we found and the average score which will be our, our... that score will be our river category which may be largely modified or seriously, critically modified.</p>	OBS.03.38-42.																												
<p>(Reading) "MiniSASS can be used to monitor the health of a river and measure the general quality of water in that river. It uses the composition of macroinvertebrates, the small animals that we find there in the stream ... living in the river based on the sensitivity of various animals to water quality" (slight deviation from the original text). To me that sounds very complicated, but in my own understanding, I know that when you do a miniSASS you go there and you look for the small animals that are found in the water. Each animal is sensitive to a different amount of pollution, so those ones which we'll find there, probably they are tolerant to pollution. Mostly a good indicator of clean water is a Stonefly, but I doubt if we'll find any there.</p>	OBS.3.02/43-50.	x																											x
<p>So let's just say maybe you happen to get a score which is 4 or 10, that doesn't tell you whether the water is safe to drink or not, but it actually tells you how polluted or how clean the water is, the river, that particular river is.</p>	OBS.3.02/ 60-62.																												x

<p>Ok, so what we do here, we just look for these stuff here, we just scoop out the invertebrates and then we pour the water and the stuff in here (pointing to the white tray) and then we identify them using this (pointing to the dichotomous key on the centre fold of the miniSASS sheet). This is what we use to identify as uNduh explained, we start here, here it says here what you do, you just look at these from start. Shell, has it got a shell? If it has got a shell then you go down and then it's ok it says here "no shell" then you go there. Has it got legs "yes" then you go down, so this is what we use to identify and then once we find these you see here there's a worm, flat worms, leeches and all. Let's say maybe we get 5 different invertebrates here, so what we do if we found worms we tick number 3, if we found bugs and beetles we tick here and then we found a true fly we tick here. That's 3 right?</p>	OBS.3.03/81-90.																										
<p>Group: So rocky type ... it's around here... so it is less than 5. ... so it is (2 group members reading together) "seriously, critically modified" that's in a very poor condition. Ja, hey (whistling), let's move away! So now it's dangerous to drink. AL: Very, very, very dangerous Group member: Very dangerous</p>	OBS.3.04/101-105.																										
<p>The people that took time to go deep into, you know, understanding the environment, because by using this score sheet it is just easy, you pick it up and it's on the sheet.</p>	OBS.3.05/ 118-120.																										

<p>.... When water is still, moving slowly there's no oxygen, so those red worms they can make their own oxygen, they perform anaerobic respiration</p>	<p>OBS.3.05/ 132, 133.</p>																									
<p>Group member: So that means in doing this exercise of identifying you need to be very careful. AL: Yes, you need to be very, very careful. Group member: All of us would say, ja it's this one, it's this one Group member: Hai, it wasn't a stonefly, no, no, no ... Group member: How did you know? Group member: The feathers, the gills... AL: Ja, the Stonefly does not have the gills. Group member: Ja Group member: Ok. AL: So ja, and the other Mayflies have the gills. Group member: Ja, that's how you should recognize it. AL: It has hairs on the abdomen. Group member: It's a little bit bigger</p>	<p>OBS.3.06/143-155.</p>																									
<p>Total x's</p>																										<p>225</p>