Environmental education's influence on awareness and perception of air quality in Grade 5 learners and their parents/guardians

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DECLARATION

I, ALBERTHA BEZUIDENHOUT, DECLARE THAT “ENVIRONMENTAL EDUCATION’S INFLUENCE ON AWARENESS AND PERCEPTION OF AIR QUALITY IN GRADE 5 LEARNERS AND THEIR PARENTS/GUARDIANS” IS ORIGINAL AND MY OWN WORK. IT HAS NEVER, ON ANY PREVIOUS OCCASION, BEEN PRESENTED IN PART OR WHOLE TO ANY INSTITUTION OR BOARD FOR THE AWARD OF ANY DEGREE.

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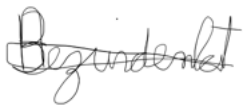

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"Education is the most powerful weapon which you can use to change the world." – Nelson Mandela

*John 1:16: "*From his fullness, we have all received, grace upon grace."

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ABSTRACT

Education is an essential right. Education aims to form open-minded citizen scientists that will focus on real-world issues. Environmental education offers learners the opportunity to gain familiarity with sustainability initiatives by identifying ecological issues, acquiring skills, and influencing attitudes and commitment that can be used to sustain the environment through critical and creative thinking, and problem-solving. By integrating environmental education into education, individuals as well as communities may change their attitudes and behaviour regarding their surrounding environment as their perceptions and awareness change. One of the greatest environmental issues that we face today and that needs more focus within the South African curriculum is air quality. Air pollutants do not only contribute to the degradation of the environment but are also known to cause acute and chronic health impacts in exposed populations. It is estimated that air pollution costs the global economy around 3.5 trillion dollars per year more than the combined GDP of all but five countries in the world. The health effects of air pollution have been studied extensively in recent years, and strong evidence exists to link fine particulate matter (PM2.5) with various health effects. The National Ambient Air Quality Standards (NAAQS) and World Health Organization air quality standards were implemented to protect human health but are frequently exceeded. Due to the pressing need for socioeconomic growth, environmental concerns are often not a top priority.

The purpose of this study is to address whether integrating environmental education in the subject of geography, with a specific focus on air quality, can influence the awareness and perception of environmental issues in a peri-urban settlement among Grade 5 learners and their parents/guardians. For the purpose of this study, a single case study was undertaken within the community. This single case study design used one primary school in a pre-experimental design, pre-test and post-test represented the 87 Grade 5 learners and their 76 parents/guardians. A multimethod approach was used for data collecting to identify the context of air quality within the peri-urban settlement, and qualitative data were used to establish the influence that environmental education can have on the awareness and perception of the participants. The data were gathered using pre-and-post-questionnaires and photovoice narratives that were analysed thematically.

The findings of the study suggest that environmental education within the Grade 5 curriculum was able to influence the awareness and perceptions of the Grade 5 learners and their parents/guardians regarding air quality and other environmental issues in their community. The findings also revealed that the participants who took part in the research study gained new

knowledge of air quality as a real-world environmental issue that affects their community as their perception of air quality evolved.

The insights gained from this study will assist future studies regarding how the awareness and perceptions of learners and their parents/guardians can be influenced by environmental education. This influence will enable people to identify the environmental issues within their communities and search for ways to address these issues and reduce the dangers of these issues. Consequently, this influence will aim to improve environmental education about environmental issues like air quality, and the effects these issues have on the inhabitants of a community.

Keywords: Environmental education, air quality, peri-urban settlement, awareness, geography education, perceptions, parents/guardians, learners

OPSOMMING

Onderwys is 'n noodsaaklike reg. Onderwys poog om oopkop wetenskaplike burgers te vorm wat op werklike kwessies in die wêreld sal fokus. Omgewingsopvoeding bied aan leerders die geleentheid om vertroud te raak deur omgewingskwessies te identifiseer, vaardighede aan te leer en houdings en toewyding te beïnvloed wat gebruik kan word om die omgewing te onderhou deur kritiese en kreatiewe denke, asook probleemoplossing. Deur omgewingsopvoeding in onderwys te integreer, kan individue sowel as gemeenskappe hul houdings en gedrag rakende hul omliggende omgewing verander, namate hul persepsies en bewustheid verander. Een van die grootste omgewingskwessies waarmee ons vandag te kampe het en wat meer fokus binne die Suid-Afrikaanse kurrikulum verg, is luggehalte. Lugbesoedeling dra nie net by tot die agteruitgang van die omgewing nie, maar dit is ook bekend dat dit akute en chroniese gesondheidsimpakte in blootgestelde bevolkings veroorsaak. Daar word beraam dat lugbesoedeling die wêreldekonomie sowat 3,5 triljoen dollar per jaar meer kos as die gesamentlike BBP van almal, behalwe vyf lande ter wêreld. Die gesondheidseffekte van lugbesoedeling is die afgelope jare omvattend bestudeer, en sterk bewyse bestaan om fyn deeltjies (PM2.5) met verskeie gesondheidseffekte te verbind. Die National Ambient Air Quality Standards (NAAQS) en Wêreldgesondheidsorganisasie se luggehalte standaarde is geïmplementeer om menslike gesondheid te beskerm, maar word gereeld oorskry. As gevolg van die dringende behoefte aan sosio-ekonomiese groei, is bekommernisse oor die omgewings dikwels nie 'n top prioriteit nie.

Die doel van hierdie studie is om aan te spreek of die integrasie van omgewingsopvoeding in die vak geografie, met 'n spesifieke fokus op luggehalte, die bewustheid en persepsie van omgewingskwessies in 'n buitestedelike nedersetting onder graad 5-leerders en hul ouers/voogde, kan beïnvloed. Vir die doel van hierdie studie is 'n enkele gevallestudie binne die gemeenskap onderneem. Hierdie enkel gevallestudie-ontwerp wat een laerskool gebruik in 'n pre-eksperimentele ontwerp van die een groep voortoets–natoets, verteenwoordig die 87 graad 5-leerders en hul 76 ouers/voogde wat aan hierdie studie deelgeneem het. ’n Multimetode-benadering is gebruik vir data-insameling om die konteks van luggehalte binne die buitestedelike nedersetting te identifiseer, en kwalitatiewe data is gebruik om die invloed wat omgewingsopvoeding op die bewustheid en persepsie van die deelnemers kan hê, vas te stel. Die data is ingesamel met behulp van voor- en na-vraelyste en fotostem-vertellings wat tematies ontleed is.

Die bevindinge van die studie dui daarop dat omgewingsopvoeding binne die graad 5-kurrikulum die bewustheid en persepsies van die graad 5-leerders en hul ouers/voogde ten opsigte van omgewingskwessies in hul gemeenskap kon beïnvloed. Die bevindinge toon ook dat die deelnemers wat aan die navorsingstudie deelgeneem het, nuwe kennis opgedoen het van luggehalte as 'n werklike omgewingskwessie wat hul gemeenskap raak namate hul persepsie van luggehalte ontwikkel het.

Die insigte wat uit hierdie studie verkry word, sal toekomstige studies help oor hoe die bewustheid en persepsies van leerders en hul ouers/voogde deur omgewingsopvoeding beïnvloed kan word. Dit sal mense in staat stel om die omgewingskwessies binne hul gemeenskappe te identifiseer en na maniere te soek om hierdie kwessies te verbeter en die gevare van hierdie kwessies te verminder. Gevolglik sal dit daarop gemik wees om omgewingsopvoeding oor omgewingskwessies soos luggehalte en die invloede wat hierdie kwessies op die inwoners van 'n gemeenskap het, te verbeter.

Sleutelwoorde: omgewingsopvoeding, luggehalte, buitestedelike nedersettings, bewusmaking, geografie-onderrig, persepsies, ouers/voogde, graad 5-leerders

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INTRODUCTION AND ORIENTATION TO THE STUDY

1.1 INTRODUCTION

This study researches environmental education's influence on the awareness and perception of air quality of Grade 5 learners and their parents/guardians. The research study aims to establish how environmental education can influence the awareness and perceptions of air quality of Grade 5 learners and their parents/guardians in a peri-urban settlement.

This chapter begins by presenting the background and the rationale of the research study. The research questions, the aim, and the objectives of this research study are followed by the clarification of concepts. Thereafter, the research methodology, methods of data collection and generation are shared, as well as the data analysis. The chapter ends with an outline of the ethical considerations, quality criteria, a chapter outline, and a conclusion.

1.2 BACKGROUND AND RATIONALE FOR THE STUDY

Internationally, education is an essential right. With the correct partners, leaders, and stakeholders within education, the lives of individuals, economies, and our world can be changed (UNESCO *et al*., 2014:16). One of the important aims of the South African education system is to produce learners who are problem solvers and decision-makers who use critical and creative thinking (DBE, 2011:5:5) to become world leaders who focus on real-world issues that we face. These aims within the South African education system to form open-minded citizens will be mastered by identifying and solving real-world issues and by making choices through critical and creative thinking (DBE, 2011:5:5). The curriculum serves as a support framework that is compulsory for all teachers in South Africa to make use of when planning their teaching and learning. The curriculum guides teachers regarding what content needs to be taught in terms of guidance and a framework within the subject that is being taught and when it must be taught. Each subject has its Curriculum and Assessment Policy Statement document containing general curriculum aims and subject-specific aims. One subject that directly addresses the real-world issues that we face, is Geography (DBE, 2011:8, 12).

In the Intermediate Phase, Grade 5 Geography forms part of Social Sciences and is taught separately from its Social Science History component. In Geography, the human and the physical

environment over space and time are studied (DBE, 2011:8, 12). According to Brown (2001), learners that have Geography as a subject in school are some of the most employable people we have. In the Intermediate Phase, Geography has nine aims. Two of those aims have direct contact with environmental education. The first aim refers to creating awareness and sensitivity for inequality in the world and making and justifying informed decisions and judgments about real-world social and environmental issues. The second aim refers to promoting in learners the values of concern for sustainable and fair use of resources for the benefit of all and recognizing the significance of informed decision-making. More importantly, the South African National Curriculum Statement Grades R-12 is based on the principles and practices of social and environmental justice as defined in the Constitution of the Republic of South Africa (DBE, 2011:5, 9). It is the latter principle statement that ensures an environmental focus in all school subjects through environmental education.

Environmental education focuses on the development of a clear awareness and concern about environmental issues. Environmental education offers learners the opportunity to gain familiarity with real-world environmental issues, especially in their surrounding environment, where they learn skills, principles, attitudes, and commitment that can be used to conserve the environment. By integrating environmental education into formal education, individuals as well as communities may change their attitudes and behaviour toward the environment (UNESCO, 2010). The aims and objectives of environmental education are to increase community awareness about the environmental issues that the community is facing and discover possible solutions in addition to creating the basics for a completely educated and active citizen regarding their environment (UNESCO-UNEP, 1978:32). There are five key objectives to environmental education (UNESCO-UNEP, 1978: 24-29; EPA, 2017), namely: awareness and sensitivity, knowledge and understanding, attitudes, skills, and participation. Practicing environmental education should be a lifetime commitment to processes that can take place in multiple settings. For example, home-based education and environmental center-based settings (Ertürk Kara et al., 2015:46).

Each day, the human-environment interaction impacts the earth we live on. According to the United States, Environmental Protection Agency (2017), environmental education is much more than gaining information about the surrounding environment of a community, it creates community awareness and knowledge regarding real-world environmental issues in that community. Environmental education contributes to the development and encouragement of critical thinking, problem-solving, and decision-making skills, that learners can use when facing environmental issues. This is of great importance when studying local environmental issues within the curriculum since learners' thought patterns, attitudes and behaviour are being shaped using related school activities that the teacher decides to complete (Calderhead, 1996:92). There are various support

systems for education but in the case of environmental education there is one tool that can be used that was designed for interaction between the teachers, learners, environment, and the community and this tool is better known as the Global Learning and Observations to Benefit the Environment (GLOBE) program. The GLOBE program was initiated in 1994 by the United States Government and launched on Earth Day in 1995. On the day that the program was launched, 33 counties joined the program and 11 protocols started within the program. The GLOBE program is an international pro-active, primary as well as secondary school-centred discipline in addition to an education program with a focus on the environment and environmental education (GLOBE, 2017). For this reason, the GLOBE program should be a well-fitted program to support awareness creation about air pollution and air quality in school subjects, like Geography.

Unlike air pollution, air quality is not a specific topic that is dealt with when teachers teach about air pollution in the Grade 5 Geography curriculum. As a result, learners and communities may fail to understand air quality and the true effect of air pollution. If the issue is not addressed and if learners are not made more aware of air pollution and air quality, and if learners are not taught to become concerned citizens, communities will be faced with many challenges in improving air quality (Percival, 2017:15). Making a national change and placing more focus on air quality and creating awareness within the National Curriculum and Assessment Policy Statement may improve air quality (DBE, 2011; Stilgoe, 2009:23). Improving the air quality levels can have a great impact on the health and economy of communities if the awareness level should increase through education. Many South Africans live in peri-urban settlements that are heavily populated (Scorgie *et al.*, 2004:10). The latter residents are exposed to very high concentration amounts of ambient and indoor air pollution. One of the leading problems that we have is solid fuel burning within low-income settlements (StatsSA, 2014). The reason for the burning of fuel in many low-income households is that households are not able to afford electricity, and so, as a source of energy and heat people depend on a variety of available fuels to burn (StatsSA, 2014).

Air pollution is the pollution of indoor or outdoor air this air is polluted by gasses and solids that modify the natural characteristics of that air (WHO, 2019, p.1). Air pollutants can be defined as harmful substances that are present in the atmosphere in amounts that might be harmful (Wang *et al*., 2015:1843). Air pollutants do not only contribute to the degradation of the environment but are also known to cause acute and chronic health impacts in exposed populations (The World Bank, 2016:275). This is one of the leading global health risk factors in the age we live in today. The World Health Organization (WHO) has air quality standards that have been designed specifically to protect human health. Despite these WHO standards, the air quality is being exceeded in such a great part of the world. Even though the entire world is affected by these

conditions, low-income cities are the ones being impacted most. Ninety-eight percent of all cities within low- and middle-income countries, which have a population greater than 100 000 citizens, do not meet the annual air quality guidelines and WHO standards (WHO, 2016:31). The percentage is much smaller within high-income countries with 56%, or a 42% decline in comparison. The health effects of air pollution have been studied extensively in recent years, and strong evidence links fine particulate matter ($PM_{2.5}$) with various health effects (Norman *et al*., 2007:782). Epidemiological research has found important links between air pollution, morbidity, and mortality. Some of the health risks that the population face in these areas include chronic and acute respiratory diseases, and asthma (The World Bank, 2016:322).

Some pollutants are frequently found to be much more harmful to human health than others (Suh *et al*., 2000:625). These pollutants are classified as criteria pollutants and consist of Ozone (O_3), Particulate matter (PM), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Lead (Pb,) and Carbon Monoxide (CO). Particulate matter listed as one of these pollutants has a vast impact on South African cities and even more specifically peri-urban settlements (EPA, 2017). The National Environmental Management Air Quality Act, 2004 (Act no. 39 of 2004) more specifically the National Ambient Air Quality Standard (NAAQS) was implemented to protect human health but is frequently exceeded. The reason for the exceedance of the NAAQS is the pressing need for socio-economic growth. Environmental concerns are often not a top priority in South Africa. Air quality within South Africa is of such great concern that priority management areas have been declared in terms of the National Environmental Air Quality Act, 2004 (Act no. 39 of 2004). Great amounts of the South African population are exposed to air pollution from industrial or household sources and in many cases from both sources in peri-urban settlements. Exposure to both sources creates various problems for such settlements (Diab *et al*., 2006).

Research regarding the improvement of air quality planning has proven that when air quality planning improves, the air quality levels improve, and human health also improves considerably (West *et al.*, 2016:4900). This is evidence that more awareness should be created about air quality. A starting point would be assisting all teachers to identify where in the curriculum air quality can be addressed. Educating learners through environmental education to become critical thinkers and citizen scientists could influence learners' awareness and perception regarding air quality (DBE, 2011:5; Stilgoe, 2009:49). Studies have proven that strengthening the relationship between learners, parents, and the community, influences the learners (Epstein, 2018:183). Education may therefore influence the learner's immediate family or community's awareness of air quality.

Air quality is a real-world issue that South Africa faces and it affects people in urban and more specifically peri-urban settlements. Poor air quality is one of the greatest environmental issues we face (Percival, 2017:5). The issue of air quality needs to be incorporated and linked to the National Curriculum and Assessment Policy Statement through environmental education. The link between air quality and the curriculum may be strengthened when teachers are supported in their teaching and learning about air quality through an environmental education GLOBE protocol. Increasing the level of interest that a person has in an activity, will increase the level of awareness that the person has regarding that activity (Mahaputri, 2016:233). Therefore, the actual state of air quality in the living environment of learners and their parents/guardians needs to be researched to establish their awareness and perceptions of air quality through environmental education. Therefore, this research aims to investigate environmental education's influence on awareness and perceptions of air quality among Grade 5 learners and their parents/guardians living in a peri-urban settlement within the Gauteng Province in South Africa.

1.3 MAIN RESEARCH QUESTION

How can environmental education influence the awareness and perceptions of air quality in Grade 5 learners and their parents/guardians?

1.3.1 Secondary questions

- What is the context of air quality in the peri-urban settlement?
- How aware are Grade 5 learners and their parents/guardians of air quality?
- What is the perception of Grade 5 learners and their parents/guardians of air quality?

1.4 AIM OF THE STUDY

The study aims to establish how environmental education influences awareness and perceptions of air quality in Grade 5 learners and their parents/guardians.

1.4.1 Objectives of the study

- To describe the context of air quality in a peri-urban settlement.
- To establish how aware Grade 5 learners and their parents/guardians are of air quality.
- To establish the perceptions of Grade 5 learners and their parents/guardians of air quality.

1.5 CLARIFICATION OF CONCEPTS

Environmental education, air quality, per-urban settlement, awareness, Geography, parents/guardians, perceptions.

1.5.1 Environmental education

Environmental education is a lifelong process designed to develop a global population that is aware and knowledgeable about the environment and its related issues. Creating knowledge, attitudes, motivations, commitments, and skills to work independently and together to develop solutions for existing issues and the prevention of new issues (UNESCO-UNEP, 1978:40). According to Strapp *et al.* (1969:34), the way forward for environmental education is to create a community that is educated regarding the biophysical environment and how it is linked to real-world issues. Furthermore, the community must be involved in how to deal with and resolve real-world issues and encouraged to work toward solutions for these interrelated issues. This study, when referring to environmental education, will refer to new knowledge gained, skills, awareness, attitudes, and participation when learning about environmental issues in a community.

1.5.2 Air quality

Air quality is the measure of the physical and chemical quantity of pollutant concentrations in the surrounding atmosphere to which the overall population is exposed. Ambient air quality is determined by two main factors: The volume of pollutants emitted into the atmosphere by the numerous human actions and the speed at which pollutants break up (Department of Environmental Affairs, 2012). According to the Environmental Protection Agency (2016), various actions can affect air quality due to the origin and type of pollutant emitted. Good air quality helps to maintain a balance in life, whereas poor air quality affects and harms that balance of life. In this study, air quality refers to the (measure of) the quantity of pollution within the surrounding atmosphere that the overall population is exposed to and it will refer to the ambient state of the quality of air as perceived by members of a community.

1.5.3 Peri-urban settlement

A peri-urban settlement is a contact zone of rural and urban actions that are contrasted, with landscape features swift to adjustments, and encouraged by human activities due to the peri-urbanization process (Douglas, 2006). This zone is occasionally referred to as the landscape boundary between the town and the countryside. According to McGranahan *et al.* (2004:4), peri-urban zones are time and again more unstable in the environmental aspect than rural or urban

settlements due to the uses of this zone that mix and regularly clash. In this study, peri-urban settlement in South Africa will refer to the area where the rural and urban areas come together creating a peri-urban settlement since housing in this settlement is informally planned with formal and informal structures.

1.5.4 Awareness

According to Dourish and Bellotti (1992), awareness is when the activities of others are understood in such a way that it gives you the context of your activity. When increasing the level of awareness of an activity/situation, the participants will be uncovering gaps that they may have in their knowledge regarding the activity (Thornbury, 2005). The best-suited way to increase the level of awareness will be by increasing the level of interest that the participant may have in the activity. If the level of interest is increased, the participant will become more aware of the activity and this will be responsible for better comprehension of the activity (Mahaputri, 2016:234). In this study, awareness will refer to the ability of participants to know and understand that air pollution is real, that it exists, and to understand the circumstances thereof based on their experience.

1.5.5 Geography

Geography studies the human and the physical environment over space and time. Geography serves as a bridge between human and physical sciences supporting humans in understanding the complex world we live in. There are many branches within Geography, but all geographical phenomena have a spatial dimension within a constantly changing environment. In the Intermediate Phase (Grades 4-6) Social Sciences is made up of History and Geography (DBE, 2011:8,12). Even though these two disciplines are one subject, in this study, Geography refers only to the Geography discipline and not to the History discipline within the subject Social Sciences in Grade 5.

1.5.6 Parents/guardians

According to the South African Children's Act (2005), a parent of a child is acknowledged as a parent when the child is born in a marriage of two people or the parent has biological links to the child. A guardian of a child is a person who has guardianship over a child. In both cases, what this means is the parent/guardian is the person that has parental rights and responsibility for a child. In South Africa, this may be the caregiver of the child. This research study refers to parents/guardians of a child because South Africa has the most HIV/Aids orphans in the world according to Unicef (Unicef, 2007:115). Many children live with legal guardians.

1.5.7 Perception

Perception refers to how a person makes meaning of the surrounding environment, as well as how a person distinguishes and comprehends a specific phenomenon (Blackburn, 2005:141). According to Lindsay and Norman (1977:3), perception is the method by which people understand and form sensations that will form a significant experience of an event. In this study perception is the meaning a person gives to a specific phenomenon.

1.5.8 Grade 5 learners

A Grade 5 learner in this research study refers to a 10-year-old turning 11. The Grade 5 learner is in the Intermediate Phase as described by the Curriculum Assessment and Policy Statement (CAPS) document. In Grade 5 the learners have six compulsory subjects: Home Language, First Additional Language, Mathematics, Natural Sciences and Technology, Social Sciences (Geography and History) and Life Skills (DBE, 2011:6).

1.6 RESEARCH DESIGN AND METHODOLOGY

1.6.1 Research design

According to Leedy (1997:3), a research design can be defined as a strategy for completing a study and will consist of a complete outline of how the data will be collected. Another definition of research design is the plan for choosing themes, research locations, and methods for data-gathering processes that will be able to answer the research question (McMillan & Schumacher, 2001). This descriptive single case study follows a multimethod approach and will depend on purposive sampling to select participants from the peri-urban settlement where air quality is monitored. Data will be generated using pre- and post-questionnaires as well as photovoice narratives and will be analysed using thematic analysis because it will help identify patterns of meaning across the datasets through coding to provide an answer to the research question.

1.6.2 Methodology

According to Schwandt (2007:55), research methodology is a theory of how a study should progress. It contains an analysis of the expectations, values, and processes in a specific method of inquiry. This multimethod research uses a qualitative and quantitative research approach. This research is qualitatively driven, with qualitative and quantitative coinciding (Monroe *et al*., 2019:309). This research study followed a single case study design using one primary school in

a pre-experimental design of the one group pre-test and post-test. A case study is an intense study focused on an individual or a group (Thomas, 2011:518). Yin defines a case study within research as a practical method of investigating a present case. This case should be investigated in depth with a real-world perspective when the limitations between phenomenon and circumstance may not be obvious (Yin, 2014:23).

1.6.3 Philosophical orientation

Philosophical orientation is the base of one's principles, attitudes, and assumptions (Kennedy & Morton, 1999). Since this research follows a multimethod approach, the quantitative approach will be based on positivism to establish the state of air quality in the peri-urban settlement, and how aware Grade 5 learners and their parents/guardians are of air quality. Positivism is an approach that is used when linking natural and social sciences under a general philosophy. What is intended with this is that human behaviour is studied through gathering and analysing first-hand data that is measurable. This term can be simplified by stating positivism is the gathering of quantitative data with scientific methods (Stadler, 2012:27). The qualitative approach will be based on interpretivism when analysing the awareness and perceptions of Grade 5 learners and their parents/guardians of air quality. According to Thanh and Thanh (2015:24), interpretivism supports research wanting to understand people. For this reason, placing an individual in a social environment presents a chance to comprehend how they perceive events (Maree, 2007:16).

1.6.4 Sampling strategy

The Climate Research Group of the North-West University's Potchefstroom Campus has been gathering air quality data within a peri-urban settlement. This monitoring station is located on primary school premises. For this reason, a primary school within the peri-urban settlement in Gauteng Province was used as a single case study. This is a case study of Grade 5 learners and their parents/guardians who live in a peri-urban settlement community. The reason for Grade 5 learners being the chosen group is, the Grade 5 Geography curriculum contains subject content that can be directly linked to air quality. The direct participants in this study were the parents/guardians of the Grade 5 learners, and the Grade 5 learners. The teachers that teach Grade 5 Geography learners were indirectly involved in this research. By making use of the GLOBE protocol on air quality, Grade 5 teachers were able to expose learners and their parents/guardians to some of the factors that play a role in air quality so that the participants could become more aware of air quality.

1.6.5 Methods of data collection and gathering

The methods used to collect and gather data were mainly dependent on the research question and objectives (Canals, 2017). In this research study, qualitative and quantitative methods were used to gather air quality data and data about the awareness and perception of Grade 5 learners and their parents/guardians regarding air quality. The data were collected and gathered via the following methods: Air quality monitoring data (quantitative), pre- and post-questionnaire (qualitative and quantitative), photovoice activity (qualitative), and photo narratives (qualitative). The quantitative phase of the research was responsible for determining the actual air quality of the surrounding environment of the participants living in the peri-urban community. This phase started in June 2018 and ended in August 2020. The period that was used for the study was 2 years. The air quality data monitoring, measuring, and gathering was done by the Climate Research Group of the North-West University's Potchefstroom Campus and analysed by the researcher for this study. The data that were shared are particulate matter ($PM_{2.5}$). A one-group pre-test and post-test questionnaire were used. The pre- and post-questionnaires were developed by the researcher and Geography teacher in the form of a teaching and learning activity for the Grade 5 learners and their parents/guardians to complete. The post-questionnaire was completed by the Grade 5 learners and their parents/guardians, respectively using their knowledge and actual experiences a substantial number of weeks after the pre-questionnaire was administered. Thereafter, the cameras were developed and analysed, after the photovoice activity was completed by the Grade 5 learners and their parents/guardians.

1.6.6 Methods of data analysis

During the study, the Met One Instruments E-BAM PLUS was used to gather $PM_{2.5}$ data. This $PM_{2.5}$ data can be sent to any location using the internet if the E-BAM is connected to a modem, if not the data need to be transported from the E-BAM to a flash drive manually by connecting the instrument to a laptop and inserting a flash drive. After the data have been obtained, it can be analysed on a computer using Microsoft Excel. The data for this study recorded hourly averages in micrograms.

Before the pre- and post-questionnaire data could be analysed, the raw pen and paper data had to be entered into Microsoft Excel. Thereafter the pre- and post-questionnaire were analysed by making use of the cross-table method for the quantitative section of the study. This method of analysis supported the search for patterns and helped in the grouping of the raw data. The cross table provided a summary of both variables for the awareness of Grade 5 learners and their parents/guardians of air quality. This software gives a researcher an entire range of platforms to

work with. The final step was to use the qualitative section of the questionnaire when analysing the perceptions of Grade 5 learners and their parents/guardians of air quality.

The photos from the pre-and post-photovoice activities that were taken by the Grade 5 learners and their parents/guardians were analysed by allocating the following criteria with a point value to the photos: For example, if the photo could be directly linked to air pollution the photo would get five points. A photo that could be indirectly linked to air pollution would get three points and a photo that could not be directly or indirectly linked to air pollution would get zero. This was done to identify if the learners understood the activity correctly. Learners were then handed back the top two photos that they took that best-represented examples of air pollution and sources of air pollution that affect the quality of the air that they breathe in their living environment. The learners were then required to write a narrative stating why that photo/s represents air pollution as an example, and sources of air pollution that affect the quality of the air that they breathe in their living environment. The researcher analysed the narratives that the Grade 5 learners wrote using thematic analysis.

1.7 ETHICAL CONSIDERATIONS

It is very important that the researcher and all personnel that have a link to a study are engaged in such a manner that it will be ethically correct. According to Henning *et al*. (2004), the awareness of people participating in the study, their confidentiality, and their sensitivity being protected can be referred to as ethical behaviour. According to Fouka and Mantzorou (2011:5), research ethics is of great significance. Ethical considerations have the main part of any research study that is being conducted (Welman *et al*., 2012).

The North-West University's Faculties of Education, Management and Economic Sciences, Law, Theology, Engineering, and Natural Sciences Research Ethics Committee granted ethics approval (Ethics number: NWU-00256-18-A2) for the research study to commence (Addendum 4). The recruitment process of the participants worked in the following manner: Once permission was granted by the Gauteng Department of Basic Education for the research to take place at the school, the researcher asked an independent person to contact the principal. After the independent person spoke to the principal, there was an agreement that the research may be conducted at the school and the principal was identified as the gatekeeper. The independent person was supposed to arrange to talk to the teachers and the parents/guardians of the Grade 5 learners, but the gatekeeper requested that all letters be sent to him for approval and that he would talk with the teachers and send out the letters to the parents. Once the participants read

the letter and understood that taking part in the research was completely voluntary the participants signed letters giving consent and assent to take part in the research. The results were shared with all participants. Some of the issues that the participants faced were explained during a gathering by the Climate Research Group of the North-West University's Potchefstroom Campus which used the actual air quality data that has been collected since 2018 to clarify issues raised. The Climate Research Group also explained to the participants how some of these air quality issues can be improved and how it will impact the community, should it be improved. For this reason, the benefits outweighed the risk involved in the future, should the air quality improve.

1.8 QUALITY CRITERIA

Since this study is a multimethod study the quantitative as well as the qualitative approach of the study were reflected on. When conducting a study with a quantitative approach two aspects are very important during the study. First, the reliability of the study. The reliability of a study is consistent. According to Joppe (2000:7), reliability is when the results are consistent over time and an accurate representation of the population within the study is reliable. The same Grade 5 learners and their parents/guardians will complete the same pre- and post-questionnaire under the same conditions and the research will also be reliable when the results of the study can be reproduced with a similar methodology. Second, the validity of the study is very important. The validity of a study measures if the study truly measured what it was planned to measure and how truthful the results of the study were. The content validity is usually determined by a series of questions (Lincoln & Guba, 1985), and the pre- and post-questionnaire contain questions that measure the awareness of air quality that Grade 5 learners and their parents/guardians have. The data analysis validation of the research was checked for errors by the study leader and the North-West University's Statistical Consultation Services. While conducting the qualitative side of the study two aspects are very important during this stage. To ensure that the research study is trustworthy, strategies were applied to the qualitative methods. According to Angen (2000:391), the credibility of a research study is dependent on the skill and competence of the researcher conducting the study. Triangulation was used to cross-check the results obtained from the pre- and post-questionnaire and the narratives from the photovoice activity to establish the perceptions of Grade 5 learners and their parents/guardians of air quality, therefore, ensuring credibility and dependability. If there is any interference with the trustworthiness and the credibility of the results, it can be found that the study is not reliable (Babbie & Mouton, 2011;78).

1.9 THE ROLE OF THE RESEARCHER

In this research study, the researcher accurately gathered data from the participants without swaying the participants' contribution at any stage of the research. The researcher gathered data objectively without influencing the contributions that the participants made since the teacher gathered the data as part of teaching and learning activities with the learners. The researcher was not biased at any time during the research and took all precautions to not be biased by keeping detailed records of meetings with the teacher and gathering feedback on the activities that the teacher managed with the learners. The researcher did not act as a participant observer. The researcher was responsible for developing the open-ended as well as closed-ended questions for the pre- and post-questionnaires with the Grade 5 Geography teacher to ensure the questionnaire was easily understood and well-suited for completion by the Grade 5 learners and their parents/guardians to master the lesson objectives. This researcher limited the questions to themes and subjects that were related to the phenomenon within the research. The research done was conducted professionally and ethically. As a result, the researcher did not at any time during the research alter the data gathered. All the participants received equal opportunities during the research and there was no favouritism. The researcher holds no personal interests in this study. Therefore, the study avoided any form of bias to be objective. The results were discussed empirically.

1.10 CHAPTERS OF THE THESIS

This first chapter serves as a broad outline of the research study explaining what will be done during the research and what the aims and objectives of the study are. This chapter highlights the research design and methodology. The role of the researcher and the ethical considerations are also addressed.

The next chapter, Chapter 2, will deal with the literature review of the research study. This chapter will be an in-depth literature study of the focus of the study. The focus points will include air quality, awareness, perception, and environmental education.

Chapter 3 will feature the method of research. This chapter includes data collection and gathering methods, data analysis, and ethical issues. The outline of this chapter focuses on the methods used during the research to address the research questions. The different data-gathering instruments used are described.

The results and discussion will be found in Chapter 4. This chapter describes the findings of the research study and outlines the results and data analyses. This chapter includes tables and charts to support the results.

Chapter 5 will be the conclusion and recommendations. This chapter discusses the findings of the research study. What the contribution of the research study is and how it can add to the literature. This chapter identifies the limitations of the study and presents some recommendations for future research.

1.11 CONCLUSION

In this chapter, the purpose of this research study is explained. The research aim and objectives are presented and the research methodology is explained. In Chapter 2, the literature that informed this study is presented.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 provided the introduction and the background of this study. The chapter also contained the problem statement and the aim of the study. To fulfill the research aim, Chapter 2 reviews the relevant literature on the phenomenon under study. Chapter 2 provides an in-depth discussion regarding the importance of the South African Grade 5 Social Science curriculum and more specifically the Geography section of the curriculum. Additionally, there will be a focus on environmental education within the Geography curriculum. Further, this chapter discusses the education for sustainable development, the 17 sustainable development goals set for 2030, and how the GLOBE program can support these goals. This chapter also discussed an international air quality overview, criteria for air pollutants, and the health impacts of poor air quality. Alongside the air quality overview and pollutants, this chapter discussed the air quality management standard and environmental laws regarding air quality. Lastly, a detailed discussion of the awareness and perceptions of air quality will follow concluding with the theoretical framework of the study.

2.1.1 The importance of education with a focus on Grade 5 Geography

Education is seen as one of the most important foundations of society. Being educated serves as a source when creating a good life and a symbol of freedom. According to Bhardwaj (2016:24), “Education is Must” and “There is no Life without Education”. The basic foundation for success is good quality education, yet this is only one of the advantages of education. Good quality education can improve the lives of individuals, the communities they live in, and our world (UNESCO, 2014:13). Education plays a significant part in society, education can teach people various skills and values. Therefore, it is rational to say, education plays a significant part in all human life. Within education, there are various aims, one of the aims is to form open-minded citizens. What is meant by open-minded citizens is that the learners will one day become citizens that place their attention on real-world issues that we face during our everyday life. The goal with this aim in reality is that educated citizens will recognize real-world issues and will work on solutions for these issues (DBE, 2011:12).

Within South Africa, the National Curriculum and Assessment Policy Statement serves as a support framework for teachers to use when planning teaching and learning. All subjects have

their Curriculum and Assessment Policy Statement document that contains the subject-specific aims (Kelly, 1999:98). One of the subjects that directly address some of the real-world issues that the world faces are social science and more specifically the Geography section of the social science curriculum. Geography in the Intermediate Phase Grades 4-6 is not the main subject itself but is part of Social Sciences. According to Brown (2001), two decades ago the people that had Geography are the most employable people that we have within society. Geography can improve lives directly, on a local and global scale. One of the most common real-world issues that are faced daily on a global and local scale is poor air quality.

Air quality is one of the most important and harmful issues that South Africa faces. The issue of air quality needs to be addressed and linked to the National Curriculum and Assessment Policy Statement. Currently, air quality is not a specific topic that is dealt with when teachers teach about air pollution in the curriculum. It is difficult to measure or improve the teaching of air quality because of the absence of a clear and coordinated topic dealing with air quality. As a result, learners and communities may fail to understand air quality and the true effect of air pollution. If the latter is not addressed and if learners are not made more aware of air pollution and if learners are not taught to become concerned citizens, peri-urban communities will be faced with many challenges in improving air quality. Improved air quality may have a great impact on the health and economy of peri-urban communities if the awareness level can increase through education.

The issue of air quality and how it affects people, gets addressed in two main areas within the South African National Curriculum and Assessment Policy Statement. First, within the curriculum content for Grade 5 Social Science within the Geography section. In this section, the curriculum deals with pollution. For that reason, air quality can be addressed within Grade 5. Second, air pollution is addressed in Grade 10 Geography. According to the Department of Basic Education (DBE, 2011:13), the curriculum for Geography aims to create learners who masters the 10 skills. Six of the ten skills can be linked to environmental education:

- Skill 1: Are interested in the environment they live in.
- Skill 3: Recognize the relationship between civilization and the environment.
- Skill 4: Think by themselves and justify their ideas with knowledge.
- Skill 5: Concern for the environment and the welfare of all living things on the globe.
- Skill 6: Recognize and use a variety of sources, such as maps, data, and pictures.
- Skill 7: Observe and participate in occurrences in their immediate environment.
- Skill 8: Use a variety of resources to learn about places, people, events, and topics, such as books, people, photographs, and the Internet.

An important part of the Intermediate Phase social science curriculum for Geography is that the aims set to improve the six set of skills that refer to environmental education can make real changes and improvements within society.

2.1.2 The relationship between environmental education and Geography

Over the years there have been various definitions for environmental education, but one of the original definitions that have been used and are still accepted today is known as the International Union for Conservation of Nature (IUCN) definition. The IUCN states “Environmental education is the process of recognising values and clarifying concepts to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among men, his culture and his biophysical surroundings. Environmental education also entails practice in decision-making and self-formation of a code of behaviour a bow issue concerning environmental quality” (IUCN, 1971:111). The Geography component of the social sciences curriculum aims to “provide opportunities for learners to look at their worlds with fresh, critical eyes” and it aims to get learners to understand the world they live in beyond their everyday realities (DBE, 2011:8). The latter refers to an awareness of current environmental issues. According to (UNESCO, 2010:3; EPA, 2018), environmental education’s main focus is on the creation of awareness and identifying the environmental issues and concerns humans should have. Environmental education is an opportunity for all learners to be familiarised with some of the environmental issues within their local community and worldwide. Not only will learners be familiarised with environmental education, but they will acquire skills and principles to shape them into environmentally responsible citizens. The Geography component of social sciences focuses on both physical and human processes over space and time, and it gets learners to understand the complex world they live in (DBE, 2011:12) that environmental education promotes through new knowledge and understanding.

Within environmental education, there are aims and objectives created to reach the overall goal of creating environmentally responsible citizens. The aims and objectives can be described as follow: These aims include an increase in community awareness. The community awareness creation should be related to the environmental issues that each community faces, create possible solutions, and fully educate citizens regarding their environment (UNESCO-UNEP, 1978:40). According to Knapp (2000:1), environmental education aims to change the behaviour of individuals towards the environment, and this can be obtained by creating environmentally literate and responsible citizens. Salequzzaman and Stocker (2001) state that environmental education creates awareness and concern for the actions that people have on the environment. The latter can be responsible for familiarising learners with environmentally responsible behaviour.

Environmental education has five main objectives: awareness and sensitivity, knowledge and understanding, attitudes, skills, and participation (UNESCO-UNEP, 1978: 24-29; Environmental Protection Agency, 2017).

2.1.3 Perceptions and attitude to environmental education

Perceptions about the environment are regarded as useful evidence in environmental management (Bennett, 2016:3). People's perceptions about the environment and environmental issues are a matter of public concern (Kaiser & Wilson, 2000), and therefore public perceptions of the environment need to be focussed on when studying the relationship between people and the environment (Bi, Zhang & Zhang, 2010). A United Kingdom campaign to increase the public's awareness about climate change and energy conservation, through media (newspaper and television advertisements) failed because the policymakers did not include perception studies in environmental education. Awareness of climate change did not increase because the campaign design excluded previous findings on climate change (Löfstedt, 1995:83). A lack of environmental education has been said to lead to lower awareness of environmental problems, and lower expectations of what the extent of environmental problems is (Stefanexcu & Baltatexcu, 2013:232).

When practicing environmental education, it should be a lifelong commitment that should be made in various settings, not only in a school setting but in a home as well (Ertürk Kara *et al*., 2015:46). What is meant by this is that if environmental education can form open-minded environmentally responsible citizens it will not only apply to the learners but also the people within their surrounding environments. For example, learners will influence their direct family (parents/guardians, siblings, grandparents), friends, neighbours, and community. In the future, these learners will become environmentally responsible adults and they will have a new influence on their foreseeable family (spouse children), friends, and community.

Teachers have a very important role to play in the successful operation of environmental education within schools. Research has shown that the attitude, knowledge, and behaviour of teachers regarding environmental education directly influence the learner's attitude toward environmental education (Summers *et al*, 2000). Environmental education within schools can be directly linked to the development and inspiration of critical thinking, problem-solving, and decision-making skills that learners can gain and use when facing local environmental issues (Ernst & Monroe, 2004). Learning these skills is of great importance when studying local environmental issues within the curriculum. The reason for the latter is that the learner's thought patterns, attitude, and behaviour are shaped using related school activities that the teacher

decides to complete during the curriculum (Calderhead, 1996:92). According to Genc (2015), not only can environmental education change the attitudes of its participants, but it can do it to a higher level if taking part in an environmental project when taking part in education. Over the last 50 years, environmental education has developed and grown into a socio-ecological movement worldwide with various dimensions within community involvement and decision-making (Irwin, 1990:3). The main reason for the increase in environmental education is that teachers have a substantial part to play in the successful application of environmental learning in their teaching and learning especially when it comes to the youth. One of the most important programs developed for teaching the youth about environmental education is the United Nations Education for Sustainable Development (UNESD).

2.1.4 Education for Sustainable Development

In 1992, 178 countries approved a plan to create a worldwide partnership for sustainable development. The partnership's main goal was to better human lives and safeguard the environment. In the year 2000 member states accepted the Millennium Declaration at the Millennium Summit. Throughout this summit, eight Millennium Development Goals (MDGs) were set to lower extreme poverty by 2015 (UN, 2015:4). In 2002 the United Nations announced from 2005 to 2014 will be the Decade of Education for Sustainable Development (UNDESD). When the UNDESD ended, it was replaced with the Global Action Programme (GAP). This program was developed to build and support the replaced UNDESD. In 2015, leaders from 193 different countries worldwide came together to discuss the future. The conclusion was daunting and on that day they decided that the future did not have to be that way (UN, 2017:41). Leaders decided to create a plan to replace the GAP program that came to an end in 2019 and the United Nations announced a new framework named "Education for Sustainable Development: Towards achieving the (ESD for 2030)". This plan consists of 17 goals to improve the future over the next 10 years (UN, 2019:1). The ESD for 2030 framework focuses on education's role in achieving the Sustainable Development Goals (SDGs) (UNESCO, 2020).

2.1.4.1 The 17 Sustainable Development Goals for 2030

The 17 sustainable development goals were set for all people to create a world where no one will be left behind (FAO, 2015). The South African Department of Environmental Affairs implemented 17 goals with 169 targets and 231 indicators for the South African 2030 Sustainable Development Agenda (DEA, 2016:6). Within the 17 Sustainable Development Goals, some goals can be directly linked to environmental education and the education curriculum of South Africa. Some of these goals can even be linked to one another. The goals that are directly linked to the South African education system to make a change include: Goal 3 Good Health and Well-being, Goal 4 Quality

Education, Goal 6 Clean Water and Sanitation, Goal 7 Affordable and Clean Energy, Goal 11 Sustainable Cities and Communities, Goal 12 Responsible Consumption and Production and Goal 15 Life on Land. The goals that were set by the UN were adopted by South Africa to improve our future.

These goals each play a role in the curriculum and they can also be linked to each other. For example, Goal 12 ensures sustainable consumption, and production patterns can be linked to Goal 15. By responsibly using the resources and by making sure that people are aware of sustainable development through awareness and environmental education, we will ensure that life on land is possible. Another example is Goal 3, Goal 4, and Goal 6. If people receive a quality education, for example through environmental education, they will be aware of air quality, clean water, and sanitation and they will be healthier and have good well-being. These are some of the examples of how the goals can be linked to one another and the South African curriculum through environmental education. When it comes to environmental education, there is one tool that can be used that was planned for the interaction between teachers, learners, the environment, and the community. This tool is known as the GLOBE program.

2.1.5 The GLOBE program

The GLOBE program better known as the Global Learning and Observations to Benefit the Environment Program, is known worldwide. This is a program using science within education to focus on some of the environmental issues we face. This program is active in over 120 countries around the world with 33 846 schools that are involved, and 35 334 teachers within those schools, getting various measurements from each school (GLOBE, 2019). The GLOBE Program is a primary as well as secondary school-centered discipline (GLOBE, 2017). In 2017, the Globe program collected air temperature and cloud cover data in the United States. With the support of schools, the program took over 80 000 observations. Given a large number of observations, this was a good occasion to explore the accuracy of the GLOBE citizen science data collection (Czajkowski *et al*., 2019:501). With the correct support and involvement teachers using the GLOBE program can help form open-minded citizens that will focus on some of the real-world uses we face. According to Murphy *et al.* (2018:1), the GLOBE program creates a global chance for people to take part in data gathering and the scientific process, and contribute to the understanding of Earth. The GLOBE program does not only include the learners and teachers involved. In 2016, a study was done using the GLOBE app on phones to involve learners' families (Murphy *et al,.* 2018). This is clear evidence that the GLOBE program serves as a wonderful tool when creating awareness through environmental education beyond the classroom and into family households within a community. When it comes to worldwide environmental education, the

GLOBE program is said to be the best tool that can be used for the interaction between teachers, learners, the environment, and the community.

2.2 AIR QUALITY AND HEALTH IMPACTS

Air pollution is the amount of harmful substance that is present in the atmosphere that is harmful to human health, animals, and plants (Wang *et al*., 2015:1843). Air pollution is one of the leading global health risk factors due to the deterioration of air quality. According to the World Health Organization (2016), the air quality standards that were set to protect all life are being surpassed in countless parts of the world. More than 80% of all urban living people worldwide are living in some of these areas with poor air quality. Though the entire world is affected by poor air quality low-income cities are the areas that are affected most. In 98% of all cities that are located within low- and middle-income countries that have a population of more than 100 000, residents do not meet the World Health Organization standards that are set annually to protect all life. On the other hand, this percentage drastically decreased to 56% worldwide within all high-income countries. In recent years, decision makers within some countries have realized that poor air quality has a dangerous health impact on human life. Air quality measurements within the major cities of these countries have just about doubled. This is because almost 50% of people living in developing countries depend on coal, wood, dung, and crop for the domestic energy they need. These resources are usually burnt in old coal stoves with very high combustion that is lacking the needed chimney (Bruce *et al.*, 2000:1081). Coal stoves, wood burning, and candles are some of the sources of indoor air pollutants that are seen as everyday activities oftentimes, these pollutants can be very harmful to human health (Villanueva *et al.*, 2022:546).

2.2.1 An international air quality overview

Worldwide research has been done that proves that air pollution levels have increased annually. The increase in poor air quality has been linked to an increase in the number of people dying within highly polluted areas. Evidence has proven that the health of people living in highly polluted areas for a long period differs drastically from people living in those areas for a short period (Dockery *et al.*, 1993). Some of the health risks that have been proven to be caused by poor air quality and an increase in ambient air quality are the risk of stroke, heart disease, chronic lung cancer, acute respiratory diseases, and asthma (WHO, 2016:39). Throughout 2013 it was estimated that there were approximately 5.5 million premature deaths worldwide due to people living in poor air quality areas. The statistics identified air pollution and people dying of poor air quality as the fourth leading environmental risk factor for premature demise and global disease

(Brauer *et al.*, 2016:4; Forouzanfar *et al.*, 2016:1703). Poor air quality and more specifically indoor and ambient air pollution are one of the most recognised environmental issues that South Africa faces (DEA, 2011).

2.2.2 Criteria air pollutants

The US Environmental Protection Agency (EPA) has created a list of six names of air pollutants that have been labeled as “criteria air pollutants”. What this means is that these pollutants are the main pollutants that come forth and are the pollutants that have the highest health risks to human life and cause the most damage. These six pollutants harm human life because most of the pollutants enter the body through the airways and the respiratory system. According to Hajat *et al.* (2015), high levels of these six criteria air pollutants can be linked to informal settlements. Provided in Table 2.1 are the description, source, and effects of the six criteria air pollutants.

Table 2.1: Environmental Protection Agency Criteria air pollutants

EPA CRITERIA AIR POLLUTANTS		
Pollutant	**Sources**	**Health and Environmental Effects**
Ozone (O_3) Ground-level A colorless gas that forms as a result of chemical reactions between volatile organic compounds (VOCs), nitrogen oxides (NO_x), and oxygen in the presence of heat and sunlight.	Motor vehicles, electric utilities, factories, landfills, industrial solvents, and miscellaneous small sources such as gas stations, lawn equipment, etc.	Causes coughing, chest tightness, wheezing and can inflame and damage lung tissue. Aggravates asthma and can even be a cause of asthma. Irritates the respiratory system, reduces lung function and makes it more difficult to breathe. Aggravates chronic lung diseases and may cause permanent lung damage. May reduce yield of agricultural crops and damages forests and other vegetation.
Carbon Monoxide (CO) An odorless, colorless gas resulting from incomplete fossil fuel combustion.	Motor vehicles (the majority of CO in NH), small engines, some industrial processes, boilers and incinerators. High concentrations can be found in confined spaces like parking garages, poorly ventilated tunnels, or traffic intersections especially during peak hours.	Impairs the ability of blood to deliver oxygen to vital tissues affecting the cardiovascular, pulmonary, and nervous systems. Symptoms include dizziness, headaches, nausea, fatigue, memory and visual impairment, and decreased muscular control.
Nitrogen Dioxide (NO_2) A brownish gas that forms quickly when fuel is burned at high temperatures. Contributes to the formation of ground-level ozone and fine particle pollution	Motor vehicles, electric utilities, industrial boilers, and off-road equipment.	Irritates the lungs, may cause lung damage and lower resistance to respiratory infections such as influenza. May adversely affect terrestrial and aquatic ecosystems through regional transport and deposition.

Particulate Matter (PM) Mixture of solid particles and liquid droplets in the air; particles may be visible or microscopic.	Formed directly from windblown dust, crushing and grinding operations, unpaved roads and construction, fuel combustion (from motor vehicles, power plants, industrial facilities), wood stoves, and agriculture (plowing, burning off fields). May also be formed in the atmosphere from gases such as SO_2 and NO_x.	Causes eye, nose and throat irritation, decreased lung function, aggravated asthma, development of chronic bronchitis, irregular heartbeat, nonfatal heart attacks, and premature death in people with heart or lung disease. Serves as a carrier for toxic metals, damages human-made materials, and is a major cause of reduced visibility in many parts of the U.S.
Sulfur Dioxide (SO_2) A highly reactive colorless gas, odorless at low concentrations, but pungent at very high concentrations.	Formed when fuel containing sulfur (mainly oil and coal) is burned in industrial, institutional, utility, and residential furnaces and boilers. Other sources include petroleum refineries, smelters, paper mills, and chemical plants.	May cause breathing problems, respiratory illness, alterations in the lungs defenses, aggravation of existing cardiovascular disease, and permanent damage to lungs. Forms acid aerosols and sulfuric acid, which are associated with acidification of lakes and streams, accelerated corrosion of buildings and monuments, and reduced visibility.
Lead - A heavy metal found naturally in the environment and in manufactured products.	Soil, dust, paint, etc., transportation sources using lead in their fuels, coal combustion, smelters, car battery plants, and combustion of garbage containing lead products.	Elevated levels can cause brain and other nervous system damage and adversely affect kidney function, blood chemistry, and digestion if ingested or directly inhaled. Children are at special risk due to cumulative effects even at low doses. Lead can also harm wildlife through deposition onto leaves which are a food source for grazing animals.

(Source: New Hampshire Department of Environmental Services, 2012).

The most harmful of the six pollutants identified in Table 2.1 is Particulate Matter (PM). PM is made up of solid and liquid particles. These particles have certain physical and chemical characteristics that make PM an air pollutant. Some of these characteristics consist of soil dust, dirt, smoke, pollen, ash, aerosols, and liquid droplets. PM can be categorised by the size of the particles. There are three main size categories with PM namely: total suspended particulates (TSP), PM_{10}, and $PM_{2.5}$ (World Health Organization, 2013). PM is very rarely large enough to see with the naked eye. PM is normally studied using an electron microscope due to its very small size. There are two sizes of a PM that are well known within the air pollution community studies namely; coarse fraction and fine particulate matter. The coarse fraction is PM with a diameter smaller than 10 µm, which is also known as (PM_{10}). The bigger PM is made up of crust materials from the earth and dust from factories and roads. Fine particulate matter is PM with a diameter smaller than 2.5 µm and this is known as $PM_{2.5}$. $PM_{2.5}$ is the most dangerous PM with this fine diameter for health risks (RTI International, 2015:213). Human hair is approximately seventy micrometers; illustrated in Figure 2.1 is a comparison of human hair to $PM_{2.5}$ and PM_{10}.

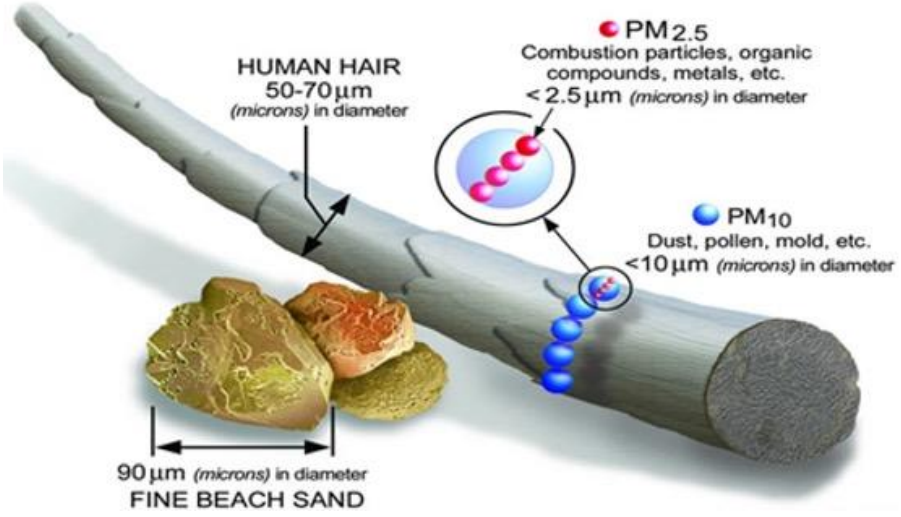


Figure 2.1: $PM_{2.5}$ and PM_{10} comparison with a human strand of hair

(Source: RTI International, 2015)

$PM_{2.5}$ is made up of secondary aerosols, combustion particles and organic, metal vapours, hydrogen ions, and some acid droplets are present in fog. The chemical composition of PM is made up of sulfates, nitrates, ammonium, other inorganic ions such as ions of sodium, potassium, calcium, magnesium, and chloride, organic and elemental carbon, crustal material, particle-bound water, metals (including cadmium, copper, nickel, vanadium, and zinc) and polycyclic aromatic hydrocarbons (PAH). Biological components such as allergens and microbial are some of the other compounds that come forth within PM (World Health Organization, 2013). The reason why $PM_{2.5}$ is so harmful to the health of humans is due to its size. These very small particles find their way deep into the respiratory system where it causes damage. $PM_{2.5}$ within the atmosphere has a much longer life operative time and Influence than PM_{10}. This is of great concern due to $PM_{2.5}$ being harmful to human health (World Health Organization, 2013). $PM_{2.5}$ can be emitted into the atmosphere as a primary or secondary particle. If the particles are emitted directly they will be primary particles. Primary $PM_{2.5}$ can either be from anthropogenic (man-made) or non-anthropogenic (natural) sources.

Combustion sources, like coal boilers, diesel and petrol engines, and even household implements are the prominent source of anthropogenic PM. The erosion of roads is also responsible for air pollution (Tian *et al.*, 2019:202), and industries and their transportation plays a large role in this part of air pollution (Yang *et al.*, 2019:9). Secondary particles will form when there is a chemical reaction within the atmosphere. Some gas pollutants that will be responsible for the reaction and formation of secondary particles will be sulfur dioxide, oxides of nitrogen, ammonia, and non-methane volatile organic compounds (World Health Organization, 2013). According to Khairy *et*

al. (2016:2), volatile organic compounds, nitrogen dioxide, and carbon monoxide are just some of the chemical pollutants that can be linked to poor air quality and health issues. These chemical pollutants can oftentimes be linked to mining which can then be linked not only to environmental issues but also health issues (Emmanuel *et al.*, 2018). Evidence points to the fact that within areas where air quality management has improved, human health has also improved (Krewski *et al*., 2000:33).

2.2.3 Health effects of $PM_{2.5}$

Evidence points to the fact that air pollution is a substantial source of morbidity and poor health quality (Martinez *et al*., 2018:2). The term environmental health forms part of the natural and human environment that can affect human health. According to the World Health Organization (2018), "Environmental health addresses all the physical, chemical, and biological factors external to a person and all the related factors impacting behaviours". These environmental influences can affect the health of humans if it is not managed correctly. When a human comes into contact with some of these factors for a duration of time, the person is exposed to the pollutant and health effects can follow (Mathee & Wright, 2014:106). The pollution that gets emitted into the atmosphere is a burden of disease and a public health threat for all people but more so for people living in those areas with high concentration levels of pollution.

The health effects that PM causes are due to the particles that are so small that they affect the thoracic region of the respiratory system. The effect of PM exposure can be over a short-term (hours, days) or long-term (months, years). Some of these health effects are respiratory and cardiovascular morbidity, like asthma and an increase in hospital admissions, mortality from cardiovascular and respiratory diseases, and lung cancer. Both $PM_{2.5}$ and PM_{10} exposure have respiratory health effects, however, $PM_{2.5}$ is a substantial risk factor due to the very small size of the particles that range between 2.5–10 µm. The daily mortality is estimated to escalate between 0.2–0.6% per 10µg/m3 of PM_{10}, and it is estimated that long-term exposure to $PM_{2.5}$ increases the risk of cardiopulmonary mortality by 6–13% per 10 µg/m3 of $PM_{2.5}$ (WHO, 2013). One example of a PM that is very dangerous is exhaust gasses from diesel engines (mainly particles within the gasses). Figure 2.2 displays the possible outcome effects that PM can have on health.

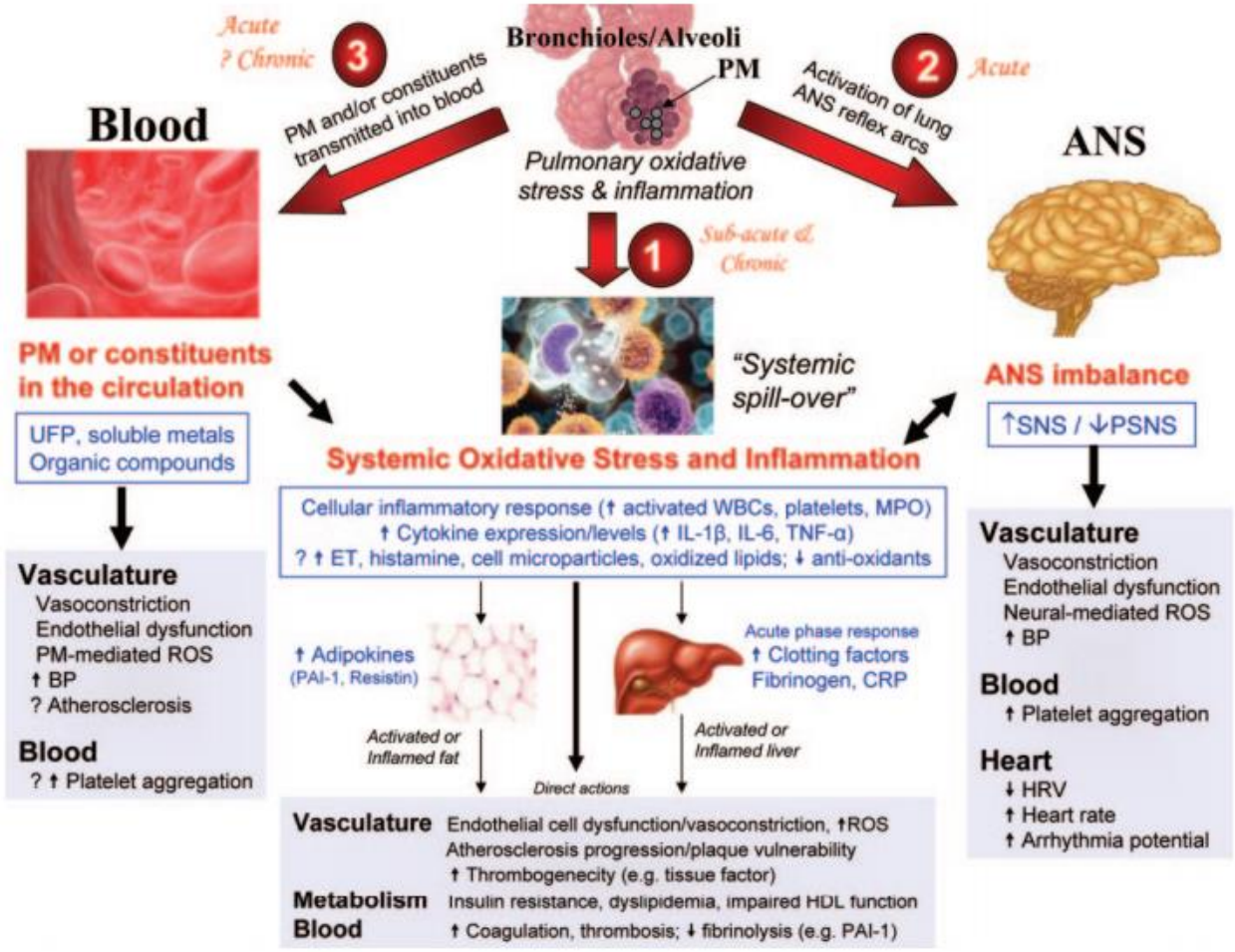


Figure 2.2: Biological pathways linking PM exposure with CVDs

(Brook *et al.*, 2010:2353)

Some PM grow through condensation in the moist respiratory tract after inhalation. After reaching the alveoli, the PM will come into contact with a water-repellent surface. After fine PM and ultra-fine PM (0-25nm and 0-02nm) have moved into the tissue of the lungs they can cause inflammation. Studies have shown that ultra-fine PM and $PM_{2.5}$ particles increase the mortality risks, whilst coarse particles are not so significant (Brook *et al*., 2010:2360; Kan *et al*., 2007:2). There are two types of PM exposure: short-term and long-term, and the periods that people are exposed to PM influence the health effects that can follow.

2.2.3.1 Acute (short-term) PM exposure

The very first methodological study done regarding short-term PM exposure and mortality was completed to estimate the short-term variations that exposure to air pollution can have on human health. During the 1990s a daily study was completed focusing on the daily mortality that was associated with the changing air quality in extreme levels of pollution (Pope & Dockery, 2006:711).

According to the World Health Organization (2003), studies have proven that the people most vulnerable to $PM_{2.5}$ are the elderly and people with pre-existing heart, cardiovascular, respiratory, and lung diseases. There is no evidence that there is a safe level of $PM_{2.5}$ existing where no health effects are present. Various short-term exposure studies over recent years, have linked $PM_{2.5}$ exposure to the number of mortalities even at very low concentration levels. Since 2009 more studies have been done linking $PM_{2.5}$ with health effects (Sacks *et al*., 2012:65).

2.2.3.2 Chronic (long-term) PM exposure

Numerous years of epidemiologic studies have collected evidence that proves long-term exposure to $PM_{2.5}$ pollution has a great effect on human health and can be linked to an increase in mortality levels within areas with high levels of $PM_{2.5}$ concentrations. These studies have shown that socially disadvantaged people and people with poor education respond even more strongly in terms of mortality (Pope & Dockery, 2006:670). Long-term exposure to $PM_{2.5}$ can reduce lung growth in children (WHO 2003). The main reason why PM is so harmful is due to PM contains various toxic compounds that can be breathed in by humans and move deep into the lungs. When PM moves into the lungs of a person it will be absorbed and move to the alveoli. Here it will develop inflammation and moves into the bloodstream of the person (Brook *et al*., 2010:2355; Kan *et al*., 2007:7). Over the years there have been two known studies done that can be referred to, namely the Six Cities Study (Dockery *et al.,* 1993) and the American Cancer Society (ACS) Study (Pope *et al.,* 1995:673). According to Dockery *et al.* (1993) and Pope *et al.* (1995:715), the increase of $PM_{2.5}$ has increased the mortality rate by 26%.

During the 1970`s Dockery monitored 8 111 adults within the United States for 14 - 16 years as part of the well-known Six Cities Study. Pope monitored 552 138 adults from 1982 to 1989 for the American Cancer Society Study and found that high levels of $PM_{2.5}$ could be linked to an increase in levels of mortality once again. The overall outcomes of the two studies showed that the difference between $PM_{2.5}$ within the most polluted cities and the least polluted cities was 15%. In time, series of studies similar to the Six Cities Study and the American Cancer Society Study evidence, proves that the elderly and very young children are even more at risk of air pollutants, specifically $PM_{2.5}$ (WHO 2003). This is of great importance due to $PM_{2.5}$ being linked to informal settlements (Hajat *et al*.,2015).

2.2.4 Air quality management standards

2.2.4.1 International standards

The World Health Organization's air quality guidelines (AQGs) aim to inform nations on the relatively safe pollution levels where health impacts are minimised. These guidelines were developed to guide the actions of a country in accomplishing air quality within a country that will protect the citizen's health in various situations. Alternatively, a country's air quality standard is set by each country individually. These standards should protect their citizen's health and serves as a significant section of national risk management and environmental policies within the country. Each country's national standards will differ given the type of approach that the country has implemented for balancing its health risks, technological feasibility, economic considerations, and various other political and social factors. The national standards will be subject to the level of growth and national ability within the air quality management system (World Health Organization 2006).

2.2.4.2 A South African overview of air quality

According to the Department of Environmental Affairs (2011), ambient air quality can be defined as the physical and chemical amount of pollution within the ambient atmosphere that the overall population of the surrounding community is exposed to. Various sources are responsible for air pollution and that causes health effects in South Africa. Some of the sources include power stations, industrial factories, waste disposal, transportation, biomass burning, domestic fuel burning, landfill sites, wastewater treatment, and agriculture. Air pollution is not only responsible for various health effects but also environmental effects. The exceedance of the air quality standards within some of the most polluted areas is due to emissions from various industrial sectors, residential fuel burning, vehicle emissions, and mining (Department of Environmental Affairs, 2011).

In 2013, there were 10 432 deaths in South Africa that could be linked to ambient particulate matter, at the same time 9 587 deaths could be linked to household air pollution (HAP) from solid fuel burning. Both these shocking amounts of deaths that could be linked to air pollution in South Africa during 2013, brought the total to 19 801 (IHME, 2015). Air pollution can be linked to six times more deaths than malaria and four times more deaths than HIV/AIDS (Brauer *et al*., 2016:4). Within recent years the current state of air quality in South Africa is at a very crucial stage. The South African Government has identified areas within the country with very high levels of air pollution that are of great concern (Brauer *et al*., 2016:13). These highly polluted areas are known as "hot spot areas" within the country. These hot spots areas are classified as the areas with

some of the poorest air quality within South Africa. The ambient air quality standards within these areas are being exceeded annually. As mentioned, the state of air quality is due to emissions from various sources. The main sources of a problem within South Africa are the industrial sectors, residential fuel burning, mining, and transport emissions (Brauer *et al*., 2016:14).

One of the greatest problems South Africa faces is the high number of poor people living within the country. High levels of pollution in South African low-income formal and informal residential areas (townships) are of great concern due to poor atmospheric dispersion that causes pollution at high levels. One of the reasons people living in low-income areas are at risk, is due to these people living adjacent to an industrial area and main road. The poor are also in need of energy and heat during the winter months so the levels of $PM_{2.5}$ and PM_{10} peak even more during the winter months than in the summer months (Zunckel *et al*., 2011:13). People live in these areas to be close to their work and for this reason, people living in these areas are more prone to health effects due to air pollution. If the pollution levels can be managed and reduced there should be health, economic and environmental benefits (Janssen & Metha, 2006:61). These levels should be better managed and should not exceed the set standards should South Africa wish to lower the number of deaths that can be linked to air pollution.

2.2.4.3 South-African environmental laws

Within South Africa determining and improving poor air quality concentrations is important due to the health effects that air pollution can have on the population living within the heavily polluted areas (Venter *et al*., 2012:561). The South African Constitution was promulgated to protect all South African citizens. What this means is that all South Africans have the right to an environment that is well maintained to not harm their health and well-being in any way. Due to these rights, the awareness of all environmental laws has increased drastically over the last few years. The awareness of air quality has specifically increased, concerning decision-making and the consequence that some of the actions have on the environment. All establishments that function within the environmental sphere of South Africa are required to obey all norms, principles, standards, or guidelines that pertains to the environmental legislation of South Africa. The legislation relevant to the establishments mentioned consists of, but not limited to, the following laws: (GCS, 2016).

- Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996).
- National Environmental Management Act, 1998 (Act No. 107 of 1998).
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).
- National Water Act, 1998 (Act No. 36 of 1998).
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983).

- National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004).
- National Heritage Resources Act, 1999 (Act No. 25 of 1999).
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008).
- Regulations, Ordinances, and Bylaws. (GCS, 2016).
- National Housing Act, 1997 (Act No. 107 of 1997).
- National Water Services Act, 1997 (Act No. 108 of 1997).
- Environment Conservation Act, 1989 (Act No. 73 of 1989).

Within this study, the focus will be on the World Health Organization air quality standards and the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) or better known as NEMAQA, and the National Ambient Air Quality Standards (NAAQS) that was set by this Act.

2.2.4.3.1 South Africa's air quality legislation: The National Ambient Air Quality Standards

NEMAQA controls air quality in such a way that the government can protect the environment and the citizens by providing the citizens with sensible measures as guidance for the inhibition of air pollution. NEMAQA consists of legislation within the main act that impacts air quality management directly and indirectly, as well as the implementation of NEMAQA (Department of Environmental Affairs, 2005). A National Ambient Air Quality Standard (NAAQS) was set up by the Environmental Protection Agency for the citizens. These standards were specifically set up so that human health will be protected against the criterion of air pollutants. Having legislation to protect people is very important within all areas of the country. This is especially important within the informal settlements due to most of the people living there being too poor to afford basic health care. According to Bruce *et al.* (2000:1088), the pollutant that was found to be emitted during household combustion to be of greatest concern within informal settlements, is $PM_{2.5}$ and Carbon Monoxide (CO). Presented in Table 2.2 below is a list of these standards.

Table 2.2: National Ambient Air Quality Standards for $PM_{2.5}$

Averaging Period	Concentration	Frequency of Exceedence	Compliance Date
24 hours	65 µg/m³	4	Immediate - 31 December 2015
24 hours	40 µg/m³	4	1 January 2016 - 31 December 2029
24 hours	25 µg/m³	4	1 January 2030
1 year	25 µg/m³	0	Immediate - 31 December 2015
1 year	20 µg/m³	0	1 January 2016 - 31 December 2029
1 year	15 µg/m³	0	1 January 2030
The reference method for the determination of $PM_{2.5}$ fraction of suspended particulate matter shall be EN 14907			

(Source: NEMAQA (Department of Environmental Affairs, 2005).

2.3 AWARENESS AND PERCEPTIONS OF AIR QUALITY

Countless South Africans live in peri-urban settlements with very high levels of air pollution (Scorgie *et al.*, 2004:22). The high levels of air pollution are responsible for dangerous concentrations of ambient and indoor air pollution. One of the leading problems that South Africa has is solid fuel burning within low-income settlements. For a source of energy and heat, many people depend on a variety of fuels to burn within these settlements (StatsSA, 2014). Epidemiological studies have proven that there is an important link between air pollution and morbidity and mortality (The World Bank, 2016:322). According to West *et al.* (2016:4900), if air quality planning improves then the air quality levels and human health also improve. For this reason, it is very important for people living within such highly polluted areas to be aware of the issues they face.

Recent studies have shown that there are somewhat high levels of concern regarding the awareness of air pollution (Omanga *et al.*, 2014:7). A study in 2018 was done regarding the awareness and perceptions that people have of air quality. What was found is that the mainstream participants that took part in the study had a very low level of awareness (Schmitz *et al.*, 2018:532). The lacking environmental health awareness linked to sustainable environmental health programs is one of the most Important challenges that developing countries face (World Health Organization, 2007). In 2018 a study was done regarding the awareness and perception of air pollution of people living in rural and urban areas. The latter study showed that the awareness levels in urban areas are much higher due to three main variables, namely education,

residence, and communication (Sarker *et al*., 2018:24). Studies have proven that people with a higher education level have higher levels of awareness regarding air pollution (Liao, 2015).

In 2014 there was a study done in Ningbo, China. What was found during this 2014 study, is that there was a lack of awareness among the elderly and less educated people (Qian *et al*., 2016:5). For this reason, the link can be made that education can help improve the awareness of air quality among people and one way of educating about air quality at school is through environmental education. It has been acknowledged that environmental education supports the creation and improvement of awareness, concern, recognition, and changes in environmentally responsible behaviour (Salequzzaman & Stocker, 2001). Community perception of air pollution might also affect the communities' environmental routines and behaviour. If so, this can affect the communities' decisions (Vangeli *et al.*, 2014; Wang *et al*., 2015:1837).

2.4 THEORETICAL FRAMEWORK OF THE STUDY

According to Varpio *et al.* (2020:10), a theoretical framework is when a researcher constructs a series of concepts and premises to justify a study, they do so from several theories in a logically structured and interconnected method. To develop a theoretical framework, the researcher must identify the theories and concepts that will serve as the foundation for the research that is being conducted, connect them logically, and connect these theories to the actual study being conducted. A theoretical framework, in essence, reflects the researches efforts while implementing a theory in particular research. The researcher works from the theory to the actual data. When working with a theoretical framework for environmental education, many theories can be used. The two theories that were applied to this research study were Bronfenbrenne's ecological systems theory and the situated learning theory.

Bronfenbrenner's Ecological Systems Theory states that human development is influenced by the different types of environmental systems that interact with one another. This can range from a child's home and school to other areas for example cultural values, laws, and customs (Bronfenbrenner, 1977:514). According to Guy-Evans (2020), the relationship between the child and his/her home and school, should not only be studied but also the relationship between the child and the larger environment. Bronfenbrenner's ecological systems theory categorises a person's environment into five systems, namely microsystem, mesosystem, exosystem, macrosystem, and chronosystem. The microsystem is the system closest to the child that contains the house (family) and school (friends and teachers). Figure 2.3 shows the five different systems

and how these systems are interrelated with each other. This figure is described by Guy-Evans (2020).

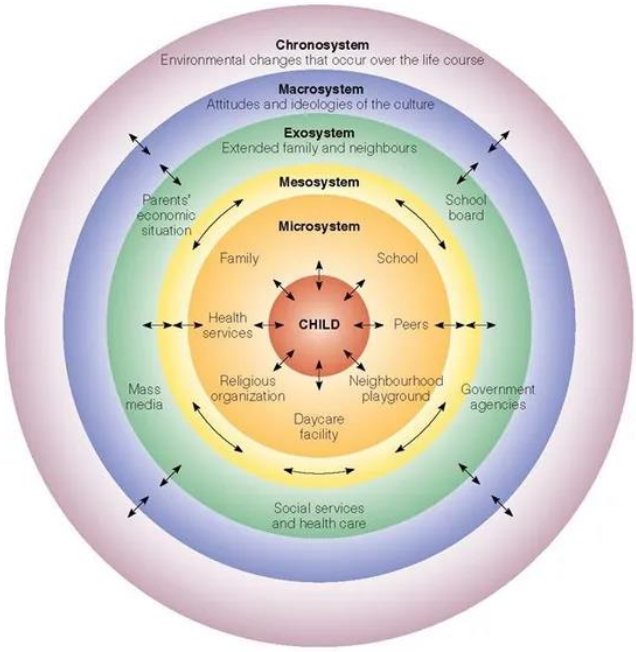


Figure 2.3: Bronfenbrenner's Ecological Systems Theory

According to Bronfenbrenner (1977:514), the microsystem is the relationship between the developing person and their home, school, community, or work, and this is the smallest and most immediate environment, for example inside the child's home. The mesosystem also contains the microsystem. This is interactions among the microsystems, this is where the person socially interacts within these systems, for example, the child socializes with friends and family of the friends. The exosystem is linked to the mesosystem and this is when the person is not directly involved but can be directly influenced by the people within the mesosystem, for example, if the child's parent loses his/her job, this will influence the child and his/her parents will be unable to buy food. The macrosystem is the largest system and this system contains all the people and places that can affect a person. This consists of a person's culture or subculture values, dominant beliefs and ideas, and political and economic systems that affect a person's life, for example, poverty will influence a child's home or school environment. Last, the chronosystem is the changes within an environment that take place over a lifetime and influence development. This also involves the socio-historical contexts that influence a person. An example of this system can be a child moving to a new school or a child's parents getting divorced (Guy-Evans, 2020). In Bronfenbrenne's ecological systems theory, children are the products and the producers of their environments (Bronfenbrenner, 1977:5), meaning that both "children and the environment form a network of interdependent effects" (Berk, 2006:27-29), which is necessary for environmental learning. In this

research study, the Grade 5 learners who take part in their photovoice activity allow for environmental learning to take place amongst themselves and their parents/guardians as the latter learn from their children.

In this research study, the Grade 5 learners were exposed to a teaching and learning activity with their parents/guardians where they interacted with the environment and develop an awareness of air quality that affects their perceptions of air quality. On an exosystems level, the local living environment can provide the Grade 5 learner and his/her parents/guardians with a space in which to not only live, but learn as well. Environmental education teaching-learning experiences, like the photovoice activity, a system thinking activity since the environment in which the Grade 5 learners and their parents/guardians are learning, is a system of systems.

The next theory is Situated LearningTtheory. This theory is how human knowledge emerges during activities, particularly how individuals construct and understand representations. Situated learning is focused on how individuals learn daily (Clancet, 1995). Lave and Wenger (1991:23) believe that learning is an active process of collaboration in groups of practice, an engagement that initially is ostensibly secondary but eventually grows in depth and involvement. One key fact is the situational nature of learning, remembering, and comprehending. Human minds evolve in social environments, and they use the resources and visual media that culture offers to sustain, enhance, and rearrange mental abilities. This theory places particular emphasis on how learning and the social environment in which the learning takes place to interact. According to Brown *et al.* (1989:23), there are four elements in situated learning, namely giving skills for collaborative work, demonstrating diverse roles, challenging unproductive techniques and ideas, and solving problems together. Kirshner and Whitson (1997:160) state that situated learning takes place when skills and knowledge are developed in an environment that resembles how the knowledge is received and used in real-world circumstances. The notion of learning as a sociocultural experience, as opposed to the act of a person obtaining broad knowledge from an abstract body of knowledge, is essential to the situated learning theory. Situated learning was also important to this study due to it having implications for adult education-related research. Situated learning in adult education focuses on how individuals create and interpret new knowledge through engagement in an activity (Clancey, 1995).

According to Schell and Black (1997:6), it is important to encourage natural learning processes while developing a situated learning environment. In discussions, role-played teamwork, and speech production exercises, students verbalised their understanding and contrasted their approach to problem-solving. Courtney and Maben-Crouch (1996:41) also state that learning takes place easier within a “natural learning environment”. In a natural learning environment,

learners work together to solve real-world, non-routine issues that they will probably face again within a workplace. Collaboration involves everyone adding to the conversation and coming up with new solutions. Educators motivate their learners to take part in self-examination by addressing the fundamental assumptions and beliefs of other learners proposed solutions. By framing issues in environments similar to the ones that will be faced within the workplace, knowledge is obtained. Situated learning can make use of interactive experience techniques to assist in knowledge gaining and encourage people to learn and use skills in a social setting (Anderson *et al.*, 1996).

In this research study, the situated learning theory of Lave and Wenger (1991:35) is applicable. The Grade 5 learners will use prior knowledge they have of some real-life situations and actively learn and gain new knowledge during the photovoice activity that they will complete with their parents/guardians. This new knowledge was taught to the Grade 5 learners by the teachers that are seen as the experts. This theory applies not only to the teachers and the Grade 5 learners but the parents/guardians of the Grade 5 learners too. The latter is supported by Lave and Wegner (1991:35) when they state that “Situated learning is a process of participation in communities of practice”. Situated learning requires a few steps that can be linked to the study in the following way: An authentic work environment will be created in the form of the school and teachers, and the Grade 5 learners who’s revived lessons at school will lead to increased participation in teaching and learning activities. The Grade 5 learners and their parents/guardians will complete pre- and post-questionnaires with photovoice activities, and together the Grade 5 learners will learn from the teachers. The parents/guardians will learn from the Grade 5 learners as they become more aware of environmental issues in their community while learning from mentors. Perceptions may be changed, and new knowledge may be gained as the Grade 5 learners learn from the teachers and the parents/guardians learn from the Grade 5 learners. Situated learning within this study promotes critical thinking, and emotional relationships by exposing learners to working together with parents/guardians through completing activities and working as a community.

2.5 CONCLUSION

In this chapter education was presented as one of the most important foundations within society. Geography is one of the subjects within the curriculum that helps develop open-minded citizens, and this can improve lives directly, on a local and global scale. These important skills are focused on the Geography curriculum and can be accomplice when environmental education takes place,

are linked to the topics that the learners complete during exposure to the curriculum. A way of improving people's knowledge was found to create awareness in schools to develop learners that will become environmental citizens. With the correct support and tools, teachers can create awareness regarding environmental issues and help learners truly understand the issues that the world face. This chapter revealed that the Globe tool serves as an ideal to use when supporting the teachers in this journey of creating awareness and this tool is well-known for studies where not only learners are involved but also the families of the learners.

This chapter presented poor air quality as one of the most common real-world issues that are faced daily on a global and local scale. The World Health Organizations air quality standards and the National Environmental Management: Air Quality Act are often exceeded in South Africa. This exceedance is especially high within the peri-urban settlements. Peri-urban settlements within South Africa are faced with multiple complex air quality issues. There are multiple criteria air pollutants that are harmful to the environment and human health but one of the most harmful pollutants is $PM_{2.5}$. $PM_{2.5}$ is the pollutant that causes the most harm to human health within South Africa. $PM_{2.5}$ is such a dangerous pollutant due to the particles of this pollutant being very small and traveling deep within the human respiratory system. Both short-term and long-term $PM_{2.5}$ exposure is harmful to human health. This chapter ended with a presentation of the two theories applicable to this research study, namely Bronfenbrenner's ecological systems theory and situated learning theory.

The next chapter will discuss the research design and the methodology that the researcher followed. This chapter will also show the methods of data collection, generation, and analysis for the air quality data, pre- and post-questionnaires, photovoice, and all challenges faced during this phase of the study. The researcher will discuss the researchers role in the study and how the quality criteria and establishment of reliability and trustworthiness was completed. Last, the ethical consideration will be discussed.

CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

The previous chapter dealt with the literature review and theoretical framework of this study. The research design and methodology are an explanation of the path that the researcher took to administer the research. This allows the researcher to plan the path used to formulate the problems and the objectives (Sileyew, 2019). This chapter focuses on the research design and methodology. The main purpose of this chapter is to discuss the methodology, research paradigm, sampling methods, methods of data generation, and methods of data analysis. As such, the various processes and undertakings utilised in the study will be discussed, as well as the methods used to ensure that the findings of the study were credible and trustworthy, that the quality criteria were met, and that the study was conducted ethically.

3.2 RESEARCH DESIGN

A research design is a strategy used when completing a research study, it should consist of a complete outline explaining how the data will be collected (Leedy, 1997:54). This research study followed a multimethod approach and a single case study research design. The multimethod research approach contains both qualitative data gathering and quantitative data collection phases and analysis (Kemper *et al.*, 2003:587). This single case study design consisted of one school. There are multiple reasons for this. There is only one primary school within the peri-urban settlement of Carletonville in Gauteng. This school is in a community where air quality is not well managed, and the researcher was able to get accurate air quality data from this community that was collected from the school premises. The community has many factors surrounding it that influence air quality.

According to Yin (2014), a case study is an experiment or observation-based study that explores a case or cases that agrees with real-life content that the researcher has little or no control over. The researcher discusses the “how” and the “why” questions relating to the study and the aspects of the study. The main purpose of the design was to establish how environmental education can influence the awareness and perceptions of air quality of Grade 5 learners and their parents/guardians within a single school. During this study, the researcher also used

environmental samples in the form of air quality data. This data was used to answer the second question that pertains to the context of air quality in the peri-urban settlement.

3.3 METHODOLOGY

The methodology of a research study is a theory of how a study should progress (Schwandt, 2007:55). This study made use of a multimethod research approach. The multimethod approach can be defined as a method that consists of qualitative and quantitative data gathering and collection phases, respectively, and analysis in parallel form (Kemper *et al.*, 2003:587). This method makes use of data gathering and collection strategies, views, and interpretation (Johnson *et al*., 2007:115), thereafter integrating the data in the various phases of the analysis. Although there are many ways that research can take place and be adapted, the focus of this research study was to establish how environmental education can influence the awareness and perceptions of air quality of Grade 5 learners and their parents/guardians within a single school. The research also includes the use of an environmental sample, air quality, to create a link between the context of air quality within the community and the awareness and perceptions that the participants have.

The overall purpose of the qualitative component of this study was for the researcher to establish how environmental education influences the awareness and perception of Grade 5 learners and their parents/guardians regarding air quality. This was achieved by gathering pre- and post-questionnaires from parents/guardians and learners, as well as narratives and visual data from learners. This data was collected in three phases during August and November 2021 and then later during May 2022. Quantitative research collects and analyses numerical data. When this data is analysed, averages, predictions and relationships can be made (Bhandari, 2022). The researcher had access to actual air quality data of the surrounding environment from 2018 to August 2020 where the participants lived. The period that was used for this research study was two years (2018 – 2020). By undertaking this research, an opportunity was created to establish how environmental education can influence the awareness and perception of air quality in Grade 5 learners and their parents/guardians. The researcher originally intended for all data to be collected during the same time frame during this study. Due to unforeseen circumstances in the form of the Covid-19 pandemic, it was not possible to collect all the data in 2020. The researcher could only access the school from the second half of 2021.

3.3.1 Philosophical orientation

The philosophical orientation is the abstract outlook of the researcher's ideals. Since this research study follows a multimethod approach two research paradigms apply to this study, namely positivism for the quantitative side and interpretivism for the qualitative side.

3.3.1.1 Positivism

Positivism is used when combining natural and social sciences under a philosophy (Stadler, 2012:16). What is expected when using this approach, is that human behaviour is studied when collecting and analysing initial data that is quantifiable. This term can be easily explained as the gathering of quantitative data using scientific methods (Stadler, 2012). The best-suited paradigm for the quantitative approach was the positivist research paradigm which was used to create the foundation needed to complete the research in the most accurate and best-suited way. The main reason for working within this paradigm is that it has the needed support to complete the research for establishing the state of air quality in the peri-urban settlement and how aware Grade 5 learners and their parents/guardians are of air quality. For this reason, when placing an individual in a specific social environment there is a chance to comprehend how they observe the event (Maree, 2007:16). This supports the researcher in formulating an accurate conclusion from the data collected in this research.

3.3.1.2 Interpretivism

Interpretivism is more focused on personal context and inputs than the positivist research philosophy (Alharahsheh & Pius, 2020:41). According to Scotland (2012:12) interpretivism means always considering that the actual experiences of all individuals can differ. For this reason, Collins (2010) wrote that research participants do not present similar interpretations of a citation. The qualitative side of the study will be based on the interpretivist research paradigm when analysing the perceptions of Grade 5 learners and their parents/guardians of air quality. The questionnaires and photovoice activity will help the researcher gain understanding of the perceptions of the participants. According to Thanh and Thanh (2015:24), interpretivism assists researchers in determining how to understand people. During this study, it was of great importance to understand that multiple participants can have different perceptions.

3.3.2 Case study design

Case study designs are mostly used in social or life sciences studies. According to Heale and Twycross (2018:8), a case study is when a researcher conducts a thorough study of a person or

a group to investigate data relating to several variables. In this research study, the researcher was keen to establish how environmental education can influence the awareness and perceptions of air quality of Grade 5 learners and their parents/guardians in one school. According to Alpi and Evans (2019:1), a case study helps the reader to understand the study more in-depth. Qualitative methodology case studies are normally much more complicated than ordinary case study reports. A qualitative research case study may need the researcher of the study to act as an instrument during the data-gathering process. During such a study, it may be necessary to make use of multiple methodological approaches to explain the problems to the reader (Creswell, 2016:23). Yin (2018:250) describes a case study as a method of experimental analysis that is appropriate for determining "how and why" something is happening holistically and in a real-life context.

3.3.2.1 Descriptive single case study

Descriptive research in a case study is a research method that can be used to report actual data as accurately as possible (McCombes, 2022). During descriptive research, the researcher can use various methods to gather the needed data. Some of the methods that can be used include questionnaires, interviews, or even observations. The fundamental objective of descriptive research is to gather data and describe the study. During this research, a primary school within a peri-urban settlement of Carletonville in Gauteng was used as a single case study with a multimethod approach. This case study represents all of the Grade 5 learners and their parents/guardians in the peri-urban settlement community.

3.3.3 Sampling strategy and participants

The sampling strategy can be described as the way a person or people are chosen for a sampling group (Martínez-Mesa *et al*., 2014:610). When using this approach, the strategy needs to be planned in detail before the sampling takes place. When doing this sampling, the sample size can be affected (Krause *et al*., 2011). The people who take part in such studies are referred to as the participants of the study.

3.3.3.1 Purposive sampling

Purposive sampling is used to better match the sampling design to the aims and objectives of the study. This can improve the study's trustworthiness of data and results explained as credibility, transferability, dependability, and confirmability (Etikan *et al.*, 2016:2).

In this study, purposive sampling was used to enable the researcher to choose the participants that will take part in the study. A reason for only one school being chosen and no other within

another community is, this was a single case study and no two different communities have the same characteristics as each other. Furthermore, this specific school was chosen to be the main focus of the study due to various reasons. First, the Climate Research Group of the North-West University's Potchefstroom Campus was busy collecting air quality data and doing research within this community, more specifically on the school premises. This means that the air quality monitoring stations being used to measure $PM_{2.5}$ is located on this school's premises. Second, the school is the only primary school within the peri-urban community. There are no other primary schools located close enough to form part of this research study. Also, this peri-urban community is unique since no two communities have the same characteristics as each other. For example, within one community air quality may be recognised as burning coal stoves and in another, it will be burning wood.

3.3.3.2 Sample population

During this research, the primary school within a peri-urban settlement of Carletonville in Gauteng was used as a single case study. This case study represented the Grade 5 learners and their parents/guardians of the peri-urban settlement community. The Grade 5 group of learners was chosen for the research study because the curriculum content in Grade 5 Geography deals with air pollution; therefore air quality can be addressed within that Grade. The only other area within the school curriculum where pollution is directly addressed in such a way that it can be linked to air quality is within the Grade 10 Geography curriculum.

This research's main focus was on the Grade 5 Geography theme related to air quality, but knowledge of air quality was integrated within the other Grade 5 subjects too. All of the participants directly involved in this study were the Grade 5 teachers, the parents/guardians of the Grade 5 learners, and the Grade 5 learners. There were 87 Grade 5 learners within the school. They took part in the study during the pre-questionnaire and pre-photovoice activities. During the post-questionnaire and post-photovoice activities, some of the learners were absent and only 75 learners took part. There were 75 parents/guardians who participated with their child during the pre-completion of the activity and 76 parents/guardians who participated with their child during the post-completion of the activity. These activities took place in two Grade 5 classes, with one Geography teacher. The parents/guardians of the Grade 5 learners and the Grade 5 learners were asked to complete a pre-and post-questionnaire. These questionnaires were the main instruments used in the research study. There was no control group during the research due to both the Grade 5 classes taking part in the study. All content topics must be taught as per the curriculum requirements. It would be wrong for the teacher to try and explain to learners why one class is not dealing with the same work that is required to be completed in the curriculum and why

one class is not taking part in the research like the other class. Most importantly, the learners would have talked to one another so the data from the second group of learners (a control group) may have been contaminated.

Throughout this research study, quantitative and qualitative methods were used to gather air quality data, and data relating to the awareness and the perception of Grade 5 learners and their parents/guardians regarding air quality within the peri-urban settlement. During the study, the data was gathered in stages. The data gathering was divided into four main stages, two of the stages had sub-stages. Stage 1 was the stage where the pre-questionnaires for the Grade 5 learners and the parents/guardians of the learners took place. This stage was one of the stages that had a sub-stage, the sub-stage was the pre-photovoice activity. Stage 2 was the post-questionnaires for the Grade 5 learners and the parents/guardians of the learners. Stage 2 also had a sub-stage which the photovoice activity took place. Stage 3 was when the paragraph narrative about the photos taken in the photovoice activity took place. Stage 4 was when the collection of the actual $PM_{2.5}$ air quality data gathered within the community for 2 years had to take place. The data collection methods used are discussed below.

3.4 METHOD OF DATA COLLECTION

The research question and objectives are the main reason for the methods that are chosen and used during the data collection phase of research (Canals, 2017:390). When collecting data, there is a specific method that the researcher uses to gather all of the needed information that will support the research study (Roberts, 2007). During this research study, the method of data collection was selected in a way that supports the answering of the research questions at best. The selection of the data collection methods and analysis methods during this research study, was based on how the data collection and analysis methods balance one another's assets and flaws (Peersman, 2014:1). Table 3.1 provides a summary of the course of the data collection and gathering processes.

Table 3.1: A summary of the course of the data collection and gathering process

Air quality data collection process	Data gathering and collection process		Dates	Stage
The $PM_{2.5}$ data were collected from June 2018 to June 2020. This data was collected within the peri-urban settlement that is being discussed within the research study. Stage 4	Pre-questionnaire activity for learners	Containing both quantitative and qualitative data	12 August 2021	Stage 1
	Pre-questionnaire activity for parents	Containing both quantitative and qualitative data	12 August 2021	Stage 1
	Pre-photovoice activity	Containing qualitative data	13 August 2021	Stage 1
	Workshop for teachers	-	29 September 2021	-
	Post-questionnaire activity for learners	Containing both quantitative and qualitative data	18 November 2021	Stage 2
	Post-questionnaire activity for parents	Containing both quantitative and qualitative data	18 November 2021	Stage 2
	Post-photovoice activity	Containing qualitative data	18 November 2021	Stage 2
	Pre-and-post photovoice narratives	Containing qualitative data	6 May 2022	Stage 3

3.4.1 Air quality monitoring data

The quantitative side of the research study entailed the actual measurement of the peri-urban settlement air quality. All air quality monitoring, measuring, and gathering was done by the Climate Research Group of the North-West University Potchefstroom Campus. The researcher received the data from the Climate Research Group department. After receiving the raw data, the researcher was responsible for the analyses.

Monitoring and measuring the particulate matter, $PM_{2.5}$ of the peri-urban settlement was done using a Met One Instruments E-BAM PLUS, a transportable, present beta gauge. This measurement can be compared to the national and WHO standards for daily average $PM_{2.5}$. The Met One Instruments E-BAM PLUS is very similar to the methods the United States Environmental Protection Agency (U.S. EPA) uses for measuring fine $PM_{2.5}$ and coarse particulate matter PM_{10}. This instrument obtains accurate, detailed, present measurements of fine particulate matter (Met One Instruments Inc, 2017). One of the important strategies used to understand air quality issues is monitoring, and this helps to identify poor air pollution patterns and trends and the long-term effects that poor air quality may have on surrounding communities.

Generally, monitoring air quality is a long phase to gather the needed data and evidence. Very seldom is air quality monitored over a shorter term. When monitoring is done it uses the guidelines of the National Environment Protection (Ambient Air Quality) Measure (EPA, 2018). The E-BAM uses an SD card as storage for the $PM_{2.5}$ measurements. The data was moved from the E-BAM Plus to a flash drive manually. This was done by connecting the instrument to a laptop and inserting a flash drive into the laptop. After the data were obtained it was analysed on the laptop. Once the air quality data was obtained from the E-BAM, the data were altered into the correct format for the researcher to understand and use the data during the study. The data used for this study were from 2018 to 2020. Due to the Covid-19 pandemic during 2020, the researcher could not access the school and complete the qualitative data and the pre- and post-questionnaires. The researcher had to wait until 2021 to have access to the school. During this research study $PM_{2.5}$, and PM_{10} data were collected within the community. The focus of the study was on $PM_{2.5}$, though. The reason for this is that evidence points to high levels of health effects when in contact with $PM_{2.5}$ (Xing *et al*., 2016:72).

Throughout, the research study the main aim was to establish if environmental education can influence the awareness and perception of Grade 5 learners and their parents/guardians regarding air quality. The air quality data collected and analysed has a direct link to a secondary question. The researcher used the data collected to establish the context of air quality in the peri-

urban settlement. Air quality is a big concern in South Africa and holds a very big health risk. If the data collected proves that air quality is a problem within the community, the researcher could link this to environmental education. This data was analysed and illustrated using descriptive statistics. Descriptive statistics are used in a study to describe and summarise the data used in the study, it is also used to simplify the data for the reader. Descriptive statistics can be seen as the first step in data analyses (Mondal *et al.*, 2022:70).

When using descriptive statistics there are four important sections (Mondal *et al.*, 2022:71). The first are measures of frequency. This is the count, percent, and frequency. This section is where the researcher illustrates how often something takes place. The second is the measures of central tendency. This is the mean, median, and mode. This section is used when the researcher illustrates the average or most common points of the data. Third, is measures of dispersion of variation. This is the range, variance, and standard deviation. This section is used to identify the data by intervals of high and low points. The researcher uses this section to illustrate to the reader the dispersion of the data. Last, is measures of position. There are the percentile ranks and quartile ranks. This section helps the reader to understand how the data are connected. The researcher used the section to compare data.

The first step was using the $PM_{2.5}$ 5 minute instantaneous measurements collected from the peri-urban settlement. The $PM_{2.5}$ hourly average was calculated and then $PM_{2.5}$ daily average for the two years of available data. Data were quality controlled by comparing the observed measurements to the technical specifications of the instruments, looking for single discrete outliers that could not be explained in the proper context of other measurements, and known periods where the instrument did not operate optimally.

3.4.2 Pre- and post-questionnaires

During this study, the researcher collected quantitative and qualitative data that was gathered from the pre- and post-questionnaires. The pre- and post-questionnaire had a variety of questions and the questions are carefully designed to generate data that will be used to answer some research questions.

3.4.2.1 Quantitative data collected from the pre- and post-questionnaires

The pre- and post-questionnaires were designed in such a way that quantitative data could be collected to answer some of the research questions. One of the research questions that the researcher asked was “How aware are Grade 5 learners and their parents/guardians of air

quality?" To establish how aware Grade 5 learners and their parents/guardians are of air quality, the researcher asked Question number 2,3,5 and 7 within the pre- and post-questionnaires. These questions collected quantitative data. Addendum 1 contains the pre- and post-questionnaires. The data collected from the questionnaire were analysed using crosstabulations.

3.5 METHOD OF DATA GENERATION

One of the easiest ways to gather data from a large number of people would be by making use of one of the most well-known tools in research, namely a questionnaire. A questionnaire serves as a tool when collecting data from a group of people. The main purpose of questionnaires is data collection from people in a written format (Marshall, 2005:131). The questions used in the questionnaires are often ranked or scoring options for the participants and can be open-ended and closed-ended questions. When the researcher asks a closed-ended question it confines the participant to a specified response. For example, multiple-choice questions (Save the Children, 2018). Some of the knowledge the researcher hoped to gain was a first-hand experience with air quality awareness.

3.5.1 Qualitative data generated from the pre-and post-questionnaires

The first step in this research was for the researcher to start gathering the data in the form of questionnaires. The Grade 5 parents/guardians were asked to attend a parent-teacher meeting. During this meeting, the vice-principal explained to the parents that the data gathering is for the research study and that they have given consent to take part earlier. The Grade 5 parents/guardians received a pen and were asked to complete the pre-questionnaire. The Grade 5 learners were asked to complete the pre-questionnaires during class time. The Grade 5 learners and the parents/guardians each had a separate questionnaire that they were asked to complete. This took place in early August 2021. The teachers explained to the learners that this is for the research study they have given consent to take part. The teachers also explained to the learners that the questionnaires were designed for them and the community they live in, and that the researcher wanted to learn more about them and the community they live in. These questionnaires were formulated clearly and understandably so that the learners and the parents/guardians could easily understand what was expected of them. These questions are scored choices so that the participants had open-ended and closed-ended questions. When a closed-ended question was asked, it limited the participant to a specified response. See the attached Addendum 1. After the pre-questionnaires were completed, the researcher started to analyse the data gathered during this phase. All the Grade 5 learners and parents/guardians pre-

questionnaire data were stored safely and anonymously. During the parent-teacher meeting, the parents/guardians also received the disposable camera. The cameras were given to the parents and asked to help the learners complete the photovoice activity.

The second step was for the teachers to attend a workshop. Before the Grade 5 learners were asked to complete the post-questionnaires as a class activity, a workshop was hosted in September 2021. This date best suited all Grade 5 teachers. The workshop had light refreshments and lunch for all participating Grade 5 teachers to illustrate the researcher's gratitude. The workshop was used to create more awareness regarding integrating the Grade 5 teacher's subjects and air quality into their teaching and learning. This workshop took place in September 2021. The focus of the workshop was on the Curriculum and Assessment Policy Statement document and how to link their subject to air quality.

During the workshop, the actual air quality data of South Africa was used for teaching and learning and to share new knowledge. The air quality data that were shared were of particulate matter, $PM_{2.5}$ and PM_{10}. This data illustrated to the teachers the actual state of the air quality within the country and some of the environmental and health issues that poor air quality can be responsible for. Throughout the workshop teachers also came into contact with the GLOBE protocol on air quality. During the GLOBE environmental education program presenters spoke about the importance of teachers teaching learners about real-world issues such as air quality. The workshop also supported the teachers with the needed teaching and learning material for their classroom and how to share new knowledge through the Geography Curriculum and Assessment Policy Statement. During the workshop, new knowledge of the National Curriculum and Assessment Policy Statement through interdisciplinary environmental education was shared to link air quality.

During the workshop, the teachers and researcher discussed and agreed on the number of lessons that the Grade 5 teacher needed to complete to fulfill the requirements of the research study. The reason for this discussion was so that the researcher could understand what the teachers timetable is like. The study was completely voluntary so the researcher had to ask the teacher to accommodate the activity in her teaching and learning planning. The teaching and learning time in class that was decided on for the research study was three periods. First, the teachers taught the learners about real-world environmental issues that we face and more specifically about air quality. These lessons took place in early October 2021. During this phase, the researcher helped the teachers to plan the lessons and activities. A key area in the lessons was the three major environmental pollutants (air, water, and land) and what environmental pollutants are. Then the focus moved to air pollution. The teachers spoke about what air pollution

is, why it is seen as a diverse pollutant, its sources and causes, the effects that air pollution has on humans and the earth, and lastly ways to prevent air pollution.

The pre-questionnaire activities were explained to the Grade 5 learners and one period was then given for them to complete the activity and return it to the teacher. The pre-photovoice activity was sent home by the teacher and the Grade 5 learners and their parents/guardians were asked to help the learners complete the activity. The activity was completed in early August 2021. The post-questionnaire was completed by Grade 5 learners six weeks after they completed the pre-questionnaires and pre-photovoice activity. The post-questionnaire and post-photovoice activity were handed out in the middle of November 2021.

The Grade 5 parents/guardian received another pen during the completion of the post-questionnaire. This was the same questionnaire used as a pre-questionnaire. See attached Addendum 1. The Grade 5 parents/guardian then received the same disposable camera that they used to complete the pre-photovoice activity. This part of the study was very important where the learner and the parents/guardians had to complete the activity together. The reason for this collaboration was so that the learner will receive formal education from the teacher and the learner transfer his/her new knowledge that they learned to their parents/guardians informally while identifying and photographing examples of environmental issues and sources of air pollutants for example fires, smoke, and dust.

The researcher sent 110 cameras to the school, and only 72 cameras were returned. The disposable cameras were sent in for development and the researcher was notified by the developer that 27 cameras were damaged and could not have their photos developed. This meant that only 55 cameras were returned that were still working. Between the pre-photovoice photos taken on the camera and the post-photovoice photos, a photo of a blank page was taken to distinguish between the two sets when they were developed. During the development, the developer notified the researcher that when developing the photos, the process moves the blank page to the end of the developed photos. For this reason, the researcher could not identify the pre- and post-photos. The researcher then checked the photos for applicability and the photos that did not meet the standard of protecting others' privacy, were destroyed. Some of these photos that were destroyed were photos of learners playing outside, photos with learners and their friend’s “selfies”, photos of the learner’s family members, and photos of the classroom and the teachers. The criteria that the researcher followed to identify the photos that could be used were as follow: The photos had to have any form of environmental issues captured or a source of any environmental issues to qualify as viable photos. After the photos were developed and the photos that could not be used were destroyed, the researcher started to analyse the photos that were

left. First, the researcher went through every camera and searched the photos for duplicates. Very often the Grade 5 learners took multiple photos of the same environmental issue or cause. For example, taking five photos of the same fire or taking three photos of the same littering site. The researcher then searched through the photos to identify which photos were not clear (due to focus or the learner having something in front of the lens). After the researcher sorted all of the photos that were usable and were printed and sent back to the school for the learners to identify and ask to help distinguish which photos were pre- and post-photos. The Grade 5 learners wrote 70 narratives for the photos that they identified as their own, and of the 70 narratives, 23 learners identified their pre- and post-photos. This meant that 23 Grade 5 learners did the pre- and post-photovoice activity. Twenty-four Grade 5 learners only completed either the pre- or post-photo activity.

Learners were asked to write a narrative answering four questions for the pre-photovoice photo and the post-photo voice photo. (See Addendum 2). Due to an administrative school decision and miscommunication, the learners did not write the photovoice narrative in 2021. The narrative was only completed in early May 2022. The learners received the photos they had taken the previous year and were asked to write about the environmental issues they could identify in the photo that they had taken. The photovoice activity formed part of the qualitative phase of the research study. The activity was to identify the type of environmental issue, why the Grade 5 learner thinks this is an environmental issue, and how this issue affects the learner and their family members. After the narrative activity, the teacher asked the learners to share their learnings about the activity and their narratives during an informal discussion that was not documented in May 2022.

3.5.2 Photovoice

Photovoice as a data gathering tool, is a visual analysis method that can be used to support the visualisation of a study (Mitchell, 2011:60). The photovoice approach allows photo narratives to be used to support the explanation of the visual data (Wang *et al.,* 1996:7). This term was invented in 1995 by Caroline Wang when she wanted to strengthen the understanding and the voice of the participants. During the research study, the researcher provided the Grade 5 learners with a disposable camera. The photovoice activity was explained to the learners by their teachers and to the parents/guardians within the letter and during the meeting with the vice-principal. The cameras were given to the parents/guardians, and they were asked to help the learners complete the activity. The activity given to the learners was to take photos of environmental issues within the community. Parents/guardians and learners were asked to please be safe and take photos around the school, home and if outside to please make sure the parents accompany their child. Learners were asked not to take photos of people's faces due to privacy, but if the person is part

of the issue they will have to ask the person for permission to be photographed. The Grade 5 learners were motivated to complete the photovoice activity within three days where after they were asked to return the disposable camera to school. After the Grade 5 learners returned the disposable camera to school the researcher kept the cameras safe until the cameras were needed to complete the post-photovoice activity. The reason this activity is so important is that it gave learners the opportunity to source and use a visual source of data to show their understanding of air quality issues. Another reason for regarding this photovoice activity as being important is the informal learning that took place from the parent/guardian and learner partnership. Formal education was extended when the teacher and the learner transferred some of the new knowledge that they have learned to their parents/guardians informally.

The post-photovoice activity was given to learners and parents/guardians to complete. The learners received the same camera that they have used earlier in the pre-photovoice activity. The post-photovoice activity was completed in the middle of November 2021. The learners were asked to take photos with the help of their parents/guardians and return the cameras to school within three days. The researcher then contacted the school and asked if the learners could complete the narratives because the learners were also asked to write a narrative regarding the photos they have taken. Due to administrative decisions and miscommunication, the learners completed the post-photovoice activity but did not write the pre- and post-narrative until early May 2022. The narrative activity was that the Grade 5 learners had to write a paragraph narrative about what they have identified as the environmental air quality issue and motivate why they see that as an issue. Within the parent/guardian letter, the parents/guardians permission was asked to make use of this paragraph narrative that the learners will be writing. These paragraph narratives are a very important part of the research study. This had to be used by the researcher to establish if the Grade 5 learners could identify some air quality issues. The researcher asked the Grade 5 learners to identify in their narratives the type of environmental issues shown in both photos; why the learner thinks that photo shows an environmental issue; and how the environmental issue affects them and their family members.

3.5.3 Challenges faced with data gathering

During this research study, there were many changes and obstacles that the researcher faced. One of the biggest obstacles was the Covid-19 pandemic. Due to Covid-19, the dates for many of the activities were not followed as originally planned. First, the research study was supposed to take place in 2020, but due to lockdown and many changes in the school calendar and curriculum, the study had to be moved to 2021. Second, after the study was moved to 2021 the researcher once again faced the difficulty of completing the study while Covid-19 was still having

a big influence on the country. During this 2021 year the school was closed two weeks before the original workshop had to take place. The workshop then had to be moved to a later date. Another issue that the researcher faced was that due to Covid-19, some of the people that helped in the study got sick and the pre-questionnaires were only completed later. Last, due to some people getting sick and the school calendar getting adjusted sometimes, the amount of time the researcher had to complete the study became a challenge. The challenge was exacerbated by a very busy schedule, learners needing to complete the curriculum in time for the final exams, and the teachers waiting until November before they could give attention to completing the post-questionnaires and post-photovoice activity. An administrative decision was made to suspend the post-photovoice activity because it was too late to complete it, and learners did not have time to do this due to exams. For this reason, learners had to wait until the next year to complete the final activity with their parents/guardians.

3.6 METHODS OF DATA ANALYSIS

Data analysis is a crucial stage of any research study, when the data that were gathered throughout the research study are sorted and a structure is formed (Flick, 2013:6; Marshall and Rossma, 1989:226). In this study, quantitative and qualitative data were used and were responsible for a clear comprehensive understanding of what the research study is about and what is expected to be achieved from it. The quantitative aspect of the research study was responsible for the air quality data collection, while the qualitative aspect was responsible for understanding the links that the research study had to any social, political, or cultural background within the peri-urban settlement.

3.6.1 Air quality monitoring data's $PM_{2.5}$ analysis

During the research study, the air quality measurements in fine particulate matter ($PM_{2.5}$) data of the peri-urban settlement, was gathered. Particulate matter consists of solid and liquid particles with physical and chemical characteristics. It includes soil dust, dirt, soot, smoke, pollen, ash, aerosols, and liquid droplets. Particulate matter is categorised according to size (EPA, 2017). The Met One Instruments E-BAM PLUS was used for measuring fine particulate matter ($PM_{2.5}$) and (PM_{10}) particulate. The data were daily average in micrograms and is analysed by the researcher using Excel. By gathering the air quality data, it supported the secondary question of the research asking what the context of air quality in the peri-urban settlement is. After the data were analysed, the researcher illustrated the data visually. The researcher first made a box whisker diagram using

Excel. To make the box whisker diagram, the researcher had to do the following: First, get the daily monthly average for the two years of data. Next, the researcher had to calculate the minimum, quartile 1, median, quartile 3, maximum, IQR, whisker top and bottom, and the upper and lower bound. All the outliers within the data were identified. The daily $PM_{2.5}$ average values were presented on a monthly basis to show the annual distribution. This diagram also had the National Environmental Air Quality Act, 2004 (Act no. 39 of 2004) and the World Health Organization (WHO) air quality standards set in it, making it easy for the reader to see when these two standards were exceeded. After completing the diagram, the averages were used to compile a table. The table only contained the months that the National Environmental Air Quality Act, 2004 (Act no. 39 of 2004) and the World Health Organization (WHO) air quality standards were exceeded. The table also showed how much the air quality standards were exceeded. Chapter 4 will have a discussion regarding the months that the standards were exceeded.

3.6.2 Crosstabulations analysis of the quantitative data collected from the pre- and post-questionnaires

One of the most useful tools used in research is cross-tabulation. This tool is useful to explore different response patterns (Maree, 2007):110. When making use of cross-tabulation one variable is presented concerning another (Cohen *et al*., 2011:508). All Grade 5 learners and their parents/guardians participated in a pre-experimental design. A sample group was used during the pre-and post-questionnaire without a control group. The analysis was done by using crosstabulations which enables the researcher to analyse all the possible answers. The researcher came to a conclusion that represented the Grade 5 learners and their parents/guardians of peri-urban settlement.

In the case of this study, the researcher used cross-tabulation to show the relationship between the pre-and the post-questionnaires. The researcher also wanted to use the cross-tabulation to show the relationship between the Grade 5 learners and the parents/guardians pre- and post-questionnaires. By using the cross-tabulation, the researcher could notice a change in the pre- and post-questionnaires of the Grade 5 learners and the parents/guardians. By using cross-tabulation, the researcher was able to link the data to one of the objectives set, “to establish how aware Grade 5 learners and their parents/guardians are of air quality”. The cross-tabulation helped support the researcher’s objective and to determine if the Grade 5 learners and the parents/guardians awareness levels truly improved after environmental education took place.

The cross-tabulation compared the pre- and post-test scores of the Grade 5 learners and their parents/guardians. This method was used to study the interactions within the data. By making

use of this method of analysis there are patterns identified and grouping raw data is much easier. The data analyses were done in the following manner: In advance of the data being used in cross-table analyses the raw pen and paper data were entered into Excel. This was the first step. Second, all individual questionnaires were given an identification number: L1 for learner 1 and P/G 1 for parents/guardians. Unfortunately, due to administrative challenges and miscommunication the pre- and post-questionnaire of each Grade 5 learner and parent/guardian could not be linked, but the Grade 5 learners questionnaires were kept separate from their parents/guardians. Third, all the data on the questionnaires were typed into Excel. The questions and answers of the questionnaires had numbers allocated to make the data entering on the Excel spreadsheet easier: Question 5 was a yes- or no-question, so the code was, 1 for yes or code 0 for no. By making use of a system, the researcher easily compared how one variable differs based on another variable. Using this method of analysis throughout the research study the researcher was able to establish the awareness Grade 5 learners and their parents/guardians have regarding air quality. Descriptive statistics were used to summarize and present the data of questions 2, 5, 7 and 9 in a meaningful way.

3.6.3 Thematic analysis of the qualitative data gathered from the open-ended questions in the pre- and post-questionnaires

The thematic analysis uses several analysis classifications and patterns linked to the data. This method of analysis demonstrates the data in detail, for example the different themes and clarifications and different theories can be created and linked to the data (Boyatzis, 1998:4; Namey *et al*., 2008:138). According to Saldana (2011:36), the best way of answering the questions a researcher has, is by just asking them. Often this will be by using open-ended questions. When open-ended questions have been used the answers must be analysed thematically and it is best done by using codes. Mouton (2001:149) agrees that when analysing the researcher needs to break up the data into workable themes. A code within a qualitative research study usually refers to a word or a very short phrase that captures the data. To do coding is to identify the different parts of data. When the researcher codes the researcher creates a way they can classify the data for further analysis (Saldanha, 2011). Various types of data can be coded for example documents, photographs, interviews, field notes, and more. In this study, the researcher did not need to use codes to create categories. In the pre-and post-questionnaire analysis, the researcher noticed that the Grade 5 learners and their parents/guardians made use of many one-word responses and these responses became the categories. There was no need to cluster the responses of the participants into categories due to the responses being self-

standing. However, the researcher did record how often each word was referred to whereafter the researcher calculated the percentages of times the participants used the words.

3.6.4 Thematic analysis of the qualitative data gathered from the pre-and post-photovoice narratives and the pre-and post-photographs

The photovoice narratives were thematically analysed by the researcher. This was done by reading through the data to identify what words were repeated to create codes and then categories. In the pre-and post-questionnaire section of the study, the participants made use of very short phrases, and it was not needed for the researcher to create codes since the categories emerged from the participants responses.

The analysis was done first for the pre-photo narratives and then for the post-photo narratives. Then the categories were compared and themes that emerged were identified. This way the researcher can check the data later again and make links between some of the themes.

Figure 3.1 shows the types of environmental issues that the Grade 5 learners named during the photovoice narrative. There were three main environmental issues that the Grade 5 learners identified.

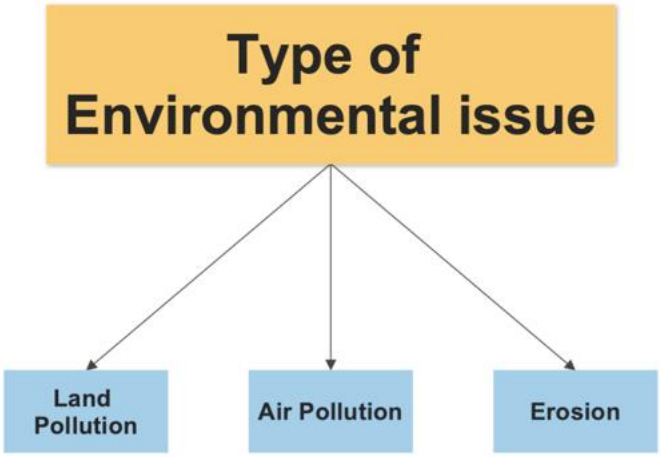


Figure 3.1: Types of environmental issues.

Figure 3.2. shows how the analysis is presented, of why the Grade 5 learners think that the answers they identified within Figure 3.1. are environmental issues. The text in the blue blocks is

some of the actual sentences that the Grade 5 learners used. There were eight reasons the Grade 5 learners gave as to why they thought their response qualify as environmental issues.

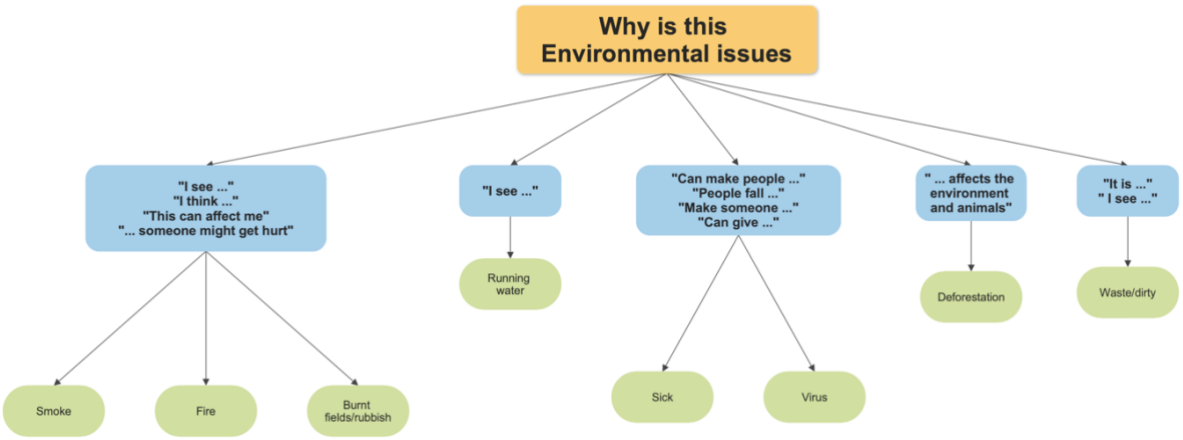


Figure 3.2: Why are these environmental issues?

Figure 3.3 shows how the Grade 5 learners think that environmental issues affect them. The blue blocks show the words used in the actual responses of the Grade 5 learners, and it was used to categorise the responses. All 87 Grade 5 learners during the pre-questionnaire and the 75 Grade 5 learners during the post-questionnaire responded in this manner, forming this pool of twenty different responses (in the green blocks), in reply to how the environmental issues affect them.

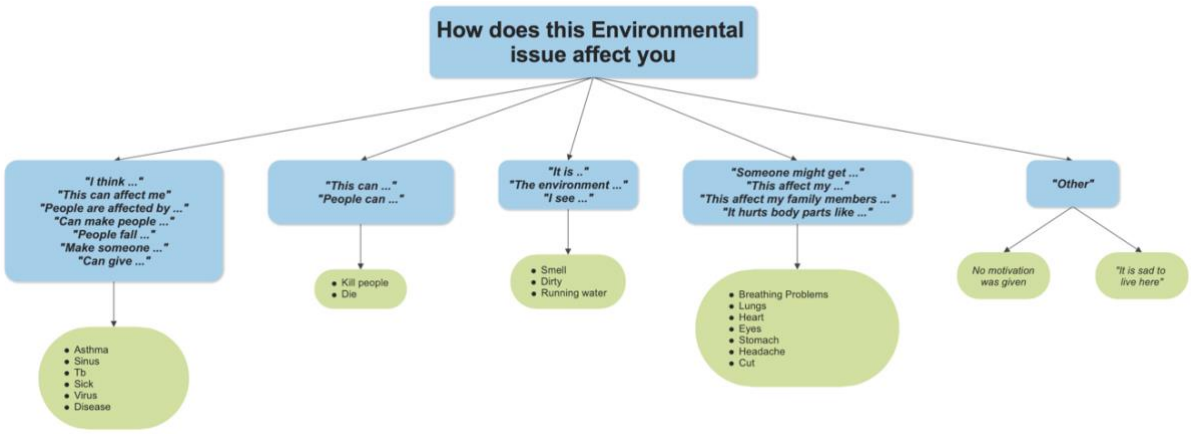


Figure 3.3: How does this environmental issue affect you?

Figure 3.4 shows how the Grade 5 learners think the environmental issues affect their family members. The actual sentences that they used are in blue blocks and are very similar to Figure 3.3. In this section, the Grade 5 learners responded that these issues affect their family members in five main categories but through twenty different ways (in the green blocks).

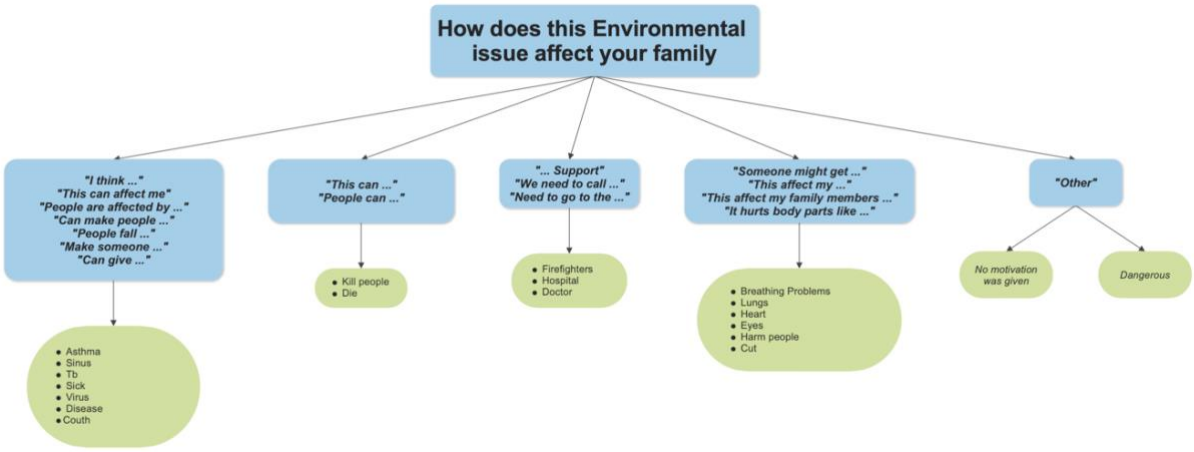


Figure 3.4: How does this environmental issue affect your family?

The first step when analysing visual data, is to examine the images captured by the participants from a researcher's viewpoint (Oliffe *et al*., 2008:530). The researcher analysed the photos by means of weighting. The order of analysis was such that the researcher did not impose her interpretation of the photo on those of the participants.

3.7 THE ROLE OF THE RESEARCHER IN THE STUDY

During this research, the researcher presented a virtual workshop to the teachers. This workshop took place on the 29th of September 2021. The reason for the workshop was so that the researcher and teachers could decide on the teaching and learning intervention together. The researcher together with the Grade 5 teachers developed the questions used in the pre- and post-questionnaires. These questions had to be developed in such a way that they could easily be understood and completed by the Grade 5 learners and their parents/guardians. The questions were developed to relate to the phenomenon within the research. During the study, the researcher made sure to conduct the study professionally and ethically. This means that the researcher did not approach the participants with bias at any time and was non-judgemental when analysing the photos. The researcher also made sure all participants received equal opportunities and there

was no favouritism, this was done by making sure all participants were kept anonymous. Last, the researcher did not modify or adjust any data during the data gathering and the data analysis of the research. This was checked for errors by the study leaders. During the study, the researcher wanted to understand how the learners and their parents/guardians perceived air quality and how aware they were of air pollution.

3.8 QUALITY CRITERIA

According to Lincoln and Guba (1985), qualitative researchers should illustrate trustworthiness. When doing research, the same types of quality criteria can be used. These quality criteria apply to all the approaches. These criteria are used by the researcher to determine if the research is credible and trustworthy (Korstjens & Moser, 2018:279). What this means is if the findings of a study can be trusted and whether the findings are accurate. When doing a study there is multiple definitions and criteria of trustworthiness that exist and that can be used in the study (Korstjens & Moser, 2017). The criteria by research approach that was used for both the quantitative and qualitative research are true value, applicability, consistency, and neutrality. Each approach uses different strategies with which to establish trustworthiness and reliability, respectively (Lincoln & Guba, 1985; Krefting, 1991:215).

3.9 QUANTITATIVE APPROACH'S STRATEGIES TO ESTABLISH RELIABILITY

According to Lincoln and Guba (1985), the four aspects of truth value, applicability, consistency, and neutrality should be different for qualitative and quantitative research. This difference is based on philosophical and conceptual divergence. Lincoln and Guba (1985), "the researcher needs to recognise that even though many techniques are available, not all of the techniques are appropriate for all studies.

3.9.1 Internal validity (Truth value)

According to Lincoln and Guba (1985), the truth value of a study is to make sure the researcher is certain of the findings of the study. Within quantitative research, the truth value is assessed by checking how the issues to the internal validity of the study were managed and the validity of all instruments used within the study (Sandelowski, 1986:524). The internal validity of a study is backed when the changes within the dependent variable can be supported by the changes within

the independent variable, according to Campbell and Stanley (1966:30). Lincoln & Guba (1985) state that internal validity is built on the belief that there is a real world that should be measured. In this study, internal validity was achieved through the use of pre-and post-questionnaires that were targeted to establish what the awareness and perceptions of air quality of the Grade 5 learners and their parents/guardians were before and after the teaching and learning intervention. The questionnaire responses were compared and the same applies to the photovoice activity. The researcher also made sure there were no extraneous variables to threaten the internal validity of the study. This was done by asking the Grade 5 learners and the parents/guardians to work in the same community for the pre-and-post activity.

3.9.2 External validity (Applicability)

External validity is to generalise the findings in the study to the larger population. The applicability then refers to the findings of the study being applied to other contexts and groups (Payton, 1979). During the research, the researcher wanted to achieve external validity so that the study's findings could apply to a broader context. The researcher wanted to generate new knowledge that could be linked to the real world. External validity was achieved by making use of a wide range of participants, in the case of this study there was only one primary school, and all Grade 5 learners and their parents/guardians were asked to participate. Due to all Grade 5 learners and their parents/guardians participating, the statistical power of the study was increased. Last, the only exclusion criteria that the study had was that all learners must be in Grade 5 to be allowed to take part in the study. The research was conducted in such a way that the quantitative data collected should be able to be applied to other low-income areas and to other participants that face similar environmental issues.

3.9.3 Reliability (Consistency)

When conducting quantitative research, reliability is the principle that is responsible for the stability, consistency, and equivalence within the study (Sandelowski, 1986:523). Reliability is to go to such an extent that the researcher can repeat the measures taken during the study and will get the same results, and even when doing so with different people expect the same results (Krefting, 1991:216). Within the goal of reliability is repeatability, the reproduction of the study should not alter the findings. This quantitative angle on consistency is also based on the real world, when studying something unchanging it should be used as a standard (Lincoln & Guba, 1985). Reliability was achieved in the study by documenting every step taken to make sure the researcher follows the same proses when needed. For example, the pre- and post-questionnaires that were completed were the same questionnaires for both the Grade 5 learners and the

parents/guardians, ensuring that the participants understood every question the same way, and also that the researcher could see the changes within the participant's responses.

3.9.4 Objectivity (Neutrality)

Objectivity is the principle of neutrality. Objectivity can be obtained through the accuracy of methodology, used to ensure reliability and validity. Objectivity can also indicate separation between the study and the researcher, this ensures that the researcher is not biased. According to Lincoln and Guba (1984), neutrality should not be seen as the research objective but rather as the data and interpretational confirmability. During this research, the researcher achieved objectivity by searching for evidence in all areas, valuing the participant's opinions and responses, not having any relationship with any of the people involved with the study, and not being biased in reporting on the findings or letting any possible subjectivity influence the research that will affect the outcome of the study.

3.10 QUALITATIVE APPROACH'S STRATEGIES TO ESTABLISH TRUSTWORTHINESS

When doing a study, it is of great importance to know that all qualitative studies will not be evaluated using the same criteria. According to Sandelowski (1986:524), the term qualitative research summarises the meaning of many diverse research methods. All of the different approaches that can be used during a research study have different purposes, methods, and ways to conclude if the approaches are trustworthy or not. Even though some rules are essential to all qualitative research, it is very important to implement the rules accurately. If the application is not done correctly for the qualitative criteria of trustworthiness during a study, this can cause problems and be the incorrect quantitative criteria to use (Krefting, 1991:220). It is also of great importance when understanding any model of trustworthiness of qualitative research, that the researcher does not use the incorrect approach of quantitative criteria when doing qualitative research. According to Krefting (1991:220), the most well-known strategies with which to establish trustworthiness are confirmability, transferability, dependability, and credibility.

3.10.1 Confirmability (Neutrality)

Confirmability is to be sure the findings are determined from the actual data from the study that was analysed correctly and not just from the researchers' ideas (Lincoln & Guba, 1985). Confirmability is how well other researchers could prove the findings of the study. According to

Tracy (2010:844), during a research study, the steps taken from the start of the study during the entire study should be documented to show the path that the researcher took. This will ensure the steps taken during the start, development, and findings are clear. This is very important for confirmability and dependability. From the start of this research study, the researcher documented all the steps taken during the study until the end of the study (see Table 3.1). All the steps have been documented and explained in detail throughout the write-up of the study. This should assist other researchers reading the study to fully understand the study and to be able to follow the same path to make sure they can confirm the findings. The criteria chosen to establish confirmability is triangulation (Krefting, 1991:219). During this study, triangulation was used. According to Knafl and Breitmayer (1989), triangulation is when various methods of data collection are merged to establish that different areas of the research have been explored. Korstjens and Moser (2018:122) state that the triangulation method is to use various approaches for data collection. In this study, the researcher made use of the triangulation method. The researcher used various approaches to gather data. The first approach to gathering data was the pre- and post-questionnaires. The second approach was the photovoice activity. The third approach was the narratives that the Grade 5 learners had to write and the last approach was the $PM_{2.5}$ data collected within the community. This helped the researcher to ensure confirmability.

3.10.2 Transferability (Applicability)

Transferability is the degree to which level the findings of a qualitative research study can be linked to different contexts. In the case of this research study, the participants live in an informal settlement causing this study's findings to give an insight into similar informal settlements. When the researcher does this, the researcher supports the transferability judgment of future researchers through broad descriptions (Lincoln & Guba *et al*., 1985). What is meant by broadening the description is to explain not only the behaviour and experiences within the study, but also the context of the behaviour and experiences. This strategy will ensure the description is meaningful to the reader (Lincoln & Guba, 1985; Tracy, 2010:844). In the study, the researcher made sure to make clear and direct links between the findings and the contexts This was done by linking the pre- and post-questionnaires, photovoice activity, and narratives to the research questions. The researcher made sure to have in-depth, dense, and broad descriptions regarding the findings and this should ensure that the research is useful to other researchers reading it. An in-depth and broad description of the findings should also ensure that all that the researcher has done is visible to any reader or person from the outside of the study. Another criterion that the researcher used, was time sampling. Time sampling is when the researcher observes all potential situations, this is in addition to the "social setting, seasons, weeks, days and even time (Knafl &

Breitmayer, 1989). This is a way to see if the data used in the research study is typical or not. In this study, the researcher collected data during certain seasons of the year. The researcher wanted to collect data during the winter months. During the winter months in most informal communities, the residents need to heat their homes due to being cold. The researcher wanted to establish if the participants in the study in a low-income community were aware of how different human activities can cause environmental issues.

3.10.3 Dependability (Consistency)

According to Lincoln and Guba (1985), dependability is how stable the findings of the study are over a period. Dependability is to ensure that the participants involved in the study provide their assessment of the findings, as well as the comprehension, and suggestions of the study in such a way that all the data are received. Again, the steps taken during the study should be documented when using the confirmability strategy (Tracy, 2010:844). In this research study, the researcher followed the same steps. The researcher made sure to document all the steps in detail. Step 1 for the Grade 5 learners and the parents/guardians is to complete the pre-questionnaire and the photovoice activity. Step 2 for the Grade 5 learners and parents/guardians is to complete the post-questionnaire and the photovoice activity. Step 3 for the Grade 5 learners is to write a paragraph narrative for the pre- and post-photos they have taken. Step 4 is for the researcher to collect the $PM_{2.5}$ air quality data. The researcher also made sure to use all the data from all the participants. This should ensure that the data are accurate, that all the participants in the study were important, and that the data are useful.

3.10.4 Credibility (Truth value)

Based on Lincoln and Guba (1985) credibility is when there is certainty within the study findings that it is the truth. The credibility of a study provides the needed information on whether the findings of the study are established from the original data that the participants provided and whether it was correctly interpreted from the participant's viewpoint and credibly. This should be the true value of the study. When making sure a study is credible there is a criterion that can be used. Triangulation as a criterion has already been discussed earlier. In this study, the researcher made sure to document all the steps to prove that the findings come from the original data. The researcher also used applied structural coherence as a criterion, making sure the data were not unexplained and linking it to the study. The researcher placed a lot of focus on the main issue of the study "environmental issues" to identify the issues within the community where the participants live. To improve the credibility of the final results gained during the research study the supervisors of the study compared the codes used in the study with the corresponding text (Glaser, 1965:437).

Reflexivity is how the researcher does a broad self-reflection on the way the researcher undertook the research study, gathering and analysing the data. This involves the researcher's own biases, preferences, and preconceptions in addition to the relationship between the researcher and the participants, and the way the researcher affects the participants' answers to the questions they received during the study (Lincoln & Guba, 1985). According to Tracy (2010:843), reflexivity is for the researcher to inspect their theoretical lens, accurate and inaccurate assumptions, bias, and beliefs and how this affects the decisions made during all stages of the qualitative study. In the study, the researcher made sure not only to always document every step but also to always follow the literature and the methodology that the researcher designed to help with the study. By doing this the researcher was always self-reflecting to ensure that the subsequent step they would take is justified.

3.11 ETHICAL CONSIDERATIONS

Before the study took place, the researcher had to consider all ethical implications and processes first. The first step was for the researcher to apply to the Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics Committee (NWU-EMELTEN-REC) of North-West University for ethical approval. After applying for this, the researcher had to do online ethical Training and Support courses from the training program in research ethics evaluation (TRREE). Once the needed ethics approval was granted, the researcher wrote a letter to the district director general at the Department of Basic Education in the Gauteng Province. This letter was to ask permission so that the researcher could conduct the study at the primary school within the peri-urban settlement of Carletonville in Gauteng. When the researcher was granted permission to go forward with the study, the researcher asked an independent person to contact the principal. The independent person provided the principal with a letter that explained to the principal what the study was about and what the benefits and risks will be if the school should take part in the research study. During the meeting, the independent person explained the research study to the principal and answered all the questions that he had, and thereafter the independent person asked the principal for permission so that the school can take part in the research study. The order that the participants were recruited worked as follows: the principal, Grade 5 teachers, the parents/guardians of the Grade 5 learners, and the Grade 5 learners.

Second, after the independent person spoke to the principal and the principal agreed that the research may be conducted at the school, the independent person arranged to talk with the

teachers to ask if they were willing to take part in the research study. The independent person explained the research study to them, what part they were responsible for, and answered all of the questions that they had. After the teachers agreed that they will take part in the research study they were asked to sign the “informed consent documentation for teachers” by an independent person.

The independent person should have met with the parents. The principal requested that the vice-principal do this so that parents will feel more comfortable with the vice-principal. The last step was to ask permission from the participants by sending a letter home with the Grade 5 learners inviting them to the parent-teacher meeting. During this meeting, the parents received a letter that explained to the Grade 5 parents/guardians and learners what the research study was about and why it was important to do the study. The letter also explained to the Grade 5 parents/guardians and learners that taking part in the research study was completely voluntary. The letter also explains the benefits and risks involved if they take part in the research study. After reading the letter, the Grade 5 parents/guardians and learners were asked if they are willing to take part in the research and they completed an “informed consent documentation for parents/guardians and an “informed consent documentation for learners”. The letter was then sent back to the school. This completed the explanation of the research study and asked permission from all participants.

The teachers that teach Grade 5 Geography learners were directly involved in the project because of their role in teaching the curriculum content and completing the air quality activity with the learners. Since there is only one primary school in the settlement the learners that attend the school come from all over the peri-urban settlement and, this gave the research a much better spatial perspective regarding the community.

3.11.1 Permission letters

After the researcher gained all the needed ethical and governmental and school approvals to conduct the study, the researcher used permission letters. All participants that took part in the study were given an informed consent letter to sign before the study began. The letters that the participants received also explain the aim and objectives of the study.

3.11.2 Voluntary participation

According to Neuman (2003:472), participating in any study must be done voluntarily. The permission letters that the Grade 5 learners parents/guardians received also explained that taking part in the study is completely voluntary. All participants that took part in the study were asked to volunteer and no participants were forced into taking part in this study. All participants taking part

in the study were also informed through the letter that if they wanted to withdraw from the research at any time, they can do so without fear of unfair treatment.

3.11.3 Privacy

In this study, pseudonyms are used by the researcher to ensure the participants' complete privacy. This information was communicated to participants through the permission letter and when the study was explained to them. Throughout the study, any personal information from the participants that were not relevant to the study was avoided. All data and information gathered during this study were placed in the office of the study leader as stated in the guidelines of the North-West University. All data from the study were collected and kept confidential. The data will be stored for five years and remain the responsibility of the project leader. All electronic data were used and saved on a flash drive that was locked in the project leader's office. This data and all hard copies will be signed out and destroyed by the NWU"s service that destroys examination papers after five years. None of the documentation used in the study required any identification and all identities will remain anonymous. The privacy of all the Grade 5 learners and their parents/guardians was protected.

3.11.4 Risk of study

The risks that the participants faced during this research study were minimal due to the air quality content forming part of the school curriculum. First, no foreseen risk was faced by the teachers. The main reason for this was the content that the teachers presented during their lessons were part of the school curriculum and not downright unknown and new. Second, the Grade 5 learners' only foreseen risk involved was for the period of the photovoice activity completion. Some precautions were taken to reduce the risk. The Grade 5 learners and the parents/guardians being asked to complete the activity together. They were asked when completing the photovoice activity that they will do so in the schoolyard and within the yard and house where the Grade 5 learners and the parents/guardians live. Additional precautions were that the learners should not take photos of any person's face within their yard, the school yard, or outside the yard of their neighbours. All photos from the photovoice activity were scanned and sorted by the researcher. The photos that did not meet the standard of protecting others' privacy were destroyed. Last, no foreseen risk is involved with the Grade 5 parents/guardians.

Nonetheless, the independent person spoke to the Grade 5 parents/guardians, explaining why it was critical for the Grade 5 learners and their parents/guardians not to complete the photovoice activity outside the given areas, and that the researcher did not want to place any participant in harm's way. Through this research study, the benefits outweighed the risks involved. The main

motivation for only focusing on the learners' immediate living environment is so that at the final gathering when all of the participants involved in the research study were invited to listen to the findings of the research, the issues that the participants face regarding poor air quality were identified as issues from their living environment. The participants involved received light refreshments the evening while the Climate Research Group of the North-West University Potchefstroom Campus explained to them how some of the air quality issues that have been identified during 2018, 2019, and 2020 can be improved and how they will impact the community. For this reason, the benefits outweighed the risk involved in the future, should the air quality improve. After the final data-gathering phase, the Grade 5 learners and teachers involved received a pencil bag containing stationary as a small token of appreciation for taking part in the research study.

3.12 CONCLUSION

The methodology of this research study followed a multimethod approach that contained both qualitative and quantitative data gathering along with analysis. This was done within a single case study design consisting of one school. By doing this research the researcher created an opportunity to establish how environmental education can influence the awareness and perception of air quality in Grade 5 learners and their parents/guardians. The philosophical orientation had two research paradigms that applied to this study; this was the positivism paradigm for the quantitative side and the interpretivism paradigm for the qualitative side. In this study, purposive sampling was used. This study's sampling strategy and participants were well-planned and detailed before the study occurred.

The quantitative side of the study was the air quality data collected, while the qualitative side of the study was the social interaction between the participants. The air quality data were completed using a Met One Instruments E-BAM PLUS. This instrument measures the particulate matter ($PM_{2.5}$) of the peri-urban settlement. Some of the other methods used to gather data were pre- and post-questionnaires for the Grade 5 learners and their parents/guardians as well as pre- and post-photovoice activities that had to be done as a collaborative activity by the parent/guardians and learner after the Grade 5 learners completed a narrative. The biggest challenge that the researcher faced during this study was COVID-19. The next chapter will present the results, a discussion thereof, and an interpretation of the results.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 INTRODUCTION

In the previous chapter, the research design and methodology that were used for the study were explained. The purpose of Chapter 4 is to present, discuss and interpret the results of the analysis of the data. This chapter starts with an introduction to explain the focus of the chapter, followed by the presentation of the quantitative and qualitative data that were analysed. The empirical research of this study aimed to establish how environmental education influences awareness and perceptions of air quality in Grade 5 learners and their parents/guardians. In addition, the purpose is to address the research questions posed in Chapter 1. They are: What is the context of air quality in the peri-urban settlement? How aware are Grade 5 learners and their parents/guardians of air quality? What is the perception of Grade 5 learners and their parents/guardians of air quality?

All the data gathered in this study from the participants was done voluntarily. The data gathering was done in 4 stages, two of the stages had a sub-stage within the study. Stage 1 was the collection of the actual $PM_{2.5}$ air quality data gathered within the community over 2 years. Stage 2 is the completion of the pre-questionnaires by the Grade 5 learners and their parents/guardians, respectively. During this stage, a pre-photovoice activity was completed by the Grade 5 learners together with their parents/guardians. Stage 3 is where the post-questionnaires were completed by the Grade 5 learners and their parents/guardians, respectively. During this stage, the post-photovoice activity is completed by the Grade 5 learners together with their parents/guardians. Stage 4 refers to the photovoice narrative written by the Grade 5 learners for the pre- and post-photos taken in the joint photovoice activity. All the data collection and gathering methods were discussed in Chapter 3. The results are discussed in this chapter.

4.2 RESULTS OF THE ACTUAL $PM_{2.5}$ AIR QUALITY DATA GATHERED WITHIN THE COMMUNITY OVER 2 YEARS

In this section, the analysis of the $PM_{2.5}$ air quality measurements taken from the Wedela peri-urban community will be presented, discussed, and interpreted. Two years (June 2018-August 2020) of $PM_{2.5}$ air quality data were collected. This data were collected using a Met One

Instruments E-BAM PLUS. The data that were gathered, were in hourly average in micrograms and were analysed using Excel. After the analyses, the researcher made a box whisker diagram using Excel. Within the box whisker diagram was the National Environmental Air Quality Act, 2004 (Act no. 39 of 2 in it. Figure 4.1 show

The daily average $PM_{2.5}$ concentrations per month of the year between 2018 and 2020 as observed in the peri-urban settlement.

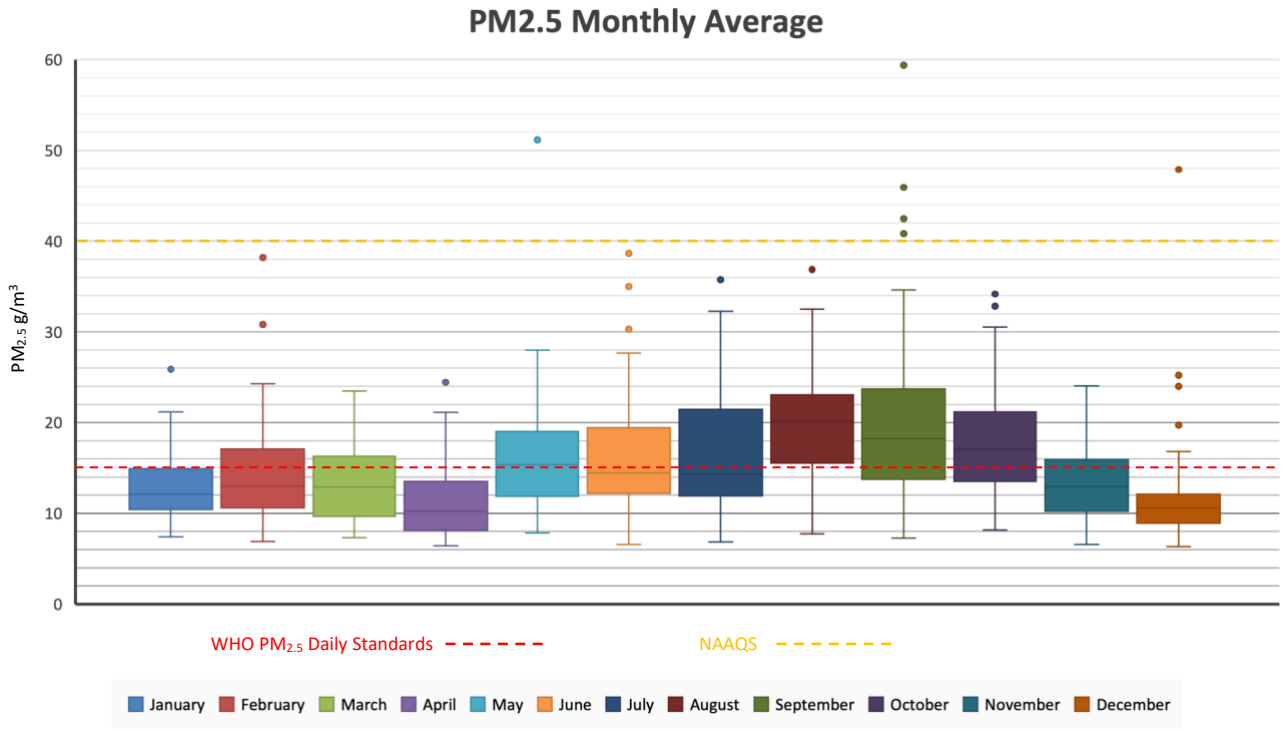


Figure 4.1: The daily average PM2.5 concentrations per month of the year between 2018 and 2020 as observed in the peri-urban settlement.

The boxes in Fugure 4.1 denote the 25% median, and 75% percentiles. The whiskers show the minimum and maximum values within 1.5 times the inter-quartile range from the median, and the outliers are presented as dots.

Figure 4.1 shows the $PM_{2.5}$ data collected during the two years. The figure shows in red the World Health Organization (WHO) air quality standards and in yellow the National Environmental Air Quality Act, 2004 (Act no. 39 of 2004) and the exceedance of the standards. This figure also shows clear exceedances of the WHO's $PM_{2.5}$ standards sometime throughout all of the months. In some months the exceedance is not very often but in other months (May, June, July, August, September, and October) this exceedance is of great concern. The National Environmental Air Quality Act, 2004 (Act no. 39 of 2004) is not exceeded as often, but is exceeded in some months (May, September, and December). Visible in Figure 4.1 are the outliers within the two years of

data, the outliers are represented with a dot on the box whisker. The outliers represent the data that are statistically significantly different from the expected values. Some possible reasons for the outliers are the following: sensor faults, human error when handling the sensors, unusual weather circumstances, and a fire near the monitor. The outliers create peeks of high $PM_{2.5}$ levels and this is represented in a dot at the top of the month. When analysing the figure, it is clear that March and November are very similar in the data gathered. The $PM_{2.5}$ levels are also at their highest between these two months during autumn, winter, and spring.

The next table, Table 4.1 shows the percentage of data that was collected or lost for every month. This table also shows the total WHO exceedance during the data collection and the outliers. The data are shown in four colours, representing the four seasons of the year, summer (red), autumn (orange), winter (blue), and spring (green).

Table 4.1: Data percentage with exceedance of the National Environmental Air Quality Act, 2004 (Act no. 39 of 2004) and the World Health Organization (WHO) air quality standards

	January	February	March	April	May	June	July	August	September	October	November	December
Data available	98%	100%	100%	100%	89%	80%	98%	77%	100%	100%	83%	100%
Data missing	2%	0%	0%	0%	11%	20%	2%	23%	0%	0%	17%	0%
Total WHO exceedance	20%	40%	32%	15%	49%	44%	44%	77%	63%	63%	28%	10%
SA NAAQS	0	0	0	0	2%	0	0	0	7%	0	0	2%
Outliers	1	2	0	1	1	3	1	1	4	2	0	4

Table 4.1 shows that six of the twelve months had all of the data and had no full days missing. The other six months had some full days of data that were missing. The largest amount of data missing was for the month of August (23%). There are various reasons for this missing data: Some possible reasons are sensor errors, human error while working with the sensors, and load shedding. South Africa is facing an energy crisis since the electricity supply cannot meet the electricity demand. Load shedding controls the available electricity by way of a rotational schedule that leaves areas without electricity.

The table shows the percentage of days that the WHO standards and the NAAQS exceeded during the twelve months. When studying the data it is clear that the cold months of the year (winter) in South Africa, the end of autumn, winter, and halfway through spring is the time in which the percentage of exceedance is the highest. The highest percentage seen during the data collection period was for the month of August (77%), the month with the highest percentage of missing data. The next two months September and October both received (63%) and had no data missing. The table also shows the number of outliers for each month. The high percentages can be a result of wind-blown dust in the dry seasons of July to September, but also waste burning or domestic burning during the other months.

The air quality data gathered is an indication that the people living within this community face some very concerning air quality issues because the WHO standards and the NAAQS are exceeded frequently. This high level of air quality exceedance is linked to some of the pre- and post-questionnaire responses, as well as the photovoice activity images captures, and narratives that were completed by the participants.

4.3 RESULTS OF THE PRE- AND POST-QUESTIONNAIRES ANALYSIS

As indicated in Chapter 3, pre- and post-questionnaires were completed during the study by the Grade 5 learners and their parents/guardians, respectively. During this data-gathering phase, a substantial amount of time went by between the pre- and post-questionnaires completion. This is discussed in Chapter 3, Section 3.5.2. The pre- and post-questionnaires used in the study were the same. This questionnaire is found in Addendum 1. The questionnaires consist of multiple open and closed-ended questions. The results of the analysis of the pre- and post-questionnaires will be presented, discussed, and interpreted in this section. The questions used were explained in Chapter 3, Section 3.5. The number of participants that took part in the pre- and post-questionnaires are reported in Table 4.2.

Table 4.2: The number of Grade 5 learners and parents/guardians that completed the pre- and post-questionnaires

	Pre-questionnaires	**Post-questionnaires**
Grade 5 Learners	87	75
Parents/Guardians	75	76

The number of Grade 5 learners and their parents/guardians is not always the same due to the study being entirely voluntary and, on some data gathering days, some Grade 5 learners or their parents/guardians were absent and did not take part on that specific day. The Grade 5 learners are made up of the learners from the Grade 5 classes at the school which has over 40 learners in each class.

4.3.1 The pre- and post-questionnaire results of what the Grade 5 learners and their parents/guardians understand by the term environmental issues

The first question “What do you understand by the term environmental issues?” was an important question the researcher asked. This question helped the researcher to establish if the Grade 5 learners and their parents/guardians understand the term environmental issues. The responses to this question also helped the researcher with interpretations of responses to the questions that followed. The analysis of this question revealed that the responses in the pre- and post-questionnaire of both the Grade 5 learners and their parents/guardians, were very similar in wording.

The responses of the Grade 5 learners in the pre-questionnaire reveal that the Grade 5 learners understand the negative effects of environmental issues, but they were unable to identify an example of an environmental issue. The Grade 5 learners’ overall responses for this question within the pre-questionnaire were that environmental issues are “Everything that affects nature negatively”; “Everything that disrupts nature”; and “Problems that affect our lives/health ending up having a disease”. The Grade 5 learners do understand that environmental issues are negative, but they only think of nature. For the pre-questionnaire, only three of the Grade 5 learners responded and mentioned humans, namely “Problems that affect our lives/health (harmful) ending up having disease, lung TB also eye problems”. None of the other Grade 5 learners mentioned humans and how humans play a role or are impacted. This data reveals that learners do understand that nature is very often affected negatively.

After environmental education took place, a substantial amount of time passed and then the researcher asked the Grade 5 learners the same question in the post-questionnaire. “What do you understand by the term environmental issues?” The analysis revealed that the Grade 5 learners had a very similar response in the post-questionnaire but there was a change within some of their responses. Some of the new responses were “It’s about our living and health” (1,3%), “Harmful effects to earth and its systems due to the actions of humans” (2,6%), “Anything that affects the environment negatively such as pollution, resource depletion, climate change” (1.3%), “Problems with the planet's system (air, water, soil) that developed as a result of human

interference” (17,1%), “Anything that involves air, water and land” (7,9%), “Are the issues that affect the environment negatively” (65,8%), and 4% of the Grade 5 learners did not respond to this question in the post-questionnaire. One can deduce from the responses of the Grade 5 learners that there was a deeper understanding of environmental issues. Grade 5 learners were able to show an understanding of how humans play a role and that environmental issues involve systems with specific reference to air, water, and land.

The analysis of the parents/guardian’s pre-questionnaire revealed that they understood environmental issues to be “Problems that affect our lives” “everything that affects or disrupts nature negatively”; “Everything that affects nature negatively due to activities of humans” and “Everything that destroys our environmental health issues”. The overall responses were very similar. These responses revealed that the parents/guardians had a very similar understanding of the term among themselves. Most of the parents/guardians understand environmental issues to be connected to nature and humans. They also refer to environmental issues being “everything” referring to a general understanding that all things are affected and connected alluding to an understanding of systems thinking. The parents/guardians also understood that environmental issues are negative for nature and affect human lives. Furthermore, they understand that humans are the cause of “everything that affects nature negatively”. There is also a reference to “health issues” and that environmental issues “destroy” or “affect it”.

In the post-questionnaire, the parents/guardians also answered the same question: “What do you understand by the term environmental issues?” The analysis revealed that the parents/guardians also had similar responses and that there was some change within some of the parents/guardians' responses. Some of the responses that the parents/guardians had was “It’s about our living and health” (2,6%), “Harmful effects to earth and its systems due to the actions of humans” (1,3%), and “anything that affects the environment negatively such as pollution, resource depletion, climate change” (5,3%), “Problems with the planet's system (air, water, soil) that developed as a result of human interference” (22,4%), “Anything that involves air, water and land” (6,6%), “Are the issues that affect the environment negatively” (52,3%), and 9,5% of the parents/guardians did not respond to this question in the post-questionnaire. One can conclude from the responses of the parents/guardians that there was a deeper understanding and a new more informed vocabulary. Words like “pollution, degradation, resource depletion, and climate change” were used. It points to new knowledge gained and the ability to name environmental issues.

When comparing the Grade 5 learners and their parents/guardians' pre- and post-questionnaires before and after environment education took place, it is clear that the Grade 5 learners and their parents/guardians had a very similar general understanding of what environmental issues are.

Both the Grade 5 learners and their parents/guardians understood that environmental issues are negative impacts on the environment as “nature”. According to UNESCO-UNEP (1978:40), awareness creation of environmental issues should be related to the specific issues that each community face. One can deduce from the responses of the Grade 5 learners and their parents/guardians in the pre-questionnaires that they are very aware of the natural issues within their community because they refer to “Problems that affect our lives” as an environmental issue. There was also knowledge of how humans and human activities are responsible for the negative impact on nature. The post-questionnaire responses of the Grade 5 learners and their parents/guardians both revealed a deeper understanding of what environmental issues are because examples of environmental issues were given. These responses can be attributed to the influence of environmental education that took place between the completion of the two questionnaires. It can be interpreted that the parents/guardians gained new knowledge about environmental issues after the Grade 5 learners shared their environmental education knowledge with parents/guardians during and after their air quality activity. In this study, the teachers complete a GLOBE program training course on air quality. Between the completion of the two questionnaires, the learners were taught through the curriculum about air quality and other environmental issues. The deduction and interpretation made are that the teaching and learning that took place in the classroom and during the photovoice activity led to new knowledge gained by learners and their parents/guardians and a greater understanding of environmental issues by both.

4.3.2 The pre- and post-questionnaire results of where the Grade 5 learners and their parents/guardians first heard about environmental issues

The question “Where did you FIRST hear about environmental issues?” was asked to both the Grade 5 learners and their parents/guardians in the pre- and post-questionnaire. They had to choose from the options provided. Very few responded with a clarification for their choice of Other. In both cases, the learners and their parents/guardians marked more than one of the choices presented to them. For this reason, the percentage exceeds 100%. The results of the comparison of the pre- and post-questionnaires of where the Grade 5 learners and their parents/guardians heard about environmental issues, are shown in Figure 4.2.

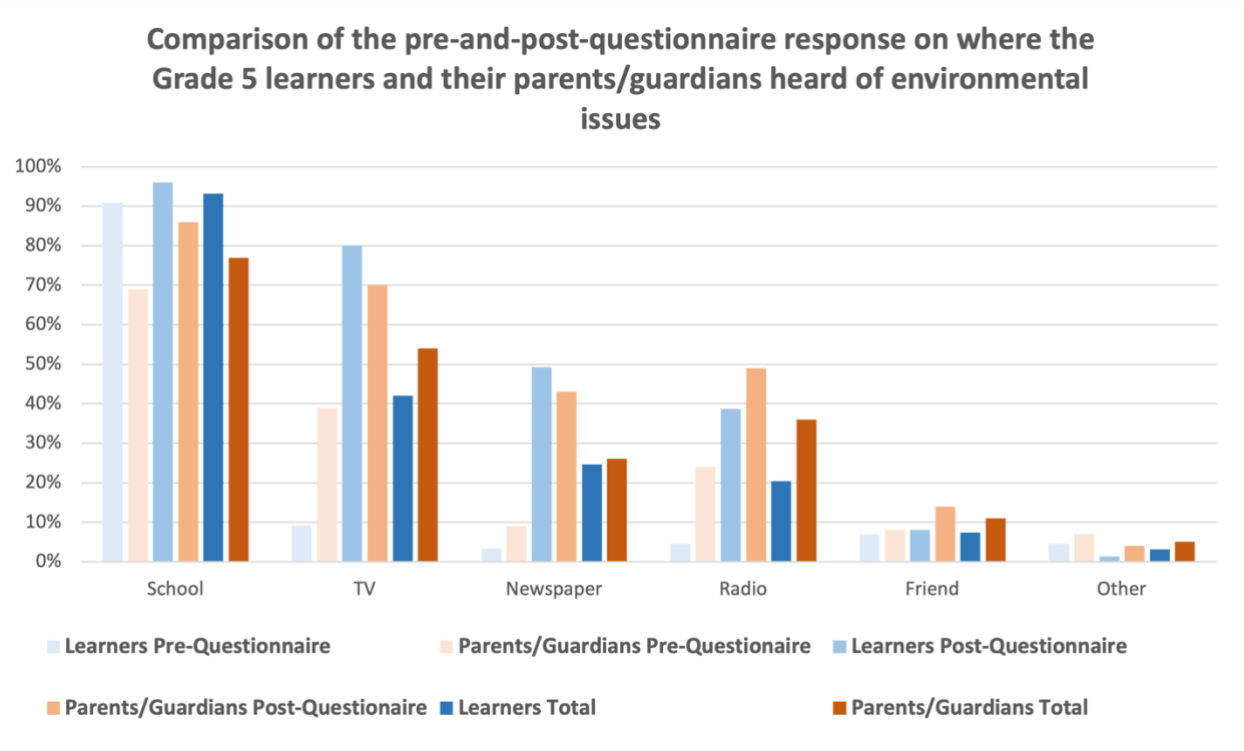


Figure 4.2: Comparison of the pre- and post-questionnaire response on where the Grade 5 learners and their parents/guardians heard about environmental issues

Figure 4.2 shows the percentages of sources where the Grade 5 learners and their parents/guardians first came to hear about environmental issues. This figure is a comparison between the results of the pre- and post-questionnaires. The learners' percentage is indicated in shades of blue. Light blue for the pre-questionnaire and medium blue for the post-questionnaire and dark blue for the total. The parents/guardians' percentage is indicated in shades of orange. Light orange for the pre-questionnaire and medium orange for the post-questionnaire and orange for the total.

From the pre-questionnaires, 90.8% of the learners said they first heard about environmental issues in school. The television, newspaper, radio, friends, or other ways accounted for less than 10% respectively of sources where Grade 5 learners heard about environmental issues. The results of the post-questionnaire show a drastic change. In the post-questionnaire, the number of learners that indicated they first heard about environmental issues at school increased by 5.2%, and from a friend increased by 1.1%. The choices of television, newspaper, and radio increased substantially. Television increased by 70.8%, newspapers increased by 45.9%, and radio increased by 34.1%. 80% of learners in the post-questionnaire indicated that they heard about environmental issues on television compared to less than 10% in the pre-questionnaire showing a great difference, and an increase in awareness of environmental issues from the television.

Newspaper awareness of environmental issues increased by 46% and radio by 34% respectively between the pre- and post-questionnaire response. The results show that learners are more aware of environmental issues being spoken about on television, in newspapers, and on the radio. A possible justification for the sharp increase in greater awareness about environmental issues from television, newspaper, and radio sources in the post-questionnaire is that the Grade 5 learners are now more aware of environmental issues and what they are after being exposed to environmental education. They are now able to recognise environmental issues within the media stories. Literature has revealed that if environmental education takes place there is a possibility that this will not only influence the participant but also the people who surround the participant, in this case, their friends who are classmates (Ertürk Kara *et al*., 2015:55). The latter may be an indication that after environmental education takes place the learners are talking to each other about environmental issues. The choice "Other" decreased by 3.3%. Despite asking for a motivation for the choice of Other, the Grade 5 learners did not clarify what was meant by the term "Other".

Figure 4.2 shows the total percentages of Grade 5 learners' responses in dark blue for the pre- and post-questionnaire responses combined. The greatest percentage of awareness about environmental issues was shown to have been obtained from school (93.2%) revealing that environmental education within the school curriculum is meaningful. The latter gives us an indication that when teaching and learning in the classroom about tangible issues that affect humans in their environment, learners become more aware of the issues that are being studied at school. The total percentages for watching television (42%), reading the newspaper (25%), and listening to the radio (20%) reveal that Grade 5 learners are aware of what an environmental issue is from media sources.

The next section reveals the results of where parents/guardians heard about environmental issues for the first time. Figure 4.2. shows this data in shades of orange.

From the pre-questionnaires, 69% of the parents/guardians said they first heard about environmental issues from school, 39% from television, 9% from the newspaper, 24% from radio, 8% from friends, and 7% from other sources. In the post-questionnaire, the number of parents/guardians that indicated they first heard about environmental issues from school increased by 17%, and the amount that heard from a friend increased by 6%. From the latter one can deduce that the sharp rise in awareness from school could be because the Grade 5 learners shared their new knowledge with their parents/guardians, and parents/guardians may also have talked with fellow parents/guardians about their children's activity and its content. The section Other decreased by 3%. Despite asking for a motivation for the choice of Other, the

parents/guardians did not write down what the Other was. The choices of television, newspaper, and radio increased. Television increased by 31%, newspapers increased by 34%, and radio increased by 25% showing that parents/guardians are more aware of environmental issues being discussed on these media platforms because their awareness has been sharpened.

Figure 4.2 also shows the total percentages in dark orange for the pre- and post-questionnaire combined. The total revealed that the greatest awareness about environmental issues was gained from school (77%). This reveals that environmental education within the school curriculum is meaningful because it reaches households and new knowledge is shared from learner to parent/guardian. The communication between the teachers and learners, and between the learners and their parents/guardians can help support the learners in the learning process and can teach the parents/guardians of the learners more about the important topics and issues we face today. Environmental education should be a commitment that is not only lifelong but also should be used in various settings, like outside of school and at home as well (Ertürk Kara *et al*., 2015:46). In Chapter 2 the researcher discussed how learners can influence the people within their surrounding environment. The responses to this question revealed that this is possibly what happened. The total percentages for watching television (54%), reading the newspaper (26%), and listening to the radio (36%) reveal a similar outcome of data results to those of the Grade 5 learners, being that the parents/guardians are more aware of environmental issues from media sources.

Results of the comparison between the Grade 5 learners and the parents/guardians regarding where they first heard about environmental issues.

From the above discussion, both the Grade 5 learners and their parents/guardians heard most about environmental issues from school. When analysing the data, it does reveal that the greatest increase in this area was for the Grade 5 learners. The deduction that can be made is that people become more aware of environmental issues through environmental education, and in this case through the school curriculum. After environmental education took place at school, the Grade 5 learners learned more about environmental issues, and air quality, among others, and it is most likely that they shared some of their learnings with their parents/guardians when they went home, and during the photovoice activity. A 2014 study found that the elderly and less educated people are not as aware of air quality issues as more educated people (Qian *et al*., 2016:5). The outcome of that research can be linked to this research in that after the parents/guardians were made aware of environmental issues like air quality because of their child's photovoice activity, they were more attentive to identifying when the environmental issues were spoken about in the media

and amongst friends, possibly because they are more exposed to television, newspaper, radio and talking to their friends than the Grade 5 learners.

It can be said that environmental education took place at school through teaching and learning and was carried over by the Grade 5 learners to their parents/guardians because they had to complete the photovoice activity together. The outcome of the questionnaire responses revealed that parents/guardians are aware of environmental issues because of what their child learns at school and from watching television, reading the newspaper, and listening to the radio. It can be deduced that they have gained new knowledge about environmental issues and are more aware of what an environmental issue is when it is spoken about in the media. It can be said that environmental education positively influences parent/guardian awareness about environmental issues, and this is supported by Salequzzaman and Stocker (2001) who said that environmental education should create awareness and concern for the actions that people have on the environment.

4.3.3 Pre- and post-questionnaire results of the three environmental issues identified by Grade 5 learners and parents/guardians in their community

Question 3 of the questionnaire required Grade 5 learners and their parents/ guardians to “Name three environmental issues within your community.” The responses to this question gave the researcher insight into what environmental issues both the Grade 5 learners and their parents/guardians could identify in the pre-questionnaire and the post-questionnaire after environmental education took place. In both cases, the Grade 5 learners and their parents/guardians responded with three environmental issues. The percentage, therefore, exceeds 100%. Figure 4.3 shows the findings from the comparison of the pre- and post-questionnaires.

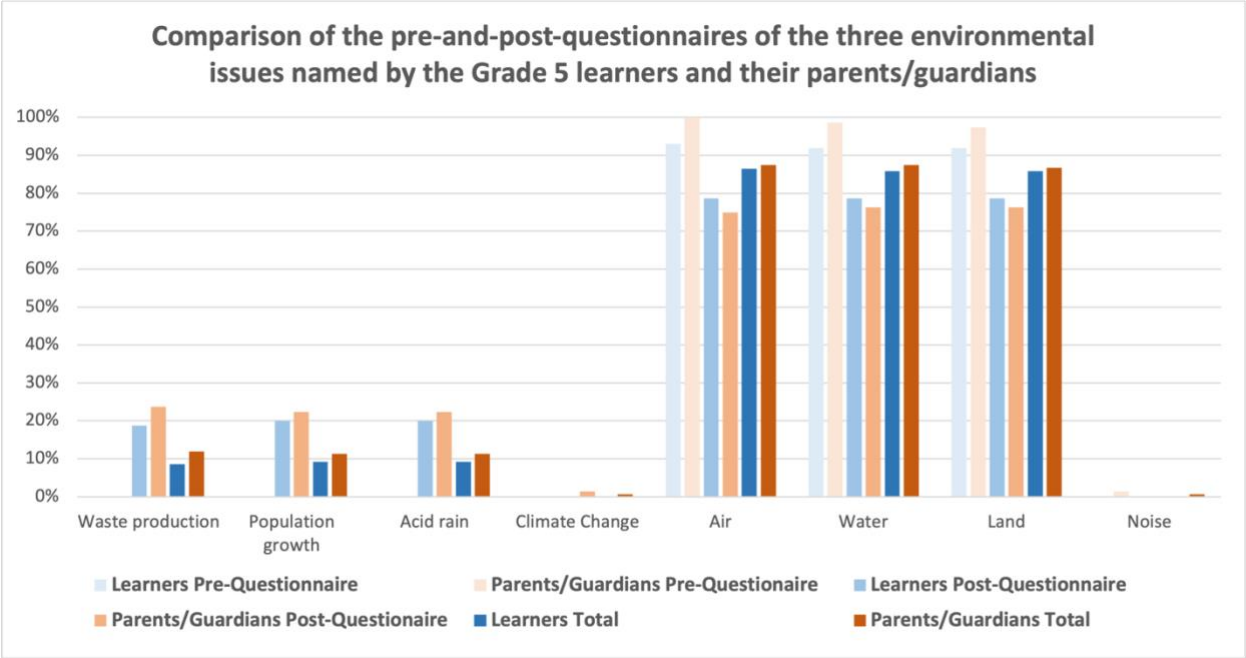


Figure 4.3: Comparison of the pre- and post-questionnaires of the three environmental issues named by the Grade 5 learners and their parents/guardians

Figure 4.3. shows the six environmental issues that the Grade 5 learners responded to. Three were identified in the pre-questionnaire, namely air, water, and land. In the post-questionnaire, six responses were listed, namely waste production, population growth, acid rain, air, water, and land. These responses were the only responses that the participants gave. The researcher did not create categories using the responses. The figure is a comparison between the results of the pre- and post-questionnaires. The learners' percentage is indicated in shades of blue. Light blue for the pre-questionnaire and medium blue for the post-questionnaire and dark blue for the total. The parents/guardians' percentage is indicated in shades of orange. Light orange for the pre-questionnaire and medium orange for the post-questionnaire and orange for the total.

93% of the Grade 5 learners that responded to the pre-questionnaire said that air pollution is an environmental issue, while 92% said that water and land pollution are environmental problems. This indicates that 7.6% of Grade 5 learners either failed to answer the question entirely and did not name any environmental issues or some of the Grade 5 learners did not name three environmental issues but only one or two. Some of the possible reasons for this could be that the Grade 5 learners were unaware of three environmental issues. This response is similar to Question 1, which asked the Grade 5 learners to share what they understand by the term environmental issues. In Question 1, most of the Grade 5 learners responded in the pre-questionnaire that environmental issues are everything that affects nature badly. This reveals that the learners could have possibly only thought of areas of air, land, and water pollution when

thinking of environmental issues. The interpretation is that the Grade 5 learners had a general knowledge regarding environmental issues when completing the pre-questionnaire.

When comparing the pre- and post-questionnaire for Question 3, the data reveals a difference within the Grade 5 learners' responses. The Grade 5 learners had three answers to the pre-questionnaire Question 3. Their responses increased from three environmental issues to six environmental issues when they completed the post-questionnaires. It could be reasoned that the learner's responses to the post-questionnaire reflected a greater level of new knowledge gained. This shift in the Grade 5 learner's responses supports the notion that environmental education can raise awareness (Salequzzaman and Stocker, Chapter 2 and above). These Grade 5 learners went beyond only naming three environmental issues. The reasoning can be because the learners had gained a deeper understanding of environmental issues when completing the post-questionnaire since 18.7% of the Grade 5 learners identified waste production as an environmental issue in the post-questionnaires. This response suggests that environmental education helped learners acquire new knowledge.

In the post-questionnaire, 20% of Grade 5 learners responded that acid rain and population growth are local environmental issues. Acid rain is one of the new environmental issue responses that the Grade 5 learners named. Acid rain can be related to the communities environmental issues with air quality. After taking part in environmental education, the learners were able to recognise acid rain as one of the environmental issues that their community is struggling with. The surrounding agriculture, wildlife, freshwater ecosystems, and corrosion of pipes are a few examples in and around the community where learners may have seen evidence of acid rain first-hand and seen the impact on the community. Grade 5 learners may have also witnessed fish dying in the pond in the vicinity of their community. These are some of the possible environmental issues that Grade 5 learners may justify after environmental education took place. The interpretation is made owing to the photovoice narratives of some of the Grade 5 learners who shared examples that can be related to acid rain. This will be discussed in more detail later in the narrative discussion.

Air as an environmental concern, declined by 14.4%, from 93.1% in the pre-questionnaire, to 78.7% in the post-questionnaire. The percentage of learners who now responded that acid rain is an environmental issue may help to justify the drop. Teachers introduced the Grade 5 learners to the concepts of air, air quality, and air pollution in the lessons that included environmental education. None of the Grade 5 learners who responded to air in the pre-questionnaire as an environmental issue responded that acid rain is also an environmental issue in the post-questionnaire. The reason for the latter could be because the Grade 5 learners were taught by

the teachers about how the environment is impacted by poor air quality and air pollution, and the learners may have gained new knowledge about what acid rain is and how it is a consequence of air pollution.

Figure 4.3 also shows the total percentage of environmental issues that the Grade 5 learners reported in Question 3. Figure 4.3 shows the total percentages of Grade 5 learners' responses in dark blue for the pre- and post-questionnaire responses combined. This figure reveals that most of the Grade 5 learners only consider the three environmental issues of air, water, and land (86.4%, 85.8%, and 85.5%) respectively, with very few learners considering or being able to mention other environmental issues or issues that are more relevant to their community. Waste production (8.6%), population growth (9.3%), and acid rain (9.3%) were the minor percentages mentioned.

This question can be linked to the main research question of the study, "How can environmental education influence the awareness and perceptions of air quality in Grade 5 learners and their parents/guardians?" This question can also be linked to the secondary question, "How aware are Grade 5 learners and their parents/guardians of air quality?" When the data from this question are analysed, it becomes clear that the Grade 5 learners were aware of air quality throughout the pre-questionnaire. The data also reveal that the Grade 5 learners awareness of acid rain grew after learning about air quality, indicating that the percentage of awareness regarding air quality issues increased following environmental education. Research by Ningbo China in 2014, supports the latter finding because that study proved that there is a link between environmental education and awareness of air quality (Qian *et al*., 2016:3).

The pre- and post-questionnaires and the three environmental issues that the Grade 5 learners' parents/guardians named.

Figure 4.3 shows the seven environmental issues that the parents/guardians responded to. Four were identified in the pre-questionnaire, namely air, water, land, and noise. In the post-questionnaire seven responses were listed, namely waste production, population growth, acid rain, climate change, air, water, and land. This figure is a comparison between the results of the pre- and post-questionnaires. The parents/guardians' percentage is indicated in shades of orange. Light orange for the pre-questionnaire and medium orange for the post-questionnaire and dark orange for the total.

In the pre-questionnaire, there were four responses that the parents/guardians gave, namely air, water, land, and noise. In the post-questionnaire seven responses were listed, namely waste production, population growth, acid rain, climate change, air, water, and land. These responses

were the only responses that the participants gave. The researcher did not create categories using the responses. These responses were fairly similar to what the Grade 5 learners identified.

100% of the parents/guardians that responded to the pre-questionnaire said that air pollution is an environmental issue, while 99% said that water pollution is an environmental issue, 97% of the parents/guardians responded with land being an environmental issue and 1% referring to noise being an issue. This indicates that 1% of parents/guardians either failed to answer the question entirely and did not name any environmental issues or some of the parents/guardians did not name three environmental issues but only one or two. Some of the possible reasons for this could be that the parents/guardians were unaware of three environmental issues. The parents/guardians' responses to this question are similar to Question 1, which asked the parents/guardians what they understand by the term environmental issues. In Question 1, all but 2,6% of the parents/guardians responded in the pre-questionnaire that environmental issues are related to earth, air, water, and land. The exact words used in the pre-questionnaire are "air, water, and land" and can all be related to the response that the parents/guardians gave in Question 3. The responses reveal that the parents/guardians only thought of the three main areas when thinking of environmental issues. As a result of only responding with mainly the same three environmental issues, the interpretation is that the parents/guardians possibly had little knowledge in the pre-questionnaire regarding environmental issues.

The data reveal a noticeable shift in the types of responses that parents/guardians gave when completing the post-questionnaire. In the post-questionnaire, the parents/guardians did not only address the three main topics but also some of the more pressing environmental issues that the world faces. The range of environmental issues mentioned by the parents/guardians also increased from four to eight in total, namely waste production, population growth, acid rain, climate change, noise, air, water, and land. The fact that the parents/guardians have added additional environmental issues from the pre-questionnaire to the post-questionnaire suggests that they may now be more aware of the environmental issues that impact their community.

In the post-questionnaire the percentages that the parents/guardians responded with for the three main issues named in the pre-questionnaire declined. Most of the parents/guardians still responded with "air, water, and land". After the Grade 5 learners received environmental education, the parents/guardians reported waste production at 24% as one of the new environmental issues they had noticed in the community. This suggests that the environmental education the Grade 5 learners received may have influenced the parents/guardians after the Grade 5 learners shared some of their new learnings. This serves as further evidence that the parents/guardians have learned to identify other community-related issues. One of the possible

causes of these environmental issues is the local mine. The mine may be a cause of multiple environmental issues. During environmental education, the Grade 5 learners learned about mines and the environmental issues they can cause. Later in the study, the participants did refer to the mine in their responses.

The next environmental issue mentioned by the parents/guardians was population growth of 22%. Parents/guardians may perceive population growth as an environmental issue due to an increase in the extraction of resources (minerals, trees, water, and wildlife), waste production, pollutants (air, land, and water), fires to generate (energy, heat, and cook) and a lack in drinking water, agriculture and medical facilities. These are some of the possible reasons the parents/guardians could have responded to population growth as an environmental issue. Some of these reasons were also named by the participants during a later stage of the questionnaire and can be linked to population growth. For this reason, it can be interpreted that after the Grade 5 learners received environmental education, the learners spoke to their parents/guardians regarding overpopulation. This can also indicate that the participants understood some of the causes for environmental issues, for example, overpopulation better and were able to now identify the causes and issues easier.

In the post-questionnaire, 22% of parents/guardians responded that acid rain is an environmental issue. Acid rain is one of the new environmental issue responses that the parents/guardians named. Parents/guardians may have noticed acid rains effects on the surrounding ecosystems, crops, animals, freshwater supplies, freshwater fish, pipes corroding, and structures being damaged. These are some of the things that the Grade 5 learners studied in their environmental education lessons and they may have mentioned to their parents/guardians. One of the sources that contribute to acid rain that is named by the parents/guardians later is mining. Therefore, it is possible that this response can even be linked to some of the other responses. The interpretation is that these are some of the possible environmental issues that the Grade 5 learners could have shared with their parents/guardians after environmental education took place.

1% of the parents mentioned climate change as an environmental issue in the post-questionnaire. This issue was not mentioned by any participants in the pre-questionnaire. Climate change was one of the topics that were discussed during environmental education teaching and learning. The outcome reveals that most parents/guardians are still unaware of climate change and the effects that climate change has on the earth and all living organisms, including humans.

The environmental issue of air decreased by 25% in the post-questionnaire from 100% to 75%. In the post-questionnaire, 25% of the parents/guardians did not mention air as an environmental

issue. However, this does not mean that the parents/guardians no longer consider air to be a concern for the environment. Parents/guardians only identified the three main areas, namely air, water, and land in the pre-questionnaire, but after environmental education took place the parents/guardians have new knowledge regarding other environmental issues. The parents/guardians are now able to identify other environmental issues within the broad term “air quality”, such as acid rain and climate change. The interpretation is that after the Grade 5 learners engaged in environmental education, their learnings were shared with parents/guardians whose knowledge of environmental issues broadened.

Water and land decreased by 24% each. This is due to parents/guardians not only naming the three main areas but naming four new areas. It is possible that the parents/guardians could still think land is a major environmental issue but instead of just responding with the term “land” they could have possibly responded with the term “waste production” and linked the two issues. The same could be for the response “water” which could be linked to “climate change” if the learners think of heavy rain as they mention in other questions. Noise decreased by 1% and was not reported in the post-questionnaire.

Figure 4.3 shows the total percentages in dark orange for the pre- and post-questionnaire combined. Within this figure, it is clear that the majority of the parents/guardians understand environmental issues as air (87%), water (87%), and land (87%). Other environmental issues like waste production (12%), population growth (11%), acid rain (11%), climate change (1%), and noise (1%), are also identified as environmental issues. In the post-questionnaire, the data revealed that the parents/guardians had a better understanding of environmental issues and the causes of these issues. This is an indication that from the time the pre-questionnaire took place to the time the post-questionnaire took place the parents/guardians gained new knowledge. The one difference that justifies the new knowledge gained by the parents/guardians was that the Grade 5 learners took part in environmental education and shared the knowledge they have gained from school with their parents/guardians.

Results of the comparison between the Grade 5 learners and the parents/guardians when identifying three environmental issues.

Figure 4.3 revealed that the Grade 5 learners and their parents/guardians understood environmental issues as air, water, and land issues. The interpretation from the data is that the Grade 5 learners gained new knowledge and they also shared it with their parents/guardians because they were all able to voluntarily identify more than three perceived environmental issues in their community. The outcome can be linked to the literature discussed in Chapter 2 regarding

environmental education and how it can influence not only the participant, but also the people within the surrounding community (Ertürk Kara *et al*., 2015:46). Figure 4.3 also shows that none of the Grade 5 learners listed climate change as an environmental issue. This data reveal that the Grade 5 learners have not linked air quality and climate change as environmental issues through their learning.

4.3.4 The pre- and post-questionnaires results of the causes of the environmental issues named by the Grade 5 learners and their parents/guardians

Question 4 asked, "What are the causes of the three environmental issues named in Question 3 within your community?". The results of this question revealed what the Grade 5 learners perceived as causes of the environmental issues they had mentioned in Question 3. The Grade 5 learners were taught about the causes of environmental issues during their lessons, and the teachers made sure to discuss the causes of environmental issues so that the Grade 5 learners were able to recognise these causes within their community.

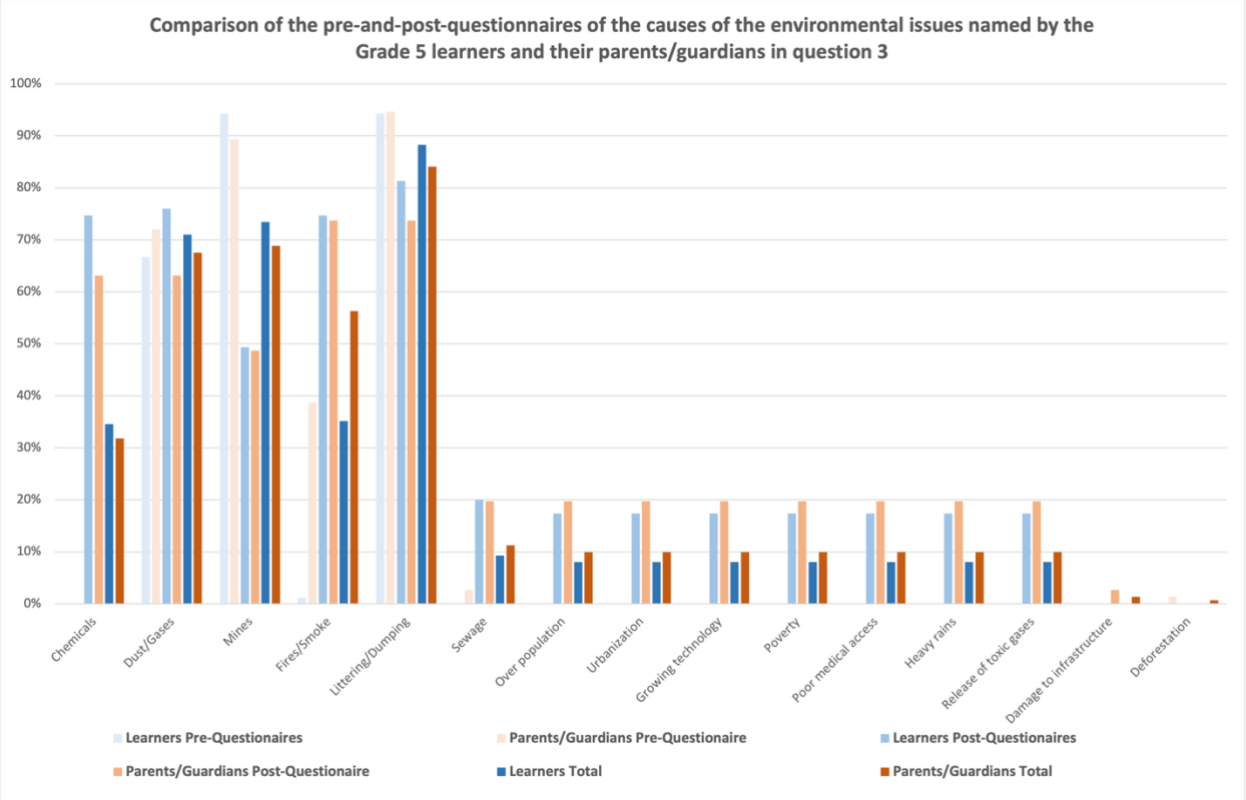


Figure 4.4: Comparison of the pre- and post-questionnaires of the causes of the environmental issues named by the Grade 5 learners and their parents/guardians in Question 3

Figure 4.4 shows the causes of the environmental issues that the Grade 5 learners and their parents/guardians responded to. This figure is a comparison between the results of the pre- and post-questionnaires. The learners' percentage is indicated in shades of blue. Light blue for the pre-questionnaire and medium blue for the post-questionnaire and dark blue for the total. The parents/guardians' percentage is indicated in shades of orange. Light orange for the pre-questionnaire and medium orange for the post-questionnaire and orange for the total. In both cases, the Grade 5 learners and their parents/guardians responded with three causes of environmental issues. For this reason, the percentage exceeds 100%.

These responses received from the Grade 5 learners and their parents/guardians were the exact responses shown in Figure 4.4. In Question 4 where the researcher asked the participants for the causes of the environmental issues named in Question 3, most of the participants listed the issue again and then the cause, for example, "air pollution: is caused by smoke and fire" or "air: burning bin", "water: chemicals" or "water pollution: chemicals and sewage" and "land pollution: littering" or "land: dumping". Some participants only listed words for example "fire, dust/gasses, mines. For this reason, the figure shows the responses given by the participants.

The pre- and post-questionnaires and the causes of environmental issues that the Grade 5 learners named.

In the pre-questionnaire, the Grade 5 learners responded with four causes for the environmental issues named in Question 3. Due to the researcher asking the Grade 5 learners to respond on Questions 3, the responses that the Grade 5 learners gave should be linked to the three responses that the Grade 5 learners gave in the pre-questionnaires Question 3.

Littering/dumping received (94%) from the Grade 5 learners. One of the major environmental issues that most peri-urban communities deal with, is littering/dumping. This is another environmental issue that most people can quickly recognise because it is visible. The majority of Grade 5 learners who responded to Question 3 by saying that land and water can be an environmental issue can be connected to this cause. The reason for this connection can be made by studying photovoice activities. In the photovoice activities, most of the Grade 5 learners identified littering and dumping on land and within the water. This will be discussed further in the photovoice and narrative section.

Mines were perceived as a cause of environmental issues by 94% of Grade 5 learners. This suggests that the mine near the community may be visible to Grade 5 learners. Environmental problems are frequently further exacerbated by mines more specifically a source of poor air quality (RTI International 2015:213). The interpretation is that the Grade 5 learners are aware that the

mine may be responsible for some of the issues they have named in the previous questions, namely air, water, and land pollution.

Dust/gasses also received a relatively high percentage of 67%. These two responses were more than often written together by the participants with one or two exceptions. Dust and gas emissions were perceived by learners as a cause of environmental issues. Since research shows that mining, factories, and fine road dust are a source of poor air quality (Tian *et al*., 2019:1; Yang *et al*., 2019:10). The interpretation is that learners are aware of the mine and dirt roads in the area and perceive them to be causes of air pollution.

Fires/smoke was mentioned as one of the reasons for environmental issues by 1% of the Grade 5 learners. This is a very low percentage. One of the issues that frequently pose a serious threat to peri-urban communities, is fires/smoke (StatsSA, 2014). The interpretation is that before teaching and learning about air quality took place, the Grade 5 learners may have been accustomed to fires and smoke that they did not perceive to be an environmental issue in their community. Also, people living in peri-urban areas start fires for a variety of acceptable reasons, for example, to generate heat, prepare food, and burn waste, among others.

The post-questionnaires were completed by the Grade 5 learners after environmental education took place. The post-questionnaire responses shown in Figure 4.3 were significantly different. The Grade 5 learners only identified four causes for environmental issues. These were extremely basic responses that could oftentimes be linked to many environmental issues, or in some cases, the cause is more along the lines of an issue itself than a cause. In the post-questionnaire, the Grade 5 learners responded with thirteen environmental issues that they identified as being connected to Question 3, namely chemicals, dust/gasses, mines, fires/smoke, littering/dumping, sewage, overpopulation, urbanisation, growing technology, poverty, heavy rains and release of toxic gasses. The most frequent response of 81% by Grade 5 learners was littering/dumping, as a contributor to environmental issues in their community even after receiving environmental education, this is to be expected when looking at the photovoice activity. This percentage did decreases by 13% in the post-questionnaire.

The second cause of environmental issues that the Grade 5 learners responded with was dust/gasses. 76% of the Grade 5 learners responded with this cause after environmental education. The responses increased by 9% and can be attributed to the fact that the Grade 5 learners were taught that gasses/dust can be harmful to the environment and people's health. The data show that the Grade 5 learners may have learned something new during the

environmental education because the Grade 5 learners also learned about acid rain as an environmental issue and some of them mentioned it in Question 3.

Fire/smoke and chemicals both received 75%. The Grade 5 learners have now identified chemicals as a new cause of environmental issues that they did not previously mention in the pre-questionnaires. Chemicals can exist as solids, liquids, or gasses. The Grade 5 learners had environmental education lessons where they learned about several dangerous chemicals and their origins. The interpretation is that they may have seen the connection to some of the environmental problems mentioned as waste production, acid rain, air, water, and land. Fires/smoke also came in second, accounting for 75% of the environmental issues in peri-urban communities. Fires/smoke increased by 75%, which is a significant improvement for an environmental issue. In reality, smoke is the result of fires. Analysing the data, the researcher interpreted that it is possible when the Grade 5 learners mentioned fires/smoke in Question 3, they may have made the connection between population expansion and air quality. Grade 5 learners might have been taught that as the population grows, more people would need more heat sources, food to cook, and waste to burn, which will result in greater smoke and environmental issues.

One of the possible explanations for the decline of 45% in mining as a cause of environmental issues, could be interpreted as being because learners became more aware of other causes, for example, chemicals, dust/gasses, urbanisation, growing technology, and release of poisonous gasses, and then perceived mining to be less important.

20% of the Grade 5 learners mentioned sewage as an environmental issue within their community. Many peri-urban communities are affected by raw sewage spillages in informal settlements (Wessels *et al*., 2019:197; Sindane & Modley, 2022:30). It is understandable that sewage was named a cause of environmental issues. The three major environmental issues that the Grade 5 learners identified in Question 3 can all be related to why sewage is regarded as a cause. The deduction made is that the learners understand that increased sewage production comes along with population growth. The connection to Question ’’s mention of water is that sewage often contaminates the drinking water that populations must use, which some of the Grade 5 learners might have observed as water and land pollution. In the photovoice activity, sewage was also one of the environmental issues that surfaced. According to Sindane and Modley (2022:30); Morole *et al.* (2022), sewage often contaminates drinking water in informal settlements.

The subsequent seven causes listed by learners, all garnered 17% and were all new causes mentioned by Grade 5 learners. The causes include overpopulation, urbanisation, growing technology, poverty, poor medical access, heavy rains, and the release of toxic gasses. These factors can all be connected to the responses in Question 3. Overpopulation can be linked to the growing population in the informal settlement where the learners live, and to the increasing waste production. Some of the additional causes mentioned by the Grade 5 learners are connected to overpopulation. Overpopulation can cause urbanisation, poverty, fires/smoke, littering/dumping, sewage, and poor medical access. These are some of the causes of overpopulation. This response demonstrates that, when describing the causes of environmental issues, the Grade 5 learners may be thinking at a higher level now that they have received environmental education.

Urbanisation of 17% can be linked to waste production, more waste is being produced. Urbanisation can also be linked to air and acid rain due to poor air quality when there is a growing population, having more fires, cars/trucks/busses, and big companies, for example mines.

Growing technology received 17%. This cause could have possibly been the Grade 5 learners' response due to what they have noticed as changes within their environment. One of the possibilities can be that they have seen an increase in big mining vehicles or machinery. This can be linked to air in Question 3 and to land due to the vehicles and machinery polluting the air and them damaging the land they use.

The Grade 5 learners also identified poverty (17%) as one of the new causes of environmental issues within their community. The interpretation of the data is that the learners perceive poverty as a cause of environmental issues. A possible reason for the learners thinking that poverty can lead to environmental issues can be because they have seen the link to air pollution. Poor households use fires to cook their food using coal stoves, heat their homes using coal or gas stoves, candles, and wood-burning (Villanueva *et al*., 2022:546)

17% of the Grade 5 learners indicated that poor medical access to healthcare was a cause of environmental issues. There is a possibility that the Grade 5 learners interpreted this question incorrectly. From the researcher's point of view, poor medical access is not a cause of environmental issues but rather a consequence of environmental issues. People within the community may be exposed to some of the environmental problems they deal with, for example, air pollution, which results in poor air quality, and then health problems like asthma, resulting in the need for medical access that is difficult to access due to overpopulation. A lack of access to clean drinking water, poor hygiene, and sewage issues due to a lack of resources and infrastructure in some communities can also result in the requirement for medical access to

healthcare. These are some of the issues that the community is possibly facing and for this reason, there is the possibility that the Grade 5 learners are linking poor medical access to environmental issues. This response demonstrates not only that some Grade 5 learners may not only be thinking at a different level, but that some of the Grade 5 learners or their family members are possibly influenced by poor medical access to healthcare.

One of the new causes named was the 17% heavy rainfall. Some environmental issues, but not any that the Grade 5 learners mentioned, can result in heavy rainfall. Although climate change can be linked, none of the Grade 5 learners mentioned it. The Grade 5 learners do not give this topic any attention at all, even though it is a highly essential one and there is a severe environmental problem globally right now. Water pollution can result from heavy rains, especially in areas with weak sewage systems. This can lead to no clean drinking water and diseases (Public Health Institute, 2016). According to Lai *et al.* (2020), two days after heavy rainfall occurred hospital admissions increased. Other studies that have been done can be linked to up to 30 days of increase in hospital admissions due to intestinal diseases (Phung *et al*., 2017:2).

The release of toxic gasses at 17% was the last new environmental issue caused named by the Grade 5 learners that can be linked to waste production, population growth, acid rain, and air in Question 3. It is extremely harmful when toxic gasses are released. The Grade 5 learners who participated in environmental education learned about several toxic gasses and why they are so harmful to human health. The Grade 5 learners learned that burning waste or starting fires inside your home is not safe. Some waste can generate fumes harmful to human health when it is burned if regularly exposed to (Rim-Rukeh, 2014:53). The researcher's interpretation is that the Grade 5 learners have gained new knowledge and understanding of some of the possible causes of environmental issues, for example, air quality and how this can deteriorate human health.

The totals of all the causes named by the Grade 5 learners are shown in Figure 4.4 in dark blue. Littering/dumping received the highest percentage of 88%, indicating that the majority of Grade 5 learners perceive that these actions are the primary contributors to environmental issues in their community. The next issue was mining (73%) as Grade 5 learners perceive the local mine as a contributing factor to several of the environmental problems their community is currently experiencing. The third-highest percentage among the environmental issues in the community that Grade 5 learners responded with was dust/gasses (71%). Chemicals (35%) and fires/smoke (35%) were two of the percentages that increased the most in the post-questionnaires. The Grade 5 learners are also concerned about sewage (9%), although it is not as significant as the other causes. The release of toxic gasses, heavy rainfall, urbanisation, growing technology, poverty, poor medical access, and urbanisation all came in last with 8% each. Figure 4.4 reveals that the

environmental education that was conducted may have given the Grade 5 learners a substantial amount of new knowledge. This growth in knowledge should also serve as a reminder of how crucial it is to discuss current environmental issues that are in the school curriculum. Once again this can be linked to the literature regarding the importance of environmental education (Ertürk Kara *et al.,* 2015:55).

The pre- and post-questionnaires and the causes of environmental issues that the Grade 5 parents/guardians named.

Figure 4.4 shows the percentage of causes that the Grade 5 parents/guardians named in the pre- and post-questionnaire. The parents/guardians responded with six causes of the environmental issues mentioned in Question 3 in the pre-questionnaire.

Littering/dumping accounted for the biggest percentage of causes. According to 95% of the parents/guardians, this is a major cause of environmental issues within their community. This cause may be related to the land and water responses mentioned in Question 3. The parents/guardians can claim that this is a major environmental issue because of the littering/dumping that is occurring within their community. Due to garbage winding up in some local water sources, littering and dumping may also be related to environmental issues with water. In the photovoice activities, littering/dumping on land and within the water was visible in the photos and this will be discussed later in the photovoice activity. Very often littering/dumping is a major issue within low-income areas, studies have also shown that the people living within the areas will oftentimes not take responsibility for littering/dumping but say it is due to a lack of infrastructure and bins and just blame other people (Schenchk *et al*., 2022).

Mines came up second at 89%, which is likewise a very high number and can be related to the responses given in Question 3. The response to this question is quite encouraging since it demonstrates that the parents/guardians are aware of some of the major environmental issues and causes in their community. Mines are linked to poor air quality and health issues (RTI International 2015:213), and they have been perceived as such by parents/guardians. Since mines require a lot of water to operate and frequently contaminate water sources, they might also be connected to the water being named in Question 3.

Dust/gas emissions (72%) are perceived as causes of environmental issues mentioned in Question 3. Due to the mine's considerable vehicle traffic, and open terrain, the fine dust has been perceived to be a cause of environmental issues. According to Tian *et al.* (2019:1), road dust in a mining area can cause an air pollution hotspot and this can have a great impact on human health. The data presented in this study may indicate that the parents/guardians are not

only aware of the mine near the community but they also think of this mine as a possible cause of environmental issues.

39% of the parents/guardians responded that fires/smoke is an environmental issue within their community. Fires/smoke can be caused by a variety of reasons. Some possible reasons for this, that the researcher interpreted from the responses within the questionnaires and literature, could be poverty (unemployment), the need to generate heat and cook food without electricity, burn candles, and the fact that many peri-urban communities lack waste collection services and often burn the waste they generate. These are a few examples of everyday problems that parents/guardians may think of that are not a major concern. Smoke/fires can affect the land and the air. Parents/guardians may link it to the air because smoke contaminates the atmosphere, or they may link it to the land because they are aware that to start a fire, the fuel must be available for burning, such as wood or coal. Literature has shown that often people living in low-income communities use to burn wood and coal (Villanueva *et al*., 2022:540).

Finally, only 1% of parents/guardians believed that deforestation was to blame for environmental problems in their community. Many peri-urban communities experience deforestation because residents require wood and cut down the trees to meet their needs (Bruce *et al.,* 2000:1079).

The Grade 5 learners' parents/guardians completed the post-questionnaires after their children received environmental education from the teachers at school. The researcher discovered that the results had significantly changed after analysing the post-questionnaire results. The parents/guardians had six causes as responses for the environmental problems mentioned in Question 3 in the pre-questionnaire. The parents/guardians now responded with fourteen causes in the post-questionnaire that they perceive to be accountable for the environmental issues listed in Question 3 after the environmental education lessons took place and the Grade 5 learners participated in the photovoice activity. This reveals that the parents/guardians possibly have more knowledge and are more aware of the environmental issues and the causes thereof within their community.

In the post-questionnaire, the parents/guardians had the highest response towards fires/smoke and littering/dumping both causes receiving 74%. In the pre-questionnaire littering/dumping received the highest response from the parents/guardians, after environmental education took place littering/dumping decreased by 21%. Most of the parents/guardians still feel that littering/dumping is the biggest environmental cause within their community. One of the possible reasons that the parents/guardians did not respond with littering/dumping as much after environmental education took place could be that the parents/guardians realised that there are

more important causes for environmental issues they would rather name. During the environmental education lessons, the teacher spoke to the Grade 5 learners about littering/dumping/waste disposable in the form of burning. Studies have shown that often within low-income communities' people burn dumpsites and waste (Rim-Rukeh, 2014:94). Studies have also shown that environmental education can influence the creation and improvement of awareness and changes in environmentally responsible behaviour of people participating in environmental education (Salequzzaman & Stocker, 2001). This creates the possibility that the Grade 5 learners spoke to their parents/guardians regarding this issue and that some of the parents/guardians do not think littering/dumping is such a big cause of environmental issues but rather the burning of the materials.

Fires/smoke 74% revived a relatively low response from the parents/guardians in the pre-questionnaire. Fires/smoke increased by 35% in the post-questionnaires after environmental education took place. One can deduce from the above that the parents/guardians may have linked some of the causes of environmental issues to one another. Another possible reason for this sharp increase in the percentage is that during the environmental education lessons the teacher taught the Grade 5 learners the impacts that poor air quality has on human health and what some of the causes for poor air quality are, for example, fire/smoke especially if a person is regularly exposed to burning materials (Rim-Rukeh, 2014:94). This then causes the possibility that the Grade 5 learners spoke to their parents/guardians regarding some of the health issues that can be related to fires/smoke and that the parents/guardians now think of this environmental issue cause as one of the most important causes.

The second highest percentage was also shared by two causes chemicals and dust/gasses, and they received 63%. Dust/gasses decreased by 9% in the post-questionnaire. This can be due to the parents thinking other causes are more important within their community. As mentioned previously, dust, especially fine dust from mining transportation can be a great threat to human health (Tian *et al.,* 2019:1). Even though this cause decreased most of the parents/guardians still think this is a major cause of environmental issues. Chemicals (63%) is a new cause that the parents/guardians named and received a very high percentage. This revealed that parents/guardians think chemicals are a big environmental issue cause within their community. During the environmental education lessons the Grade 5 learners learned about some harmful chemicals and the sources of the chemicals. It is possible that the Grade 5 learners went home and spoke to their parents about this cause. This cause is also connected to some of the environmental issues mentioned by the Grade 5 parents/guardians in the post-questionnaire. There could be some connections between waste production, acid rain, climate change, air,

water, and land. Chemicals can take the shape of a liquid, gas, or solid, and as a result, they can be connected to a variety of environmental problems. Some of the possible reasons for the parents/guardians responding to chemicals could be linked to poor air quality. Literature has linked poor air quality to chemical pollutants, for example, volatile organic compounds, nitrogen dioxide, carbon monoxide, and more (Khairy, *et al.,* 2016:2). Another link that the parents/guardians could have made is between chemicals and mining. The mining industry is very often responsible for chemical pollutants that cause environmental issues (Emmanuel, *et al*., 2018). The parents/guardians could have gained some of the new knowledge that the teachers taught the Grade 5 learners about mining. It is possible that the parents/guardians now see the mine within their community as a cause of environmental issues through chemicals.

The percentage given to Mine was 49% and it decreased with 40%. Even though mines are a major environmental issue in the community, one possible explanation for their sharp decline is that parents/guardians became more knowledgeable and were more explicit in their written responses. Other responses from the parents/guardians may be connected to mines, for example, toxic gas emissions, chemicals, dust and gasses, urbanisation, and growing technology. For this reason, it is possible that the Grade 5 learners passed along some of the new knowledge they learned from environmental education to their parents/guardians, and that the parents/guardians were still possibly writing about the mine but possibly only in more detail and on a higher level. Research has shown that environmental education can change the attitude of the participants regarding the environment, this has proven to be even more positive when the participants take part in environmental projects (Genc, 2015).

Sewage, overpopulation, urbanisation, growing technology, poverty, poor medical access, heavy rains, and the release of toxic gasses were the next eight new causes to earn 20% of the response. Sewage is a new cause that they are now noticing, according to 20% of the parents/guardians. Many peri-urban communities struggle with sewage, which is also a major contributor to several environmental issues (Wessels *et al*., 2019:197). Sewage can be linked to multiple environmental issues named by the parents/guardians within Question 3, for example, population growth due to a lack of infrastructure and basic services, water due to the sewage spilling into the water sources of the community, and land issues due to the sewage leaking from the pipes onto the soil. These are some of the issues related to sewage that the parents/guardians could have started to notice after environmental education took place.

Next, the parents/guardians responded with overpopulation as one of the new causes, which earned 20%. Several other causes, such as fires/smoke, littering/dumping, sewage, urbanisation, and poverty can also be linked to overpopulation (Baus, 2017:1-48). These are all causes that

can be linked to each other. Growing population and waste production are two additional environmental issues mentioned by the Grade 5 parents/guardians that can be related to overpopulation. This response demonstrates that the Grade 5 learners' parents/guardians may have been thinking more critically now that they have participated in environmental education and may have even discussed some of the new knowledge they have gained with their parents, who may understand the causes that overpopulation has on communities.

Technology growth and urbanisation both received 20% and are frequently related. The metropolitan area expands along with the population, which may result in more jobs, such as those in the mine, and parents and guardians may link this to the expanding technology they observe in the region. This demonstrates that the parents and guardians are now aware of all the changes in their surroundings and are connecting some of these changes to environmental problems including waste production, population growth, climate change, and issues with the air, water, land, and deforestation. The literature has linked urbanisation to natural habitats being damaged, climate change, global warming, and carbon dioxide emissions raising (Baus, 2017:1-48).

Poverty (20%) and poor medical access (20%) are two new causes named within the community that can often also be linked. Poverty and poor medical access can also be linked to other causes, for example, fires/smoke, littering/dumping, sewage, urbanisation, and growing technology. Often poor communities need to make use of fire to do everyday tasks, for example, cooking their food using coal stoves, heating their homes using coal or gas stoves, candles, and wood-burning (Villanueva *et al.,* 2022:546). As mentioned above when Grade 5 learners responded with poor medical access, it is possible that the same can be said for the parents/guardians. It is possible that the parents/guardians interpreted this question incorrectly. From the researchers' aspect poor medical access is not a cause of environmental issues but rather a consequence of environmental issues.

Next was heavy rain which received 20%. Some environmental problems may be caused by periods of heavy rain that the parents/guardians may have seen within the community as the consequence, for example, illness and sewage spills (Public Health Institute, 2016; Lai *et al*., 2020:1). During the environmental lessons, the Grade 5 learners learned about many different causes of environmental issues. Some of the causes that they spoke about were climate change and that climate change can also influence heavy rain. The Grade 5 learners also spoke about sewage and what happens if the infrastructure cannot support the sewage volume after an environmental event. Both topics can be linked to heavy rainfall. Sewage spills may be a consequence of heavy rainfall and illness can result because of heavy flooding. For this reason,

it is possible that after environmental education took place that the Grade 5 learners spoke to their parents about some of the topics they have done in the lessons, this can then be a possible reason that the parents/guardians responded with heavy rain in the post-questionnaire.

The release of toxic gasses (20%) named by the parents/guardians is a very dangerous cause named. The Grade 5 learners who participated in the environmental education lessons learned how harmful serval toxic gasses can be released as well as the damage it does to the ecosystem and human life. The release of harmful gasses may be related to Question 3's air, acid rain, population growth, and waste production. The Grade 5 learners also learned that it can be very harmful to burn waste and start fires, often the waste that is burned can release toxic and harmful gasses (Rim-Rukeh, 2014). The researcher's interpretation is that the Grade 5 learners have gained new knowledge and understanding of some of the possible causes of the release of toxic gasses, after the Grade 5 learners gained this new knowledge, they may share this with their parents/guardians. This can be a possible reason that the parents/guardians responded with the release of toxic gasses in the post-questionnaire.

The next cause mentioned by the parents/guardians was infrastructure damage which accounted for 3%. The researcher analysed this question's response and feels that the parents/guardians might have interpreted this differently. Although this is a very small percentage, it is reasonable that many times people will find it difficult to connect certain causes of environmental difficulties. This shows that the parents/guardians who provided this response were realists and made indirect connections between very significant problems and their causes. For instance, environmental issues can cause damage to infrastructure through heavy rainfall that can result in a sewage issue, which can then cause pollution of water sources, which in turn can lead to hygiene issues, which can then result in illnesses that are difficult to treat because of other infrastructure damage and limited access to healthcare. This then opens a door to other environmental concerns and starts a cycle.

Last, deforestation received 1% of the parents/guardians' responses. This low percentage is concerning to the researcher due to the Grade 5 learners learning about deforestation during the environmental lessons and the impacts that this has. Deforestation can also be linked to mining activities, dust, and poor air quality due to wood burning (Tian *et al*., 2019:1; Villanueva *et al*., 2022:540). For this reason, the findings indicate that the parents/guardians are not able to make this link, or they do not believe that deforestation is such a great cause of environmental issues.

Figure 4.4 shows the totals of all the causes mentioned by the parents/guardians of Grade 5 learners displayed in dark orange. The percentage that received the highest total was 84%, which

indicates that 84% of the parents/guardians believe that littering/dumping is the main cause of environmental problems in their community. Mining came next, 69% of parents/guardians believe that their community's mine is to blame for the environmental issues they are currently experiencing. The third largest percentage of parents/guardians believed dust/gasses were to blame for environmental issues at 68%. Fires/smoke was next with 56%. The percentage that increased the most in the post-questionnaire was chemicals at 32%. The parents/guardians are also concerned about sewage (11%). Next, at 10% each, came overpopulation, urbanisation, growing technology, poverty, poor medical access, heavy rains, and the release of toxic gasses. Last was deforestation at 1% which was a very low percentage and is concerning.

Figure 4.4 shows that the Grade 5 learners may have learned a lot from the environmental education that was undertaken and that they possibly discussed what they learned with their parents/guardians. This significant improvement in parents/guardians' understanding of environmental issues should serve as further evidence of how crucial it is to encourage learners to talk to their parents/guardians about the topics addressed in the curriculum.

Results of the comparison between the Grade 5 learners and the parents/guardians regarding the causes of environmental issues.

In both the Grade 5 learners and the parents/guardians' post questionnaire there was a very positive change within the responses shown in Figure 4.4. This promising outcome showed that after environmental education, the Grade 5 learners may have shared some of the new knowledge they had learned in the environmental education lessons with parents/guardians. This question can be linked to the main research question of the study "How can environmental education influence the awareness and perceptions of air quality in Grade 5 learners and their parents/guardians?" The results of the pre- and post-questionnaires showed that environmental education can have an impact on Grade 5 learners and their parents/guardians. This interpretation is that the Grade 5 learners share die knowledge they have gained from the environmental education lessons with the parents/guardians after the researcher analysed the data and was able to see many similarities within the data. Both the Grade 5 learners and the parents/guardians progressed from mentioning a few general environmental issues like air, water, and land to naming numerous causes of environmental issues that are related to air quality. For example, dust/gasses, mines, fires/smoke, and the release of toxic gasses. These are some of the new words that the Grade 5 learners and their parents/guardians have started to use after environmental education took place that can be linked to air quality. There are many other words that the Grade 5 learners and their parents/guardians started to use that can be linked to other environmental issues and causes that serve as proof that they gained new knowledge, for

example, chemicals, sewage, overpopulation, urbanisation, poverty, poor medical access, and heavy rains. These are just some of the new words used after environmental education took place.

In the post-questionnaire, there were also some changes within the Grade 5 learners and the parents/guardians' responses that can be positive or negative depending on the way the participants interpreted this. In both cases, for the Grade 5 learners and the parents/guardians, their response to mining as a cause of environmental issues had a sharp decrease. If the Grade 5 learners and the parents/guardians think that mines are not such a great cause for environmental issues anymore, this is surprising to the researcher and there should be more focus placed on mining and the environmental issues that mining causes. But the researcher did not interpret this as a negative response but rather positive response. The Grade 5 learners and their parents/guardians may perceive that mining is a problem but some of the participants understood this section better and did not just mention mining but some of the issues that mining can cause in the environment, for example, chemicals, dust/gasses, growing technology, the release of toxic gasses and deforestation. These are some of the words that the Grade 5 learners and the parents/guardians could have possibly linked to mining. So, it is possible that after environmental education took place the participants gained new knowledge and a better understanding of environmental issues and the causes of these issues, and how some of these causes can be linked directly and indirectly. For this reason, the sharp decrease in the cause of mining can be seen as positive.

4.3.5 The comparison of the pre- and post-questionnaires results of the Grade 5 learners and their parents/guardians and whether environmental issues affect them

Question 5 asked, “Do these environmental issues affect you or your family members?”. The results are reported in Figure 4.5. The results of this question revealed if the Grade 5 learners and their parents/guardians perceived environmental issues that are affecting them.

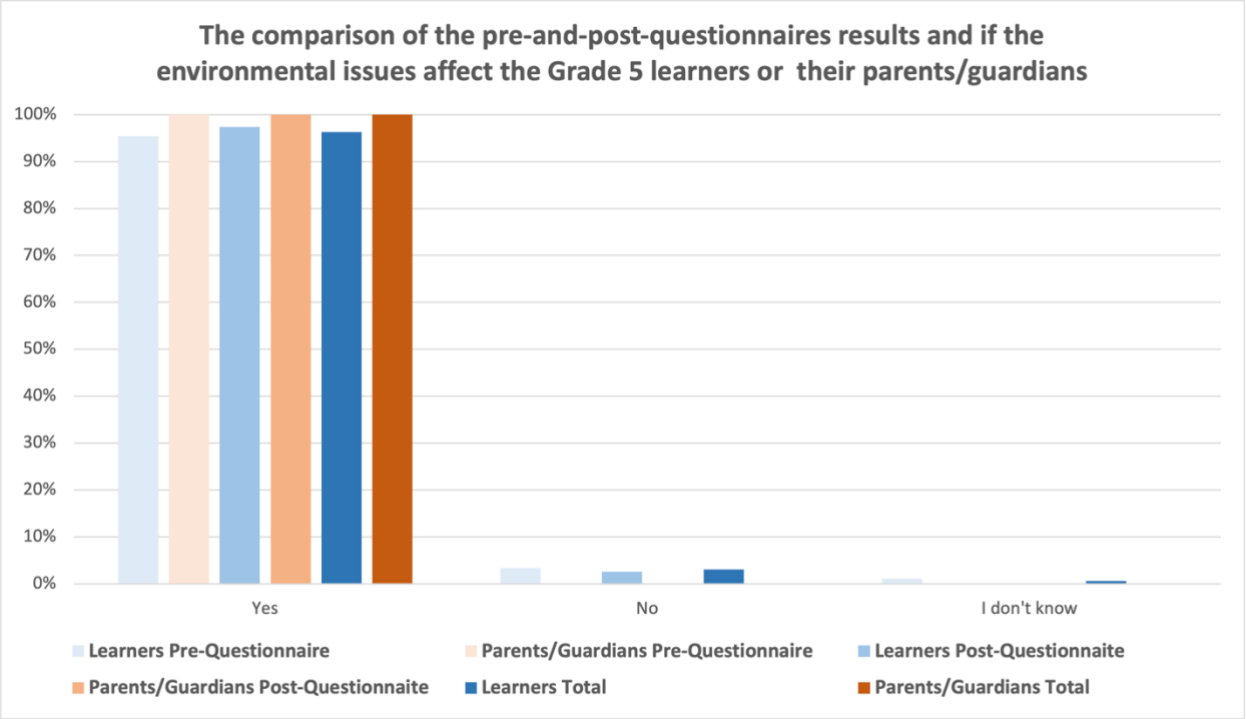


Figure 4.5: The comparison of the pre- and post-questionnaires results and if the environmental issues affect the Grade 5 learners and their parents/guardians

The comparison of the pre- and post-questionnaires results and if environmental issues affect the Grade 5 learners.

Within Figure 4.5. there is a clear indication that Grade 5 learners think environmental issues affect them or their families in their responses to the pre- and post-questionnaire. The overwhelming outcome indicates that most learners know that environmental issues exist, and they perceive them to be experienced within their community. A small number (3.4%) of the learners said that environmental issues do not affect them or their families. Only 1.1% of the learners answered that they do not know if environmental issues affect them or their families. Both the “no” and the “I don’t know answer” can be due to the learners having very little or no knowledge regarding environmental issues and their effects, or because they are not affected by any environmental issue.

In the post-questionnaire, there was a small change in the percentage after environmental education took place. In the post-questionnaire, the percentage of Grade 5 learners that answered yes, environmental issues affect them, or their family increased by 1.9%. The interpretation is that the Grade 5 learners were able to identify and link those environmental issues within their community that affect them or their families after environmental education took place. The percentage of Grade 5 learners that answered that environmental issues do not affect them, or

their families decreased by 0.7% after environmental education took place. Last, after environmental education took place none of the Grade 5 learners answered that they do not know if environmental education affects them or their families. All Grade 5 learners are now able to decide if they think environmental issues affect them or their families.

Overall, in this study, 96.3% of all Grade 5 learners answered that environmental issues do affect them and their families. This indicates that the learners are aware of environmental issues within their community and that these environmental effects possibly influence the Grade 5 learners and their families. How these environmental issues affect the Grade 5 learners will be discussed in the next question. This previous question should also be an indication that the Grade 5 learners can identify some of the possible environmental issues, and causes, and possibly knows how it affects them.

The comparison of the pre- and post-questionnaires results and if environmental issues affect the parents/guardians.

Figure 4.5 shows that the Grade 5 learners' parents/guardians all have a clear idea that environmental issues affect them or their family members. In both the pre- and post-questionnaires the parents/guardians answered the same way and received the same percentages. All parents responded yes, 100% of themselves or their family members are affected by environmental issues in the pre- and post-questionnaires. This data reveal that all the parents/guardians feel that within their community or lives there are some environmental issues affecting them. How these environmental issues affect the parents/guardians will be discussed in the next question. This previous question should also be an indication that the parents/guardians can identify some of the possible environmental issues, and causes, and possibly knows how it affects them. This data revealed that all parents/guardians are aware of environmental issues and perceive that this is affecting them or their family members in the pre- and post-questionnaire.

Results of the comparison of environmental issues affect the Grade 5 learners and the parents/guardians.

As one can deduce from the discussion above, most of the Grade 5 learners and all of the parents/guardians responded that environmental issues do affect them or their family members. This finding along with some of the other findings revealed to the researcher that the Grade 5 learners and the parents/guardians are aware that environmental issues can influence people within the surrounding area.

4.3.6 The pre- and post-questionnaire results of how environmental issues affect the Grade 5 learners and their parents/guardians

Question 6 “How do these environmental issues affect you or your family members?” When studying Figure 4.6, there is a clear indication that in the pre-questionnaires the Grade 5 learners and their parents/guardians perceive that environmental issues could affect them or their family members. The results of the pre- and post-questionnaires are shown in Figure 4.6.

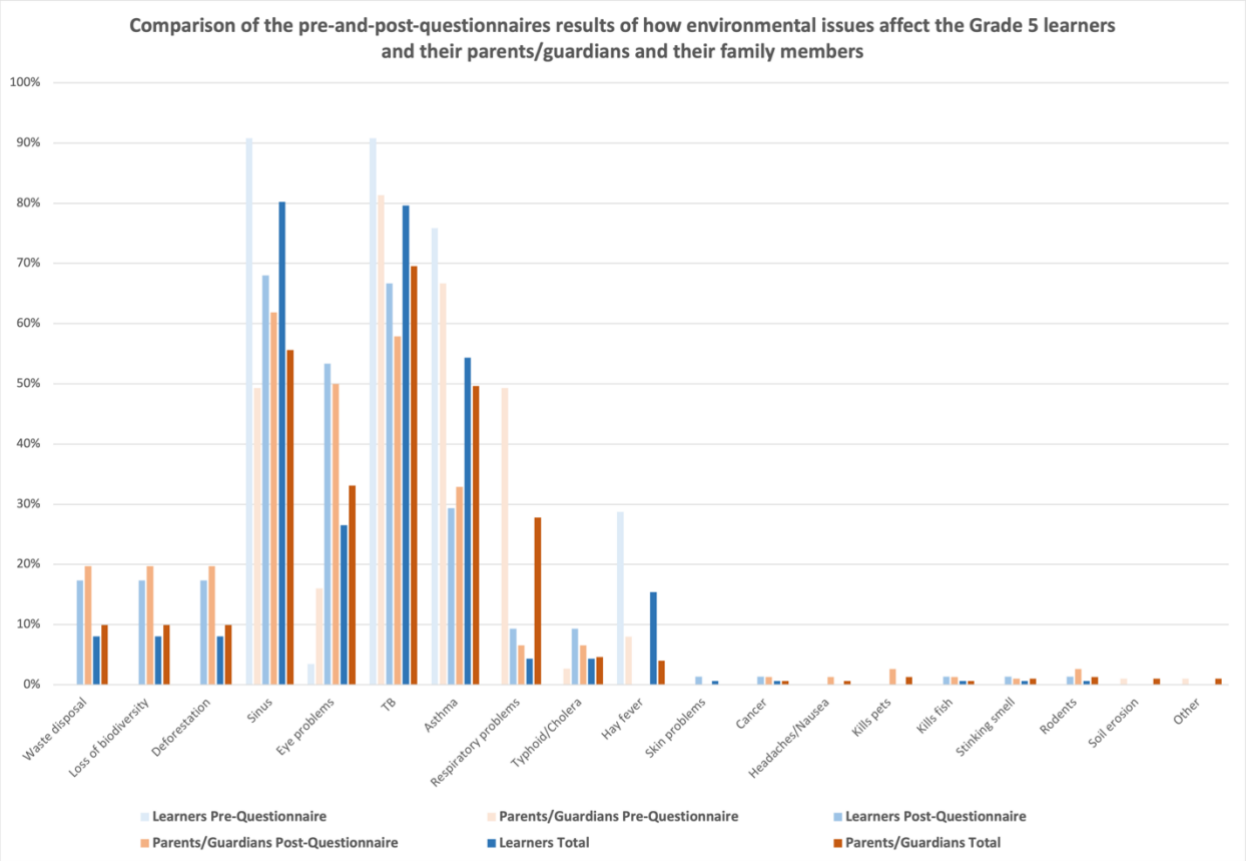


Figure 4.6: Comparison of the pre- and post-questionnaires results of how environmental issues affect the Grade 5 learners' parents/guardians and their family members

The pre- and post-questionnaire results of how environmental issues affect the Grade 5 learners and their family members.

Figure 4.6 shows how the Grade 5 learners perceive that environmental issues affect them and their family members. The percentage will exceed 100% due to the learners naming three ways they are being affected. The Grade 5 learners are represented by different shades of blue. When studying Figure 4.6 many of the effects are health-related.

Three out of the five health problems, namely sinus (91%), TB (91%), and asthma (76%) gained very high percentages and are all linked to environmental issues. The other two areas, namely eye problems (3%) and hay fever (29%) with lower percentages can also be linked to environmental issues. The top two health issues that the Grade 5 learners named were sinus and tuberculosis (TB), both received 91%. This is a clear indication that the Grade 5 learner may have first-hand experience with some of these health issues. Next, is asthma at 76%. This is still a very high percentage for the Grade 5 learners who may have first-hand experience with this health issue. Hay fever at 29% is not seen as a serious health issue and very often people refer to it as seasonal or they have hay fever for the day. Last was eye problems at 3%. Eye problems can also be linked to environmental issues. In the pre-questionnaires, the Grade 5 learners already understood how environmental issues can affect their health or the health of their family members.

In the post-questionnaires, the Grade 5 learners indicate that fourteen issues are affecting them or their family members. This is nine more issues than given in the pre-questionnaire, namely waste disposal, loss of biodiversity, deforestation, respiratory problems, typhoid/cholera, skin problems, cancer, kills fish, stinking smell, and rodents. This can be due to the Grade 5 learners gaining more new knowledge during the environmental education that took place. Some of the issues named are not health issues directly linked to the Grade 5 learners or their family members, but rather issues within the surrounding environment affecting them differently. This can be due to learners learning to care for the environment and learning to identify other effects that environmental issues can have on them. Figure 4.6 indicates that the Grade 5 learners learned how environmental issues affect them and their family members during their environmental education lessons.

The highest percentage for Question 6 responses in the post-questionnaires was sinus at 68%. This percentage decreased by 23%. Next was TB at 67%. This percentage decreased by 24%. Next was eye problems. In the pre-questionnaire eye problems did not have a very high percentage at 3%, but in the post-questionnaire, this percentage increased to 50%. This is a very high increase and can be due to the Grade 5 learners gaining a new understanding and knowledge by having environmental education. Next was waste disposal, loss of biodiversity, and deforestation, all three of the named had 17%. These three were not named in the pre-questionnaires but only in the post-questionnaires after environmental education took place. All of the following items had very low percentages but were all named only in the post-questionnaires after environmental education: Respiratory problems (9%), typhoid/cholera (9%), skin problems (1%), cancer (1%), kills fish (1%), stinking smell (1%), and rodents (1%). Some of these issues are major health concerns that affect humans directly, for example, respiratory

problems. Many of these effects can also be linked to poor air quality, for example, sinus, eye problems, TB, asthma, respiratory problems, hay fever, skin problems, and cancer.

The pre- and post-questionnaire results of how environmental issues affect the parents/guardians of Grade 5 learners and their family members.

Figure 4.6 also shows how the Grade 5 parents/guardians perceive environmental issues to affect them and their family members. This percentage will again exceed 100% due to the parents/guardians also naming more than three effects. The parents/guardians are represented in Figure 4.6 with different shades of orange. In the pre-questionnaire, the parents/guardians named nine ways they are affected by environmental issues, namely sinus (49%), eye problems (16%), TB (81%), asthma (67%), respiratory problems (49%), typhoid/cholera (3%), hay fever (8%), soil erosion (1%) and Other (1%). The Other was not motivated by the parents/guardians. Only two of the nine ways that the parents/guardians shared were not health issues that can be related to environmental issues, namely soil erosion (1%) and Other (1%).

The highest percentage was tuberculosis (TB) at 81%. TB received a very high percentage that possibly revealed that many of the parents/guardians have been in contact with TB and that this is a very serious illness within the community. The next way that the parents/guardians said they were being affected was asthma at 67%. This is a very high percentage and asthma is a very common health issue within poor air quality areas. This data show us that many of the people living within the community are possibly living with poor air quality. Next was respiratory problems and sinus at 49%. Respiratory problems are one of the leading health risks that people living in areas with poor air quality face, and this should be an indication together with asthma and sinus that if such high percentages of the parents/guardians of their family members are affected by these issues then there is an issue within the community.

The last three health effects named did not receive such a high percentage, but these issues can still be linked to environmental issues and poor air quality. Eye problems (16%), hay fever (8%), and typhoid/cholera (3%), are three health issues that are not seen as very serious to most people so for this reason very often people will not think these issues are related to environmental issues or poor air quality. The last two effects named could not be linked to health issues, i.e., soil erosion at 1% that can be linked to some environmental issues, and the Other at 1%. The parents/guardians that named Others, did not motivate their response.

The data revealed that the Grade 5 parents/guardians had a good understanding that some of the environmental issues within their community were possibly responsible for some of the health

issues that they face. This data also show the researcher that a large percentage of the parents/guardians and their family members are greatly affected by health issues.

In the post-questionnaires, the parents/guardians named fifteen ways they think they are being affected by environmental issues. This was six more ways than named in the pre-questionnaire and nine new ways, namely waste disposal (20%), loss of biodiversity (20%), deforestation (20%), cancer (1%), headaches/nausea (1%), killing pets (3%), killing fish (1%), stinking smell (1%) and rodents (3%). Eight of the fifteen ways that the parents/guardians named were health effects that can be linked to poor air quality. The other seven were ways that the environment was being affected.

Sinus (62%) had the highest percentage and increased to 13% after environmental education took place. Sinus can also be linked to poor air quality, this data revealed that the Grade 5 learners possibly spoke to their parents/guardians after they received environmental education and share some of their new knowledge. Next was TB, 58% of the parents/guardians think that TB is an effect of environmental issues. This percentage decreased by 23%. When being exposed to poor air quality, this could increase susceptibility to the development of TB. The data revealed that in the post-questionnaire the parents/guardians thought that there were other effects that environmental issues can have that are possibly more linked to them and their family members.

The next effect named was eye problems at 50% and this area increased by 34%. This is a big increase in the percentage. Eye problems can be linked to environmental issues and poor air quality, but often people will not make this link. In this case, the data revealed that the parents/guardians are now able to make this link. This is very positive and shows that the parents/guardians have possibly gained some new knowledge from the Grade 5 learners that received environmental education.

Asthma (33%) decreased with 34%. This data show that the parents/guardians now think other effects possibly affect them more than asthma does. This is surprising due to asthma being such a big problem in most poor air quality areas. But different people have different needs and concerns, in this case, the parents/guardians may perceive that they are being affected more when the effects cause problems within the environment, for example, a loss of biodiversity.

The next three effects have a direct impact on the environment, waste disposal, loss of biodiversity, and deforestation. These effects all receive 20% and are some of the new effects that parents/guardians named after environmental education took place. These are all effects that should be visible and it is possible that the parents/guardians did not show that these effects are part of environmental issues and know they can make a link.

Respiratory problems were at 7% and typhoid/cholera at 7%. The post-questionnaire respiratory problems decreased by 42%. Respiratory problems are one of the biggest and most dangerous health issues faced by communities with poor air quality. These health issues should possibly be addressed more in the future. Typhoid/cholera (7%) grew with 4%. Next was pets that are dying, killing pets at 3% and rodents at 3%. These two are new effects that the parents/guardians named. Last, was cancer at 1%, headaches/nausea at 1%, killing fish at 1%, and stinking smell at 1%. Very few parents/guardians named the last four effects, these effects can be linked to environmental issues as well.

Figure 4.6 shows the total percentages for the environmental effects that the parents/guardians named for this question. The highest percentage was TB at 70%, next was sinus at 56% and asthma at 50%. These all received a very high percentage. Eye problems at 33% and respiratory problems at 28% are also some of the effects the parents/guardians perceive to feel strongly about. The last effects did not receive very high percentages but are still an indication that parents/guardians are noticing it and some people are still being affected by these issues, that is, waste disposal (10%), loss of biodiversity (10%), deforestation (10%), typhoid/cholera (5%), hay fever (4%), cancer (1%), headaches/nausea (1%), kills pets (1%), kills fish (1%), stinking smell (1 %), rodents (1%), soil erosion (1%), and Other (1%). Some of the effects that the parents/guardians named are major health and environmental concerns that this community is facing and should be dealt with.

Results of the comparison of how environmental issues affect the Grade 5 learners and the parents/guardians and their family members.

In the analysis of this question, the researcher was able to reveal what environmental issues affect the Grade 5 learners their parents/guardians, and their family members. Most of what the Grade 5 learners named corresponds with their parents'/guardians' responses. This should be an indication that this community and the people living within the community are exposed to environmental issues that need to be dealt with. The researcher is also able to reveal that the Grade 5 learners and the parents/guardians possibly gained some new knowledge during the environmental education lessons due to the responses that they gave the pre- and post-questionnaires. This change is very positive and is an indication that not only the Grade 5 learners and the parents/guardians realise that environmental issues affect their health.

This question can also be linked to one of the secondary objectives "To establish the perceptions of Grade 5 learners and their parents/guardians on air quality." When analysing all the data that the question gathered, the Grade 5 learners and their parents/guardians showed in their

responses that they understood how environmental issues affect them. This data led the researcher to believe that Grade 5 learners and their parents/guardians perceive environmental issues to be present in their living environment. When looking at the Grade 5 learners and their parents/guardians' responses during the pre- and post-questionnaire it seems that they perceived air quality as being an issue within their community and having a part in health issues. This link can be made due to all the issues they responded to that can be related to poor air quality, namely sinus, eye problems, TB, asthma, respiratory problems, hay fever, and cancer.

4.3.7 The comparison of the pre- and post-questionnaires results of the Grade 5 learners and their parents/guardians and whether environmental issues affect the health of them and their family members

Question 7, "Do these environmental issues affect your health or your family member's health?", was included to indicate whether the Grade 5 learners and their parents/guardians understood the previous questions and are dealing with these issues first-hand. Figure 4.7. reports the pre- and post-questionnaire results of the Grade 5 learners and their parents/guardians and how they say their health is affected by environmental issues.

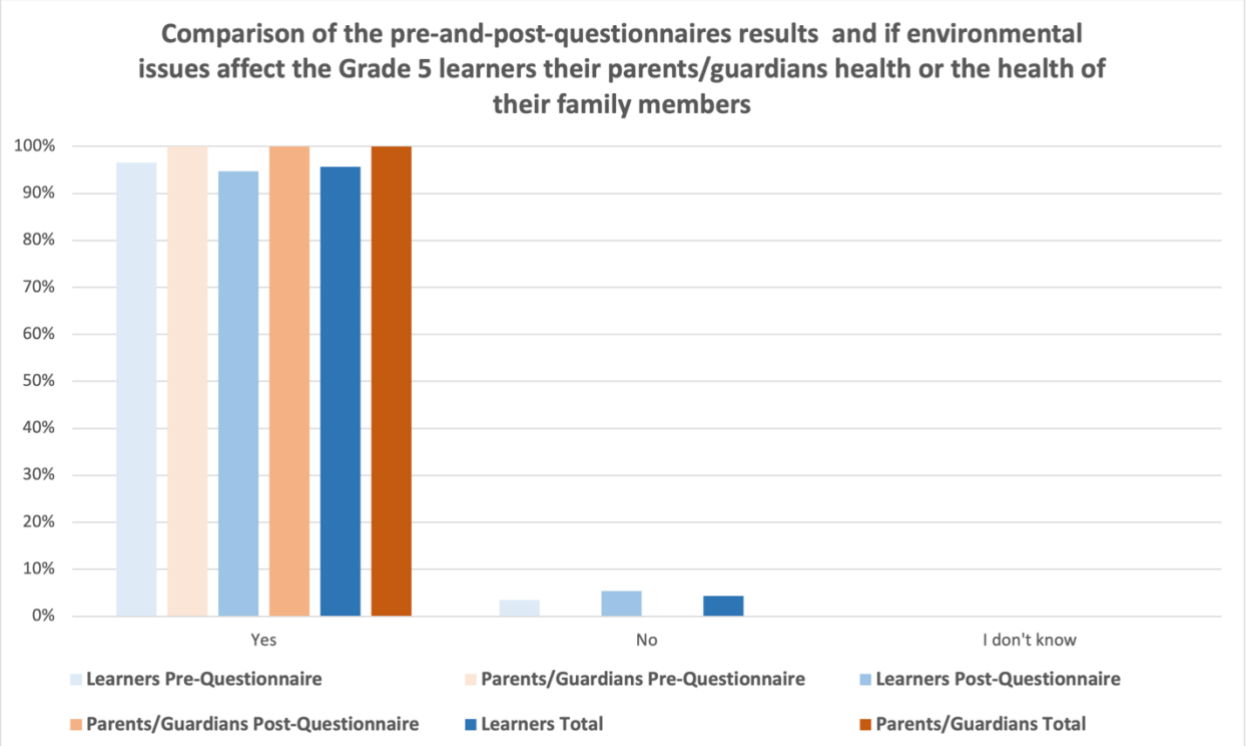


Figure 4.7: Comparison of the pre- and post-questionnaires results and if the environmental issues affect the Grade 5 learners and their parents/guardians' health or the health of their family members

The pre- and post-questionnaires results and if environmental issues affect the Grade 5 learners' health or the health of their family members.

Figure 4.7 shows if the Grade 5 learners think that environmental issues affect their health or the health of their family members. The results are indicated in different shades of blue. In the pre-questionnaire, 97% of the Grade 5 learners thought yes, their health or the health of their family members is being affected. Only 3% of the learners did not agree and said “no” environmental issues do not affect the health of them or their family members. None of the Grade 5 learners said, “I don’t know”.

These percentages above change slightly in the post-questionnaires. “Yes” decreases by 2% from 97% to 95%. This meant that “no” increased from 3% to 5%. This result indicates that the learners overwhelmingly perceive environmental issues to be the cause of their own and their family members’ illness.

Figure 4.7 shows the results for Question 7. Most Grade 5 learners perceive that environmental issues affect their health or the health of their family members. 96% of all the Grade 5 learners say their health or the health of their family members is being affected by the environmental issues they face within their community. Only 4% of the Grade 5 learners do not agree and say their health and the health of their family members are not being affected. None of the Grade 5 learners said, “I don’t know”. This number of Grade 5 learners that did say yes is much bigger than expected.

The pre- and post-questionnaire results for if environmental issues affect the Grade 5 learners' parents/guardians' health or the health of their family members.

Figure 4.7 shows if the Grade 5 learners' parents/guardians think that environmental issues affect their health or the health of their family members. In the pre-questionnaire, all the parents/guardians said yes. This meant that 100% of the parents/guardians think environmental issues affect them.

Figure 4.7 shows that in the post-questionnaire, 100% of the parents/guardians said environmental issues affect their health or the health of a family member. This data reveal that all the parents/guardians perceive that environmental issues are bad for human health and are possibly even affected by some of these issues.

Results of the comparison of whether environmental issues affect the Grade 5 learners, their parents/guardians, and their family members' health.

In both the Grade 5 learners and the parents/guardians' responses in the pre- and post-questionnaire shown in Figure 4.7, most of the participants think environmental issues are affecting their health or the health of their family members. This can be an indication that the participants and/or their family members have health issues, and they think that environmental issues within the community are the cause of these issues. This is positive data and revealed to the researcher that the Grade 5 learners and parents/guardians are aware that environmental issues cause health issues.

4.3.8 The comparison of the pre- and post-questionnaires results of the Grade 5 learners and their parents/guardians of how the environmental issues affect their health and their family members' health

Question 8, "How do these environmental issues affect your health or your family member's health?", was a follow-up question related to Question 7. This question was to identify if the Grade 5 learners could identify the health effects that they or their family members are faced with due to environmental issues they face in their community. Figure 4.8. reports the results for this question in the comparison of the pre- and post-questionnaires.

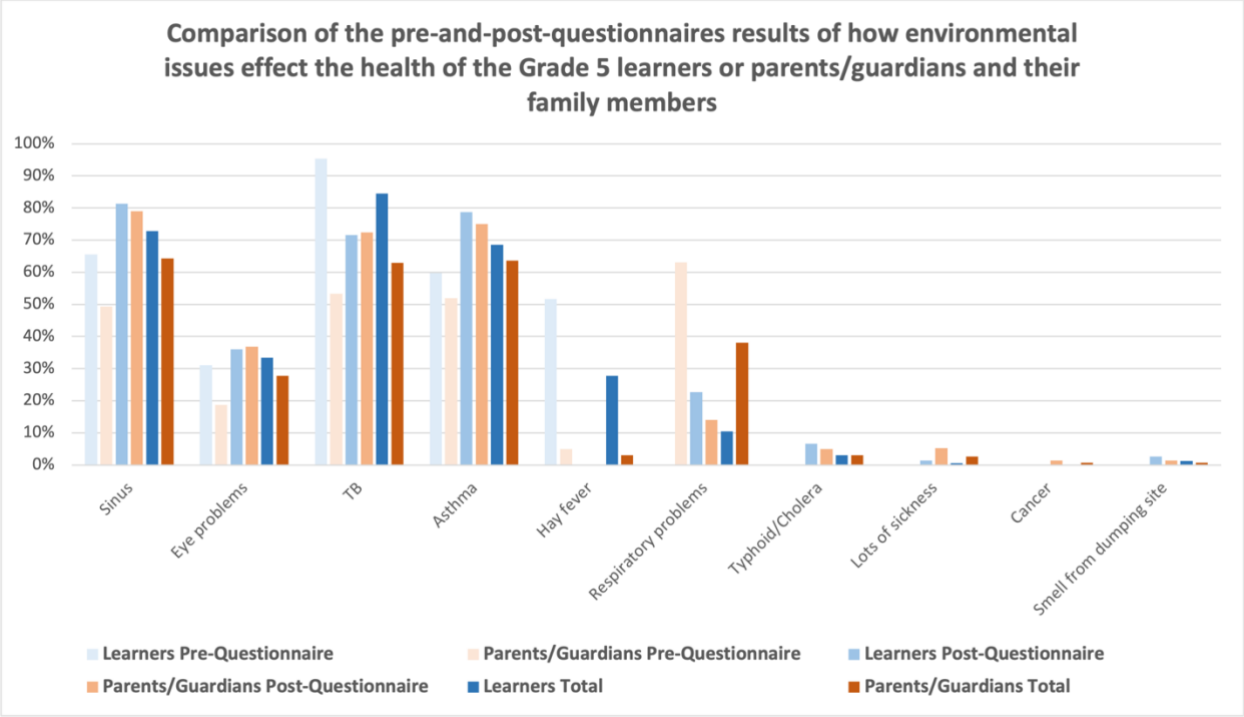


Figure 4.8: Comparison of the pre- and post-questionnaires results of how the environmental issues effect the health of the Grade 5 learners their parents/guardians and their family members

The pre- and post-questionnaires and how environmental issues affect the Grade 5 learners' health or the health of their family members.

Figure 4.8 shows the comparison of the pre- and post-questionnaire. There is a clear change within the Grade 5 learners' responses to the question. The Grade 5 learners' results are shown in different shades of blue. In this question, the Grade 5 learners had to name three health issues, and for this reason, the percentage will exceed 100%.

In the pre-questionnaire, the Grade 5 learners named five health issues, namely sinus (66)%, eye problems (31%), TB (95%), asthma (60%), and hay fever (52%) that affect them or their family members. The highest percentage was TB with 95.4%. TB is one of the biggest health issues in South Africa. In 2018 a report was completed that concluded South Africa is among the 14 countries in the world with the highest burden of TB (Van der Walt & Moyo, 2018:357). The next health issue was sinus at 65.5%. This is a very common health issue that people face particularly those living in areas with poor air quality. Next was asthma at 59.8% and this health issue is also very commonly found in communities with poor air quality (WHO, 2016:39). Also, a high percentage was hay fever at 51.7%. Very often people that have hay fever will not link this to environmental issues but just to pollen in the air. This is correct but also not because pollen is also seen as an air pollutant characteristic (World Health Organization, 2013). Environmental issues lead to high levels of pollen in the air. Last, were eye problems and 31% of the Grade 5 learners think that they or some of their family members have been affected by eye problems due to environmental issues. When looking at Figure 4.7 and Figure 4.8, it is clear that the responses correspond and there is a clear link between the questions. The responses that the Grade 5 learners gave were very similar in both questions.

In the post-questionnaires, the number of health issues that the Grade 5 learners named increased from five to eight. The Grade 5 learners responded with four new issues, namely respiratory problems, typhoid/cholera, lots of sicknesses, and the smell of dumping sites. Not all responses were health-related. This can be an indication that the Grade 5 learners now have more knowledge of health issues that are caused by environmental issues after they had environmental education. Sinus increased by 15.8%, asthma increased by 18.9%, eye problems increased by 5%, and all three of these health issues are very common within communities with poor air quality. TB decreased by 23.8%. Hay fever also decreased to 0%, this can be due to the Grade 5 learners not thinking hay fever is a very serious health issue like some of the more serious issues they face or that it is a result of air pollution. The other issues were all new issues that the Grade 5 learners did not name in the pre-questionnaires but only named after environmental education took place. The most important health issue the learners named was

respiratory problems. This new health issue that the learners named was also the issue with the highest percentage of 22.7%. This is a very serious issue that can be directly linked to poor air quality (WHO, 2016:26). The next health issue was typhoid/cholera at 6.7% which is also one of the health issues caused by environmental issues. The last issue named is not a health issue but some of the Grade 5 learners named this issue as a health issue, that is smell from the dumping sites at 2.7%. The smell is not a direct link to any health issues, but the dumping site can be linked to environmental issues and health effects caused by these smells.

The highest percentage of Grade 5 learners felt that TB is the most common health issue that they or their family members face. Sinus at 72.8% and asthma at 68.5% were the next two health issues that the learners or their family members faced, both issues can be linked to environmental issues and more specifically poor air quality. Eye problems at 33.3% and hay fever at 27.8% did not reach such high percentages in total but are also very common health issues for environmental issues. Next respiratory problems are one of the leading health issues that are caused by environmental issues and more specifically poor air quality. But this health issue did not receive a very high percentage. This indicates that the Grade 5 learners possibly do not think this is such an important health issue or that the learners cannot relate or link to the issue. The last health issue was typhoid/cholera at 3.1% and the smell from the dumping site at 1.2% that is not a health issue, but the dumping site can cause an environmental issue that can then cause a health issue.

The pre- and post-questionnaire results and how environmental issues affect the Grade 5 learners' parents/guardians' health or the health of their family members.

In the pre- and post-questionnaire, there is a change within the Grade 5 learners' parents/guardians' responses for Question 8. This is shown in Figure 4.8. The parents/guardians also needed to name three health issues, for this reason, the percentage will exceed 100%. In the completion of the pre-questionnaires, the parents/guardians named six health issues that they or their family members face, namely sinus, eye problems, TB, asthma, hay fever, and respiratory problems.

The highest percentage was respiratory problems at 63%. This health issue can be directly linked to poor air quality. Very often people do not know that the air they breathe causes this breathing problem. This data indicate that there is a possibility that the air quality within the community can be responsible for these health issues. The next health issue was TB at 53%, these health issues are also very common in areas of poor air quality. TB is also one of the biggest health issues that South Africa faces (Van der Walt & Moyo, 2018:357). Asthma, at 52%, was the third highest

percentage and this health issue can also be directly linked to poor air quality. The fourth health issue named was sinus at 49% and this issue is also very common in areas with poor air quality. Next was eye problems at 19% of these health issues can also be linked to poor air quality. Last, was hay fever at 5%, most people do not take hay fever very serious and think it is just due to some pollen in the air but can also be caused by poor air quality.

In the post-questionnaire, the number of health issues that the parents/guardians named went from six to nine. Four new issues were named thyroid/cholera, lots of sicknesses, cancer, and the smell of the dumping sites. This change in the number of health issues named can be an indication that the Grade 5 learners shared some of the new knowledge they received from the environmental education lessons with their parents, and this affected their knowledge, understanding, and perceptions. The pre-questionnaire indicates that the parents/guardians now have more knowledge regarding health issues related to environmental issues. The highest percentage was sinus at 79%. This health issue increased by 30%. The next health issue named was asthma at 75% and this issue increased by 23%. The third highest percentage named was TB 72% and had an increase of 19%. Eye problems 37% increased with 18%. Next was respiratory problems and this health issue, which is one of the leading health issues related to poor air quality decreased by 49%. Respiratory problems, at 14% are a very important health issue to be aware of. Some of the reasons that this health issue decreased by such a high percentage can be due to the other health issues especially the top four increasing by such high percentages. The top four health issues are also much easier to identify.

The next four health issues named are new issues that the parents/guardians did not name in the pre-questionnaire. Typhoid/cholera and lots of sickness, 5% of the parents/guarding did not motivate and say what type of sickness but they just wrote that they get sick often. Next was cancer at 1%; the last issue is not a health issue. The smell from the dumping site is at 1%. The post-questionnaires' hay fever was not named. The parents/guardians named nine issues in the post-questionnaires, five of the nine issues can be directly linked to poor air quality. This data can be a possible indication that the parents/guardians are not only influenced by poor air quality but can identify some of the health issues related to this environmental issue.

Figure 4.8 shows the total percentage of the health issues that the parents/guardians named. This is indicated in dark orange. The highest percentage is two health issues that can be related to poor air quality sinus and asthma with 64% each. The second highest percentage was TB 63%. Next was respiratory problems at 38%. Eye problems at 28% was the fourth highest percentage and the other health issues received very low percentages. Typhoid/cholera, hay fever and lots of sicknesses all received 3%. The last two issues named received 1% each, namely, cancer and

smell from the dumping site. These are the ten issues that the parents/guardians named in the pre- and post-questionnaires. Not all the issues named are health issues, but all the issues are serious to the parents/guardians and most of the issues can be linked to poor air quality.

Results of the comparison of how environmental issues affect the Grade 5 learners, their parents/guardians, and their family members' health.

Both the pre- and post-questionnaire indicated in Figure 4.8 shows a change within the Grade 5 learners and the parents/guardians' responses. Not only did the number of health issues that the participants named increase, but also the percentage of the more serious health issues and the issues that are possible within the peri-urban community. Major parts of these questions answered can be linked to poor air quality, and this can be linked to the second question regarding the context of air quality within the peri-urban community.

4.3.9 The pre- and post-questionnaires results of the Grade 5 learners and their parents/guardians and if they think the environmental issues can be improved

Question 9, "Can these environmental issues be improved?", was a critical question that was developed to establish the Grade 5 learners and their parents/guardians' perception and attitude towards the improvement of environmental issues. Figure 4.9 reports the comparison of the results for the pre- and post-questionnaires.

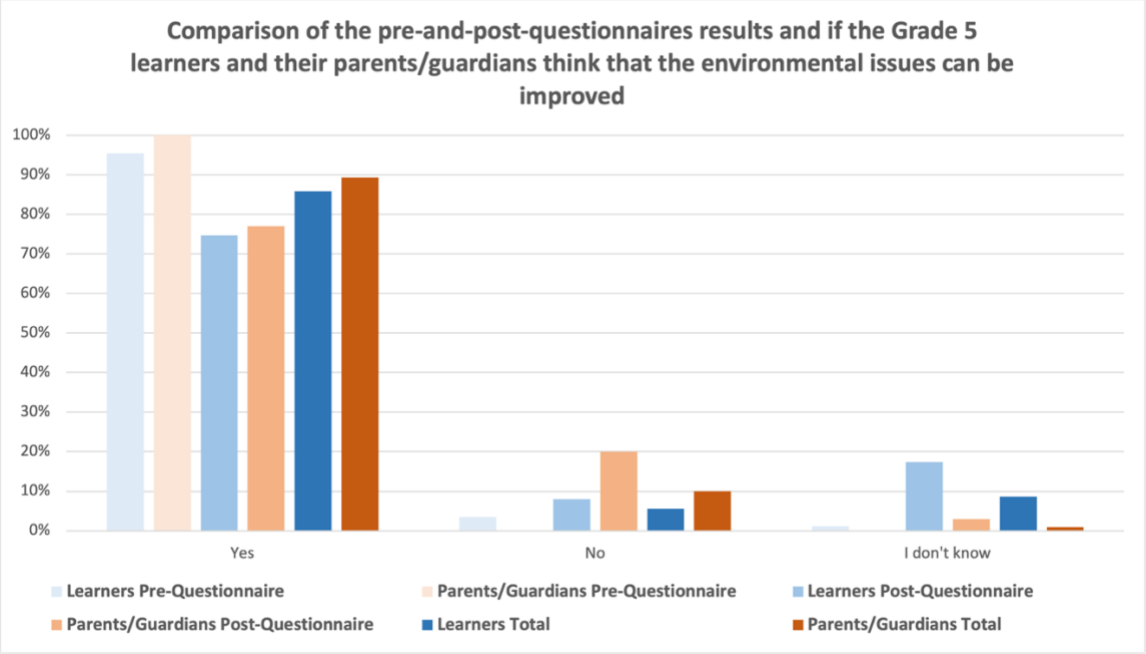


Figure 4.9: Comparison of the pre- and post-questionnaires results and if the Grade 5 learners and their parents/guardians think that the environmental issues can be improved

The pre- and post-questionnaires results and if Grade 5 learners think that environmental issues can be improved.

The pre-questionnaire data for the Grade 5 learners can be seen in Figure 4.9. The Grade 5 learners' results are shown in different shades of blue. In the pre-questionnaires, 95.4% of the Grade 5 learners said yes, they think that the environmental issues can be improved. 3.4% of the Grade 5 learners said they do not think environmental issues can be improved. Last, only 1.1% of the Grade 5 learners said that they do not know if environmental issues can be improved. This pre-questionnaire proved that the Grade 5 learners have hope that the environmental issues they face can be improved.

The post-questionnaires of the Grade 5 learners' responses can be seen in Figure 4.9. The Grade 5 learners changed their responses to this question. The percentage of Grade 5 learners that believe that environmental issues can be improved decreased by 20.7%. This is a drastic decrease in percentage and can indicate that after environmental education the learners now feel that there is little hope for environmental education to improve. One of the reasons this can be is that the Grade 5 learners now possibly feel they cannot make a change or that the environmental issues are too serious and cannot be changed by their actions. Last, 17.3% of the learners are not sure if environmental education can be improved. This can also be because the perception of the learners is that the issues are too serious, and they do not know they can improve their situation.

Figure 4.9 shows the total results of the Grade 5 learners regarding if environmental issues can be improved.

The total percentage of Grade 5 learners can be seen in Figure 4.9. 85.8% of the Grade 5 learners think that environmental education can be improved. 5.6% of the learners think that environmental issues cannot be improved and last, 8.6% of the learners are not sure if the issues can be improved.

The pre- and post-questionnaires and if Grade 5 learners' parents/guardians think that environmental issues can be improved.

The pre-questionnaire data for the parents/guardians are shown in Figure 4.9. In these pre-questionnaires, 100% of the parents/guardians said yes, they think environmental issues can be improved. In the post-questionnaires, some of the parents/guardians changed their answers. 77% of the parents/guardians said yes, they still think environmental issues can be improved the parents/guardians' percentage that said yes environmental issues can improve decreased by

23%. Possible reasons for this decrease can be due to parents/guardians thinking the issues are too serious to improve or that they possibly just don't think it is possible. Next, 20% of the parents/guardians said no, they do not think that environmental issues can be improved and 3% of the parents/guardians said that they do not know if environmental issues can be improved.

Figure 4.9 shows the total percentage that the Grade 5 learners' parents/guardians who answered Question 9. 89% of the parents/guardians think that it is possible to improve environmental issues. The biggest percentage of parents/guardians still say that yes, they think environmental issues can be improved, this is positive data. For the environmental issues to improve all people should believe it is possible and work towards that goal. 10% of the parents/guardians do not think that the environmental issues can be improved and 1% said they do not know if the environmental issues can be improved.

Results of the comparison if Grade 5 learners and their parents/guardians think that environmental issues can be improved.

From this question, it is clear that environmental education can influence the way that Grade 5 learners and their parents/guardians answer this question. After environmental education took place, Figure 4.9 shows that a growing percentage of Grade 5 learners and parents/guardians now think environmental issues can't be improved. This can be due to all the participants possibly now feeling they cannot help with this improvement.

4.3.10 The pre- and post-questionnaires results of the Grade 5 learners and their parents/guardians and how they think that environmental issues can be improved.

Question 10, "What changes can you make in your living environment (community) to improve these environmental issues?" This question was linked to Question 9 to see if the Grade 5 learners think they can make any changes and improve the environmental issue they face. Figure 4.10 compares the pre- and post-questionnaires regarding the changes that the Grade 5 learners can make within their living environment/community to improve environmental education.

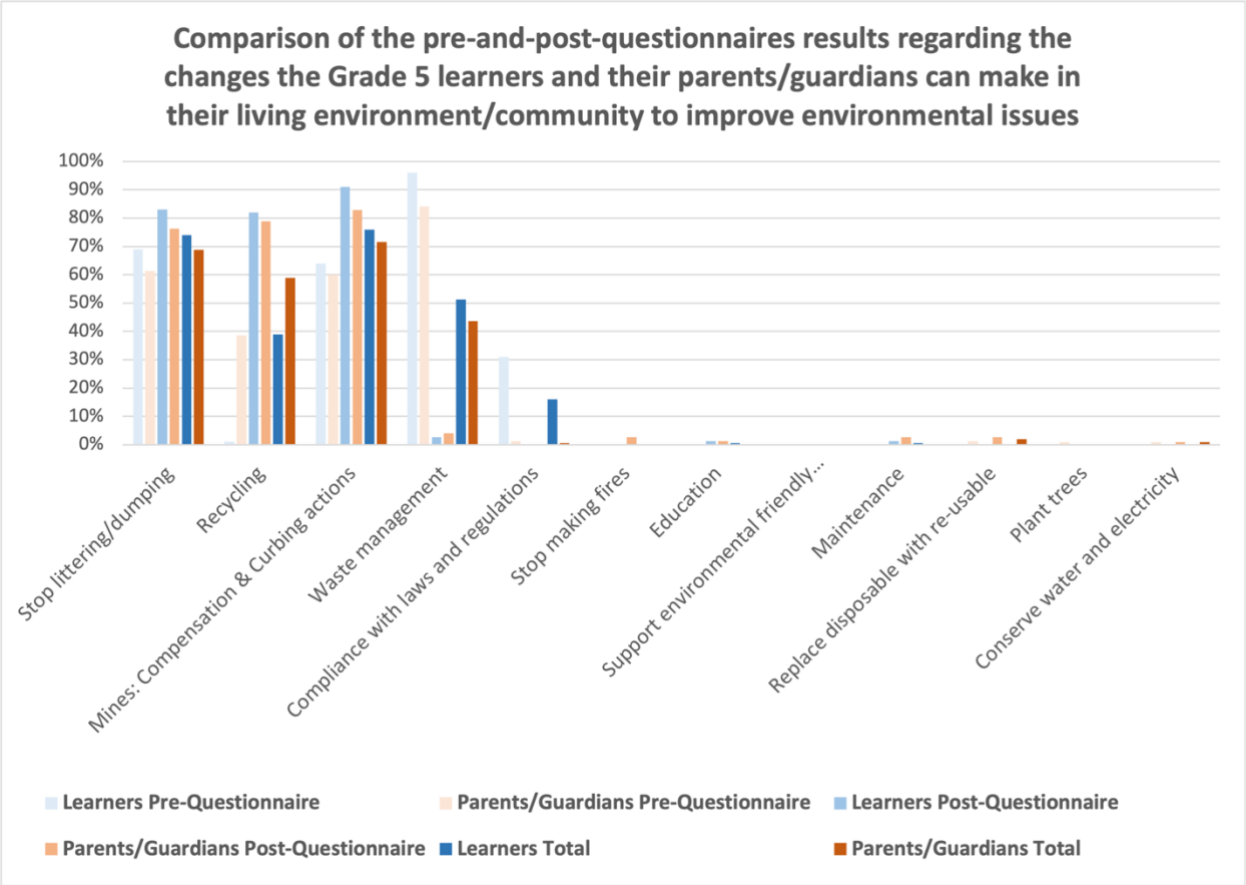


Figure 4.10: Comparison of the pre- and post-questionnaires results regarding the changes that Grade 5 learners, and their parents/guardians can make in their living environment/community to improve environmental issues

The pre- and post-questionnaires results and the changes the Grade 5 learners can make in their living environment/community to improve environmental issues.

When studying Figure 4.10 the pre-questionnaires indicated that the Grade 5 learners felt they can make some changes to help improve environmental education. The latter outcome supports the responses from the majority of learners and their parents/guardians in the previous question who believe that environmental issues can be improved. The highest percentage of learners who said they can make a change and help with waste management was 93%. Most of the learners said if they can manage waste better they think this will make a change and improve the environmental issues they face within their community showing that they perceive waste and possibly the burning thereof to contribute to poor air quality. The next thing that the Grade 5 learners said they can help to improve the environmental issues, was to stop littering/dumping at 66%. Mines: Compensation & Curbing actions at 62% was one of the highest percentages that the learners named. This can, however, not be changed by the Grade 5 learners themselves.

Compliance with laws and regulations received 30% of the responses by the Grade 5 learners. This can be done by doing some small things, for example, not making open fires, not cutting down trees, and not dumping. These are some of the things that can be easily changed with the behaviour choices a person can make. Last, 1% of the Grade 5 learners said they can recycle. Recycling is a solution to improving environmental issues and is part of what environmental education promotes.

The highest percentage of change the learners felt they can make to their living environment/ community was through Mines: Compensation & Curbing actions (92%). The Grade 5 learners responded that “mines should compensate”, “mines should get fines for what they do” and “mines should pay fines according to the law”. Again these actions cannot be taken into the hands of the Grade 5 learners themselves, but can only be raised as an issue by the learners to the community. The next change that the learners said they can make is to stop littering/dumping and this can be taken into the hands of the Grade 5 learners, and this increased by 29% after environmental education lessons took place. This is a very good indication that the Grade 5 learners feel they can make a change and help improve environmental education. Recycling was the change that the learners said in the pre-questionnaire with the lowest percentage, but the change that increased the most after environmental education. Recycling increased by 81%, and this is a good improvement in the learners’ perception that they think this can make a difference and also a good improvement in the learners’ attitude that they can make a change and help improve their situation. Waste management decreased to 3% and the learners now perceive that waste management can also help to improve these issues. Maintenance and education were not named in the pre-questionnaires but in the post-questionnaires and it was 1%. Overall, the Grade 5 learners think they can make a change within their living environment/community and that it will be able to improve the environmental issues that their community face. This is a very positive outcome.

Figure 4.10 also illustrates the total percentage of changes that the Grade 5 learners can make within their living environment/community that can help to improve environmental issues. The majority of the learners think of Mines: Compensation & Curbing actions (76%) can be a solution the some of the environmental issues that the community face. This can be an indication that the community should possibly take this change very seriously. Next was Stop littering/dumping (74%). This change is a very easy one to make if the learners make the decision and are serious about the change. Waste management (51%) received a very high percentage overall. This is also something that the learners can make suggestions for and help the community to manage better. Recycling received 39% and plays a very important role in improving environmental issues.

If the Grade 5 learners were to receive more information regarding recycling and how to recycle not only could this percentage increase even more but it is possible that the Grade 5 learners could start to recycle and motivate their family members to do the same. Compliance with laws and regulations (16%), is one of the most important roles that any person can have when it comes to improving environmental issues. Last was maintenance at 1% and education at 1%. Having such a low percentage for education is a great concern, this means that the learners do not feel that education is very important and will help them to make improvements to environmental issues by learning more about these issues. Another concern that the researcher had was that none of the learners thought of supporting environmentally friendly projects, replacing disposable with reusable, stop making fires, and conserving water and power. These are all changes that can be made within the community that will help to improve the environmental issues that the Grade 5 learners and their community face.

The pre- and post-questionnaires results and the changes the Grade 5 learners' parents/guardians can make in their living environment/community to improve environmental issues.

Figure 4.10 shows that the Grade 5 learners' parents/guardians felt that some changes can be made to improve the environmental issues. The figure shows the parents/guardians' answers in different shades of orange, the results will exceed 100% due to the parents naming multiple ways that environmental issues can be improved.

In the pre-questionnaire, the highest percentage that the parents/guardians gave was towards waste management at 84%. Most of the parents think that waste management is a big issue within the community and that it is possible to improve this issue. The second highest percentage improvement that the parents/guardians named was to stop littering/dumping at 61%. This is a very high percentage and when looking at the issues named in the pre-questionnaire this is one of the issues that the parents/guardians have noticed within the community. This issue is also an issue that all community members can help to resolve. This improvement is achievable if all people work together. Next was Mines: Compensation & Curbing actions, 60% of all parents/guardians think that another big improvement should come from the mines. Most of the parents/guardians feel that the mine causes environmental issues that should be improved. Improvement of environmental issues through mines as an action is not the responsibility of the parents/guardians themselves and should be completed by the mine, but it seems that this is one of the biggest concerns that the parents/guardians have. The last issue that received a high percentage was recycling (39%) of all parents/guardians who perceive that recycling within the community will help to improve some of the environmental issues that they face. The last 4

improvements all received 1% and most of the parents/guardians did not think this improvement was needed, namely compliance with laws and regulations, replacing disposable with reusable, planting trees, and conserving water and electricity. It is possible that the parents/guardians do not think these changes are their responsibility or that they do not think it is possible for them to make these changes.

In the pre-questionnaires, the parents/guardians named eight ways to improve environmental issues. In the post-questionnaires the parents/guardians named nine ways. Three of the nine ways that can improve environmental issues are new responses, namely stop making fires, education, and maintenance. There was also a slight change in the percentages of the pre-questionnaires responses. The highest percentage of the post-questionnaire was Mines: Compensation & Curbing actions at 83%, this improvement grew to 23%. This growth in percentage means that 23% more parents/guardians now perceive that Mines: Compensation & Curbing actions are important to improve. Next was recycling at 79%, this percentage grew to 40%. This is very high growth in percentage and is also very positive due to this improvement starting at the homes of the parents/guardians. The third improvement was stop littering/dumping at 76%, this percentage increased by 15%. The last five improvements all received a very low percentage, this can indicate that parents/guardians possibly do not see this as an improvement, they think it is not possible or they think it will not make a change. Waste production decreased from 84% to 4%. This is a possible indication that the parents/guardians feel that they cannot make this improvement. Next was stop making fires at 3%, this improvement was not named in the pre-questionnaires but only in the post-questionnaires. Other questions and the photovoice activity, this issue of making fires was identified. Maintenance of 3% was also one of the new improvements that the parents/guardians named the post-questionnaire. Replace disposable with re-usable 3%, increased with 2%. Last was conserve water and electricity 1%, this improvement did not change in percentage.

Figure 4.10 also shows the total percentage the parents/guardians thought would be possible changes that could improve environmental issues. The highest percentage was Mines: Compensation & Curbing actions at 72%. Next was stop littering/dumping (69%), recycling (59%), waste management (44%), replacing disposable with re-usable (2%), stop making fires and maintenance (2%), compliance with laws and regulations (1%), conserving water and electricity (1%), education (1%) and plant trees (1%).

Results of the comparison of the changes that Grade 5 learners, and their parents/guardians can make in their living environment/community to improve environmental issues.

When comparing this question, Figure 4.10 shows that both the Grade 5 learners and the parents/guardians have very similar views regarding the improvement of environmental issues is possible and how to do this. According to Knapp (2000:2), environmental education seeks to alter how people behave towards the environment, and it achieves this through producing environmentally aware and conscientious citizens. After environmental education took place there is a change in the responses that the Grade 5 learners and the parents/guardians gave. These are two big changes where recycling grew from the pre-questionnaire to the post-questionnaire. This is very positive data and can indicate that the Grade 5 learners and the parents/guardians think recycling is possible and they can be part of this. The other big change within the parentage was regarding waste management. This percentage decreased. This decrease can be an indication that the Grade 5 learners and the parents/guardians possibly feel they cannot make this improvement or that this improvement is not possible.

4.4 PHOTOVOICE ACTIVITIES COMPLETED BY THE GRADE 5 LEARNERS WITH THE HELP OF THE PARENTS/GUARDIANS

In the data gatherings phase of the study the Grade 5 learners were asked to complete a pre- and post-photovoice activity with the help of their parents/guardians. The researcher made sure all of the Grade 5 learners received a disposable camera and instructions from the teachers regarding how the disposable camera works and what type of photos will be acceptable, and required of them. After the pre-photovoice activity was completed some of the Grade 5 learners unfortunately lost, broke, or used up the disposable camera that was given to them. The researcher then gave the school more disposable cameras so that the post-photovoice activity could be completed at a later stage. The total number of cameras that were handed out during the pre- and post-photovoice activity was 110. Of the 110 cameras 82 cameras were returned, and 27 of the cameras that were returned broken and could not be developed. 55 cameras were developed and a total of 1200 photos. Figure 4.11 shows the total percentages of aspects related to the photovoice activity for both the pre and post-photovoice activity.

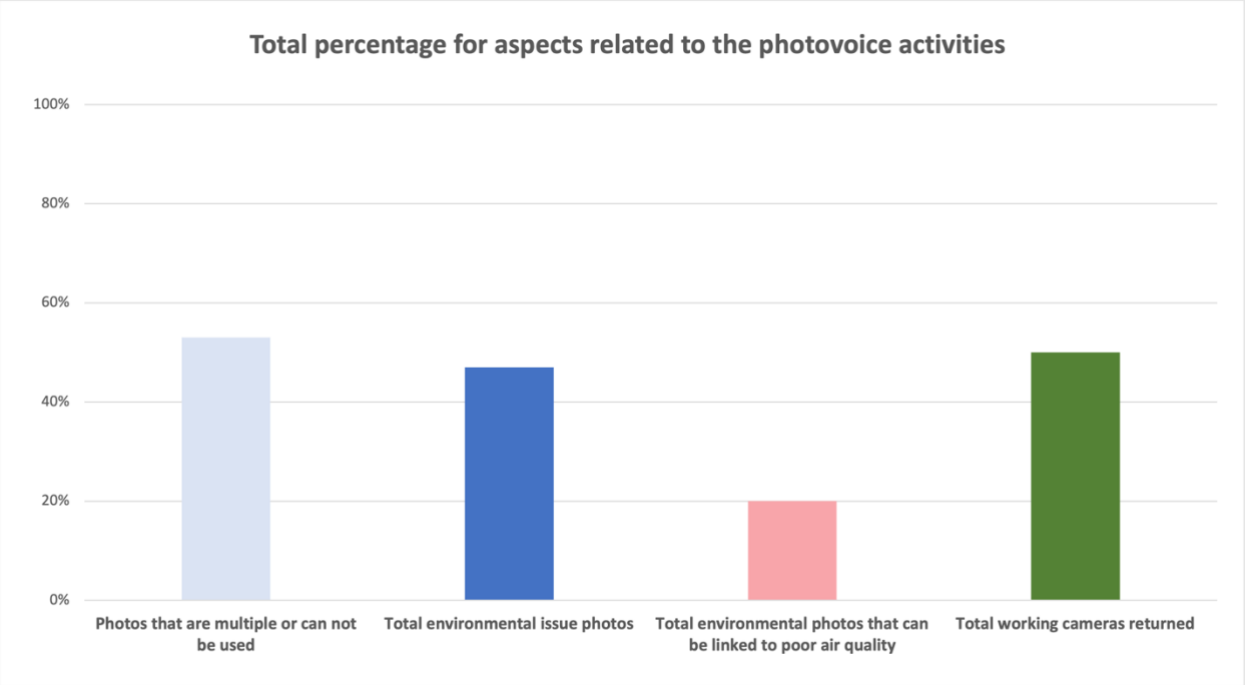


Figure 4.11: Total percentages of aspects related to the photovoice activity

Figure 4.11 shows the total percentages that are related to all aspects of the photovoice activity. 50% of the disposable cameras were returned in working order, this is represented in dark green. Of the 1200 photos that were taken in the pre- and post-photovoice activity, 46.7% of the photos were or are related to environmental issues or causes of environmental issues. The total environmental issues photos are shown in dark blue. 53.5% of the photos that were taken cannot be used due to the privacy of the people within the photos being compromised, the photos being duplicates or not related to any environmental issues or causes of environmental issues, and this total is represented in light blue. Lastly, 20% of all the environmental photos taken can be linked to poor air quality, this is represented in pink.

The next figure, Figure 4.12 shows the types of environmental issues that were photographed by the Grade 5 learners during the photovoice activity.

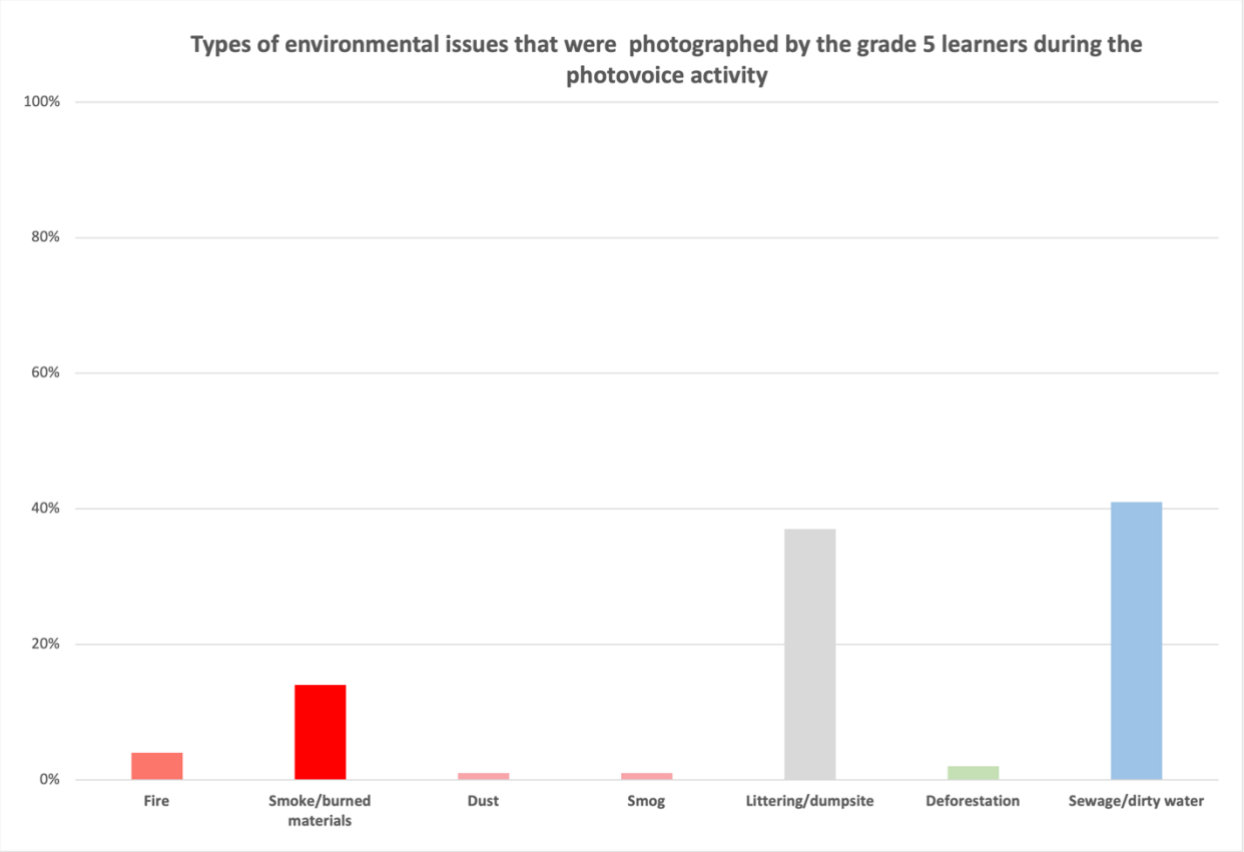


Figure 4.12: Types of environmental issue that were photographed by the Grade 5 learners during the photovoice activity

Figure 4.12 shows all the types of environmental issues photographed by the Grade 5 learners that can be related to air quality in different shades of red, namely dust (1%) in light red, smog (1%) one shade darker, fire (4%) shown in a darker shade of red, and smoke/burned materials (14%) are shown in die darkest shade of red. The combination of all the photos represented in red brings the total percentage of air-quality photos to 20%. The next section of photos taken was photos that represent deforestation at 2% in light green. Some Grade 5 learners took photos of areas where very few trees are visible. The second highest percentage of environmental issues taken was littering/dumping at 37% represented in light grey. Sewage/dirty water (41%) was the highest percentage of environmental photos taken by the Grade 5 learners.

The next four figures show some of the pre- and post-photovoice activities that fall within the four main categories described above in Figure 4.12.

In the analyses of the photovoice narratives the researcher noticed that the Grade 5 learners did link the picture to what it is in reality, but there were Grade 5 learners who did not create such a strong link to what was in the picture and to what it was in reality.

Figure 4.13 shows air quality issues that the Grade 5 learners identified in the pre- and post-photovoice activity. When studying the photos it is clear that the Grade 5 learners knew what air quality issues are and that they formed part of air pollution. Within the activity, it is clear the Grade 5 learners had a better understanding of how poor air quality affects human health during the post-questionnaire because of their reference to asthma.

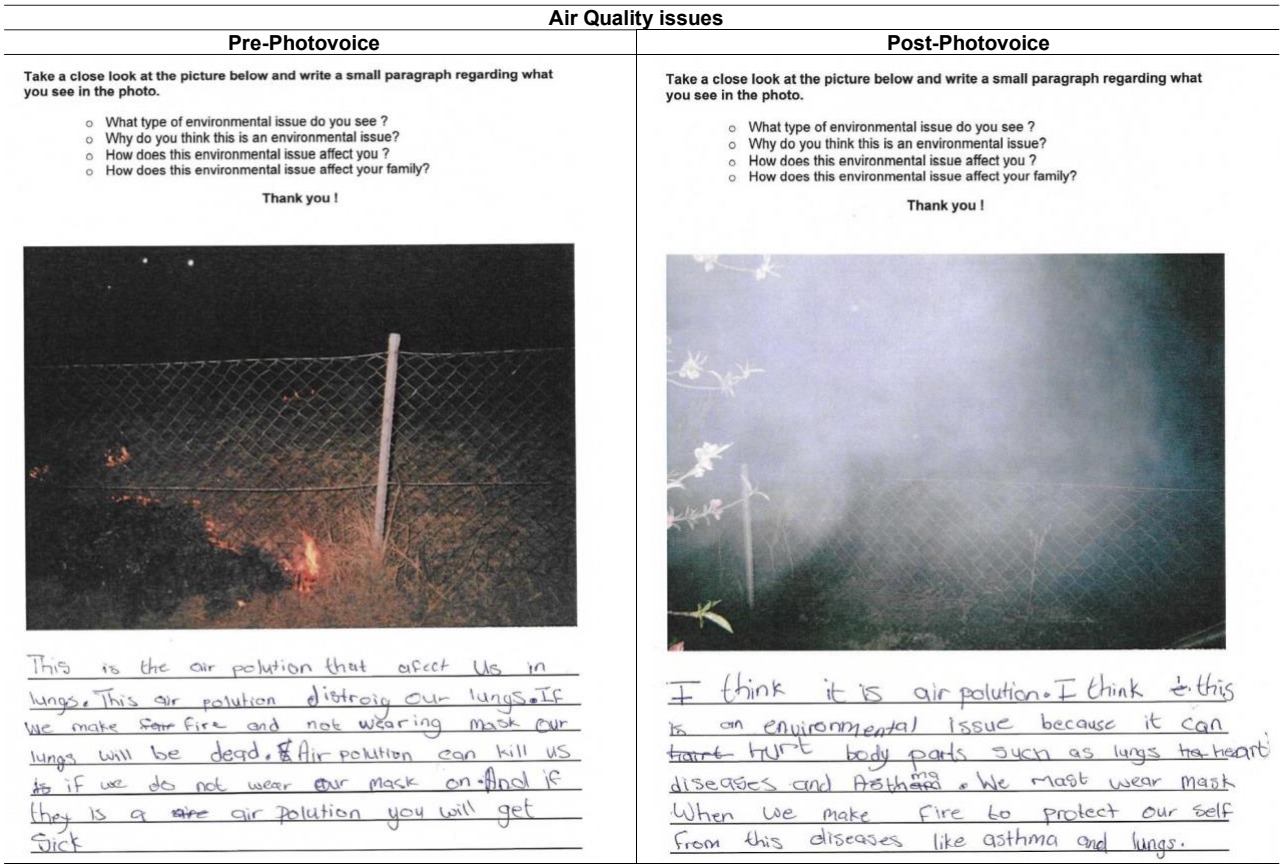


Figure 4.13: Air quality issues identified in the pre- and post-photovoice activity

Figure 4.14 shows the littering/dumpsites that the Grade 5 learners identified in the pre- and post-photovoice activity. When studying the photos it is clear that the Grade 5 learners understood what littering is and that it forms part of land pollution that they feel may affect their health or harm them physically. Within the activity, it is clear the Grade 5 learner had a better understanding of how littering/dumping affect human health in the post-questionnaire because of their reference to the materials possibly giving them a cut and then making them sick or getting a disease.

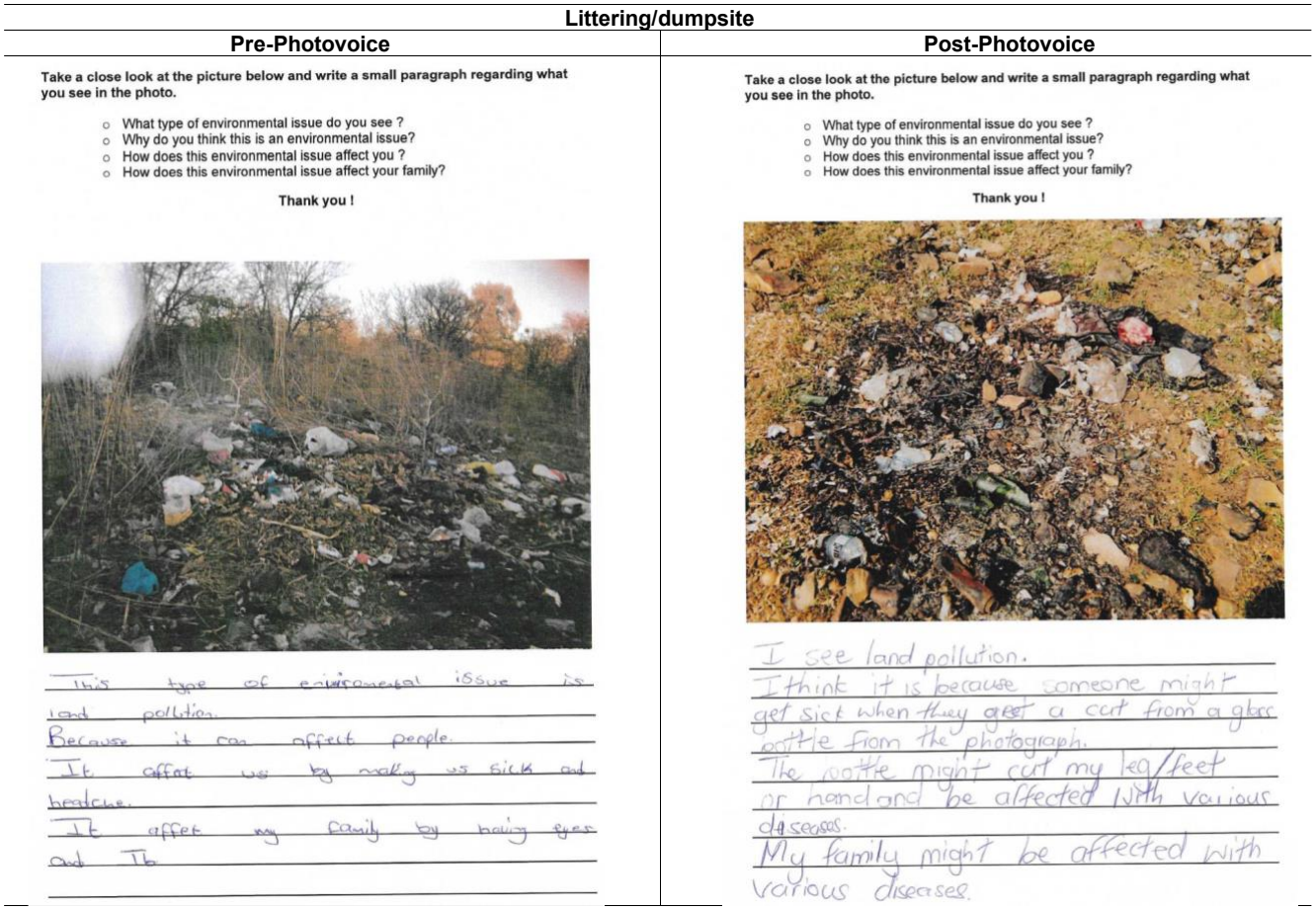


Figure 4.14: Littering/Dumpsites identified in the pre- and post-photovoice activity

Figure 4.15 show the deforestation that the Grade 5 learners identified in the pre- and post-photovoice activity. When studying the photos it is clear that the Grade 5 learners understood what deforestation is. Within the activity, it is clear the Grade 5 learner had a better understanding of how deforestation affects not only the environment but also human health during the post-questionnaire because of their reference to when the trees are cut down there is no more photosynthesis, this then affects the oxygen levels in the air that humans need to breath and survive.

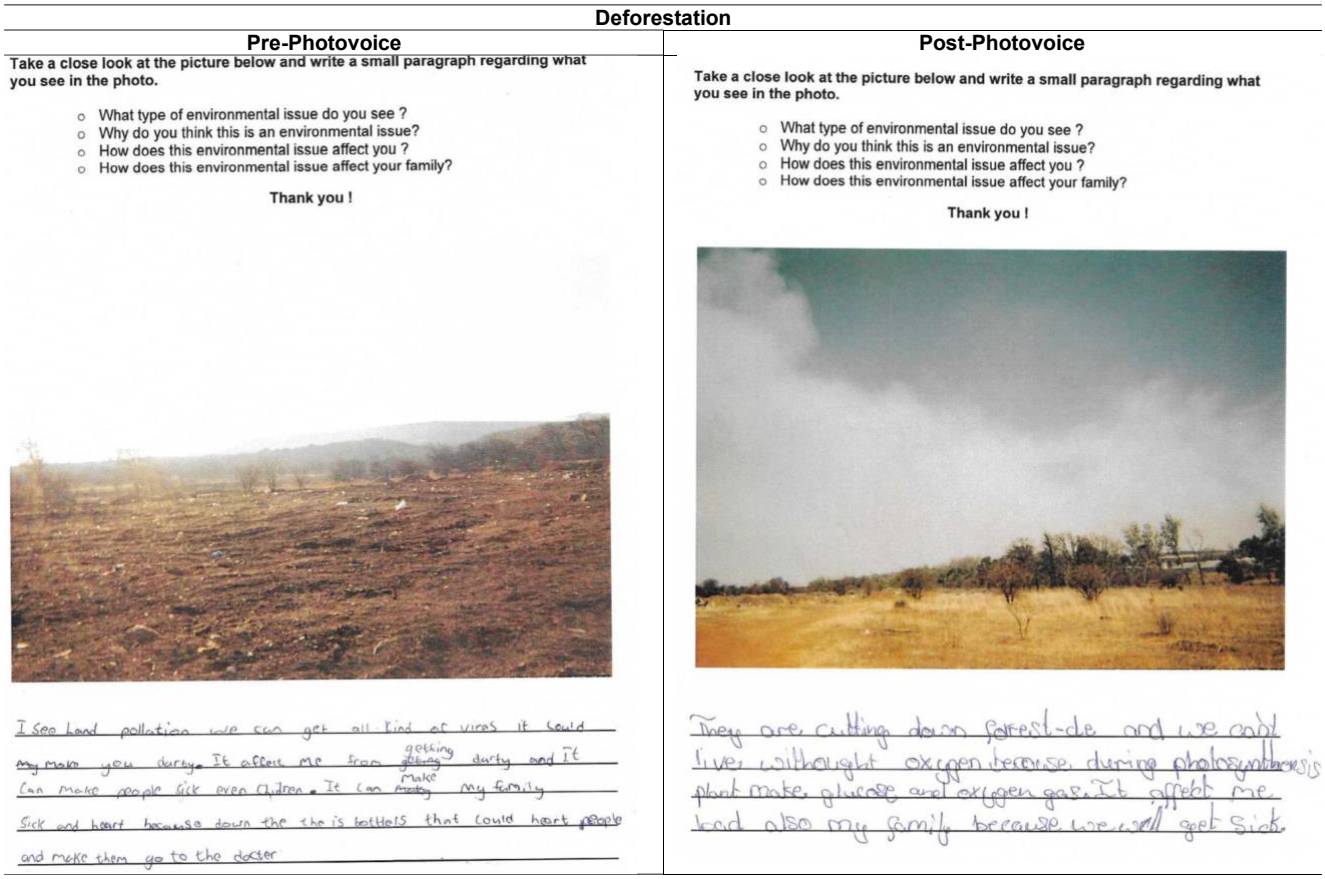


Figure 4.15: Deforestation identified in the pre- and post-photovoice activity

Figure 4.16 shows the sewage/dirty water that the Grade 5 learners identified in the pre- and post-photovoice activity. When studying the photos it is clear that the Grade 5 learners identified sewage and dirty water in the post-photo as harmful because they refer to stomach ailments. Within the activity, it is clear the Grade 5 learner had a better understanding of how sewage/dirty affects human health during the post-questionnaire because of their reference to their different body parts, namely lungs, chest, heart, stomach and saying they get sick.

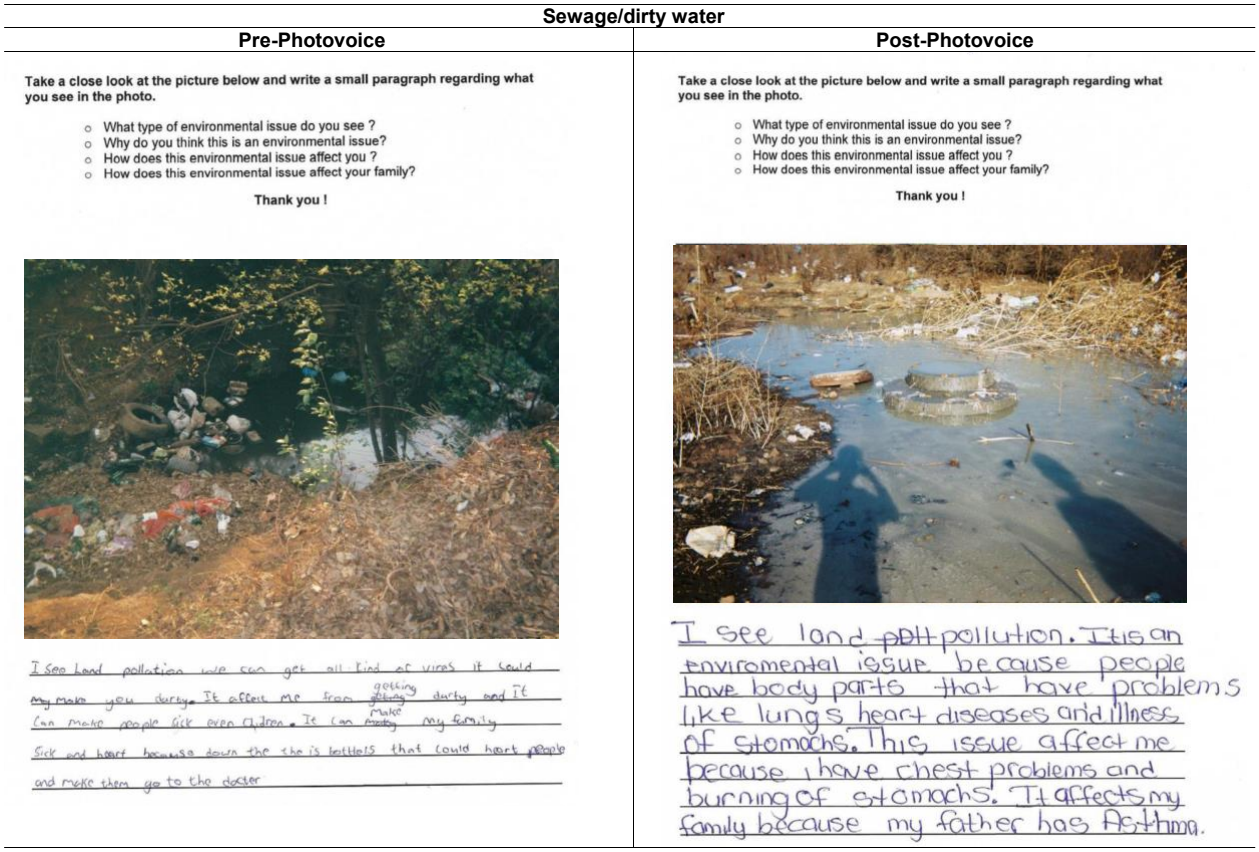


Figure 4.16: Sewage/dirty water identified in the pre- and post-photovoice activity

When studying the combination of all photos and Figure 4.12, it is clear that there is a link between the photovoice activity and the response that the Grade 5 learners and the parents/guardians gave in Question 4 shown in Figure 4.4. When comparing the photos and the responses there are some similarities, for example, fire/smoke, dust, littering/dumpsites, deforestation, and sewage. Other connections can be made when studying every photo individually. For example, some photos show dirty water and in the background is a manhole visible that is broken and where the water is coming from. This photo represents sewage and damage to infrastructure, but the Grade 5 learner identifies it as the environment that is dirty and that can make him/her sick in the stomach.

The photos from the four categories that are represented in Figure 4.12 can also be linked to Question 6, which is shown in Figure 4.6, and Question 8, which is shown in Figure 4.8. Both of these questions asked the participants to name the effects that environmental issues have on them and their family members. When studying the photos, some of the photos taken that fall within the four categories can be linked to Questions 6 and 8, killing pets (dead dog and cow,

littering/dumping photos), loss of biodiversity/deforestation (deforestation photos), soil erosion (from the dirty water running from the manhole in the photos), stinking smell (from the dumpsite and dirty water photos since these are some of the issues that were captured in the photos that can be linked to the four categories shown in Figure 4.12. Other issues can be linked to the named health issues; for example, sinus, asthma, TB, eye problems, respiratory problems, and hay fever can all be linked to the photos of the fire, smoke, dust, cancer, and smog. These health issues can be linked to the categories of air quality issues and deforestation due to more dust being visible when there is little vegetation. Typhoid, cholera, sickness, skin problems, headaches, and nausea can all be linked to the categories of sewage/dirty water and littering/dump sites.

The data from the pre- and post-questionnaires and pre- and post-photovoice, together with the air quality data in Section 4.2, serve as proof that the community has several environmental issues that they face and that the Grade 5 learners and their parents/guardians are aware of the issues and the impacts that these issues have on them and their family members.

4.5 PHOTOVOICE NARRATIVES THAT THE GRADE 5 LEARNERS COMPLETED

After the completion of the pre- and post-photovoice activity, the Grade 5 learners were asked to identify the photos they took and complete a photo narrative regarding what they observed within the photo they took using the disposable camera. 72 narratives were completed by 49 Grade 5 learners. 23 of the Grade 5 learners identified their pre- and post-photos, and they wrote 46 narratives; 26 Grade 5 learners only wrote one narrative and did not say if it was a pre- or post-photo. The remaining learners that did not write a narrative did take photos of environmental issues, but they handed in a broken camera, or did not return the camera to be developed. Figure 4.13 shows the environmental issues that the Grade 5 learners identified during the photo narrative.

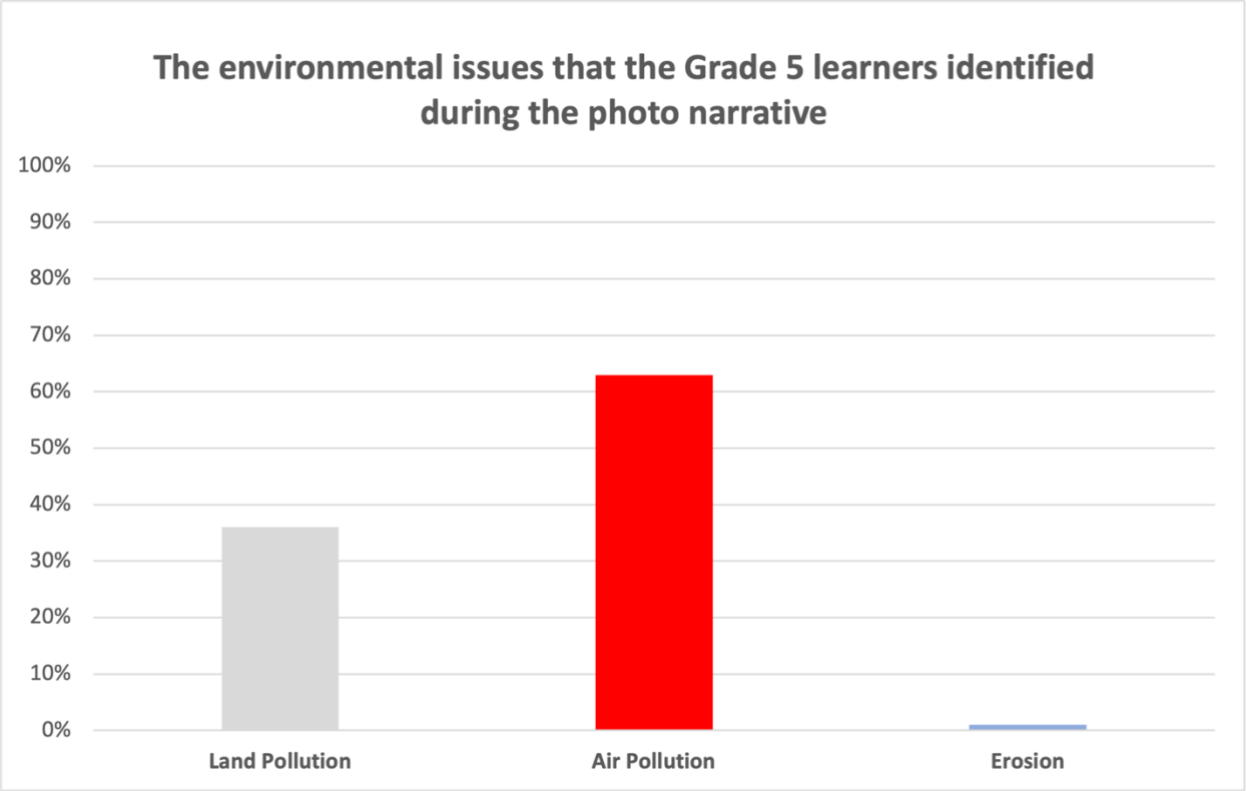


Figure 4.17: The environmental issues that the Grade 5 learners identified during the photo narrative

Figure 4.17 shows the environmental issues that the Grade 5 learners wrote about in the narrative, this is represented in a different shade of green. Erosion, air pollution and land pollution are the main environmental issues identified by the learners. Erosion (1%) received the lowest percentage in light blue. Next was land pollution (36%) in medium grey and lastly was air pollution (63%) in dark red. This data can be linked to some of the other data gathered from the participants, for example, Questions 3 Figure 3.1, Question 4 Figure 4.4, and Question 6 Figure 4.6 within the pre- and post-questionnaires that list similar responses. Last, Figure 4.13 can be linked to Section 4.2 where the percentage of air quality exceedance is shown in Table 4.1. This table serves as evidence that not only did the participants take photos of air quality issues and write about it but that this can be supported when looking at the high levels of $PM_{2.5}$ exceedance.

The next Figure 4.18 shows the examples that the Grade 5 learners identified as the environmental issues within the photos.

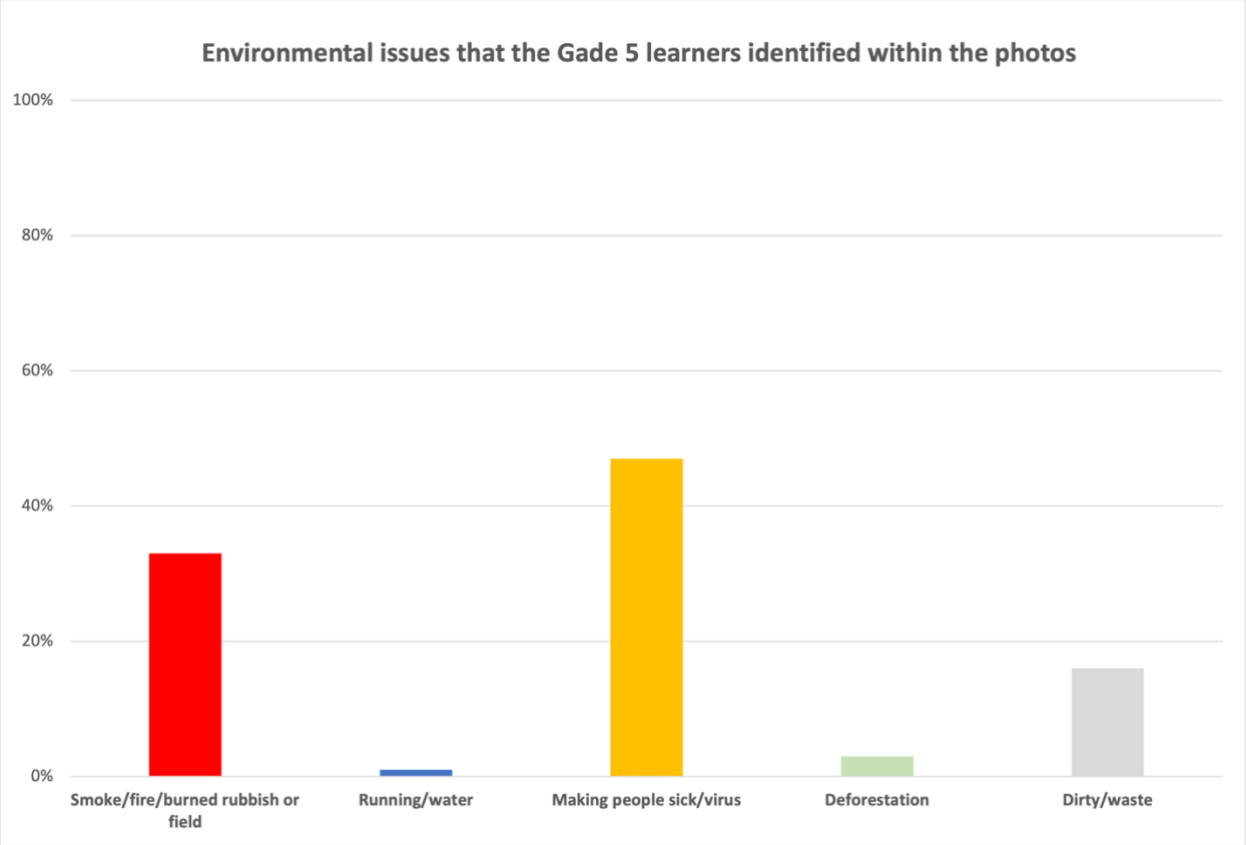


Figure 4.18: Environmental issues that the Grade 5 learners identified within the photos.

Figure 4.18 shows the different examples of environmental issues that the Grade 5 learners identified in the photos. The percentages are represented in different colours. In the narrative, the Grade 5 learners named 5 main categories. The lowest percentage shown in blue is running water at 1%. The Grade 5 learner response is shown in Figure 4.19. Next at 3% was deforestation in green. The Grade 5 learner response is shown in Figure 4.20. The third category in grey was dirty/waste at 16%. The Grade 5 learner response is shown in Figure 4.21. The second last category in red was smoke/fire/burned rubbish or fields at 33%. The Grade 5 learner response is shown in Figure 4.22. The last category in yellow was making people sick/virus at 47%. The Grade 5 learner response is shown in Figure 4.23.

Figure 4.19 shows responses from the Grade 5 learners in regard to the photos of running water this can be linked to sewage and dirty water. Within the narratives, the learners did not say that this is water pollution or issues, they felt that these issues have a big impact on the land. The Grade 5 learners did identify that the environment is very dirty and can make people sick, especially children. The learners also identified if they could get hurt due to this environment or become sick they will need to go to the doctor. Many of the Grade 5 learners identified some of

the body parts that they feel are affected by this issue, namely lungs, heart diseases, and stomach problems.

Responses from the Grade 5 learners in regard to the photos of running water

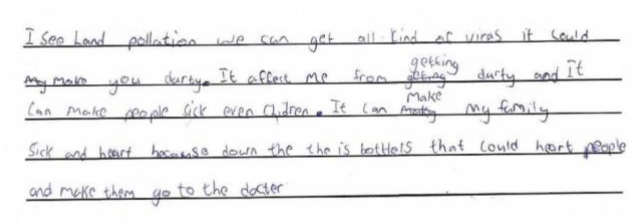
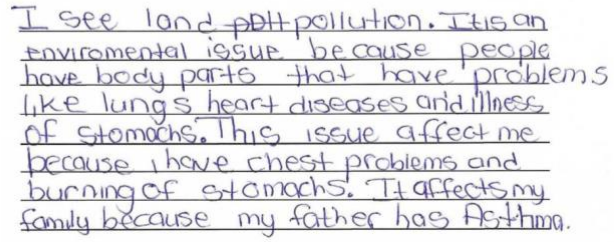
Learner 72	Learner 28
	

Figure 4.19: Responses from the Grade 5 learners in regard to the photos of running water

Figure 4.20 shows responses from the Grade 5 learners in regard to the photos of deforestation. Within the deforestation narratives, some of the Grade 5 learners were not only able to identify that this is deforestation but they were able to make a link to nature and human health. Some of the Grade 5 learners see this environment as dirty possibly due to the environment being an open area with some littering around. Another Grade 5 learner responded that cutting down the trees will influence the environment due to no photosynthesis taking place and no oxygen being produced. The learner then linked this to human health and said that humans need oxygen to breathe and live.

Responses from the Grade 5 learners in regard to the photos of deforestation

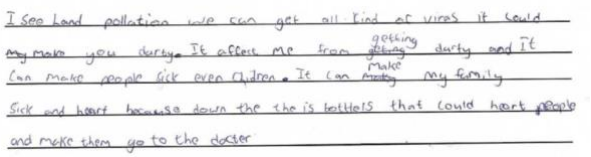
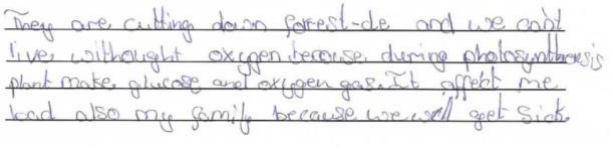
Learner 12	Learner 56
	

Figure 4.20: Responses from the Grade 5 learners in regard to the photos of deforestation

Figure 4.21 shows responses from the Grade 5 learners in regard to the photos of dirty/waste that can be linked to littering/dumpsites. With these narratives the Grade 5 learners identified these photos as land pollution. Some of the Grade 5 learners responded that the environment that is

dirty and has littering can make them sick. Other learners also said they can become sick and then explained why this can happen. Some learners said they can get hurt and this will cause illness and can even cause disease.

Responses from the Grade 5 learners in regard to the photos of dirty/waste

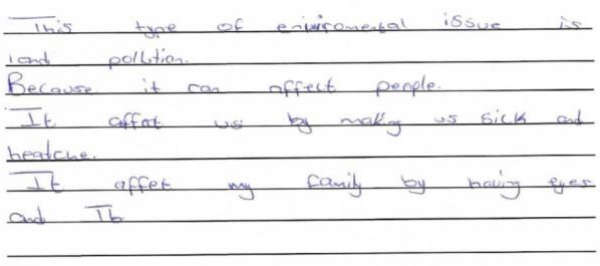
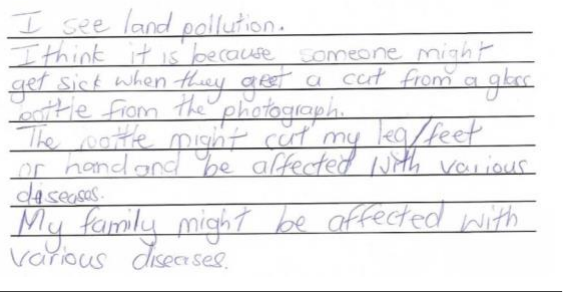
Learner 39	Learner 4
	

Figure 4.21: Responses from the Grade 5 learners in regard to the photos of dirty/waste

Figure 4.22 shows responses from the Grade 5 learners in regard to the photos of smoke/fire/burned rubbish or fields this can be linked to air quality issues. The smoke/fire and burned rubbish and fields are the environmental issues that the Grade 5 learners identified as air pollution. Most of the Grade 5 learners also named multiple reasons why air pollution is bad for human health, namely destroying lungs and harming a person's heart. Some Grade 5 learners also responded that air pollution causes asthma and that wearing a mask can help to protect human health.

Responses from the Grade 5 learners in regard to the photos of smoke/fire/burned rubbish or fields

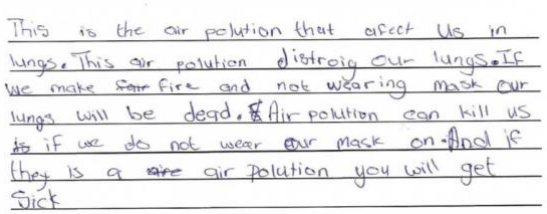
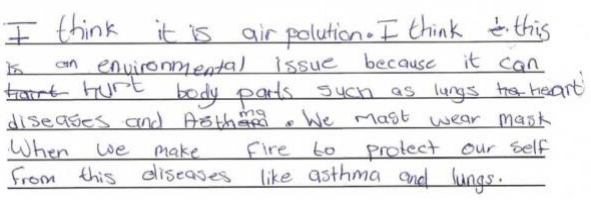
Learner 3	Learner 47
	

Figure 4.22: Responses from the Grade 5 learners in regard to the photos of smoke/fire/burned rubbish or fields

Figure 4.23 shows responses from the Grade 5 learners in regard to the photos of sick/viruses. These photos can be linked to all four categories that were identified in the photos. With the narratives that responded to sick/virus the Grade 5 learners responded that air and land pollution can harm people. Some Grade 5 learners said air pollution causes asthma and sinus. Other learners responded that land pollution can cause TB, and asthma due to the environment being dirty and that this also affects their family members.

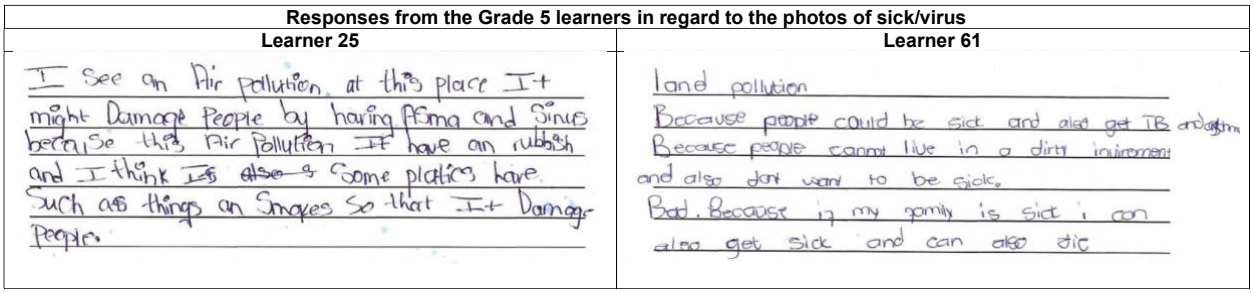


Figure 4.23: Responses from the Grade 5 learners in regard to the photos of sick/virus

All of the categories mentioned in the narrative as reasons why the Grade 5 learners believe the picture of environmental issues is accurate can be linked to other questions and figures, such as Question 3 Figure 4.3, Question 4 Figure 4.4, Question 6 Figure 4.6, and Question 8 Figure 4.8. These figures can be linked to the four questions mentioned due to those questions having similar responses to the narrative, for example, different environmental issues, the causes of these issues, and the effects they have on the environment and human health. These narratives can also be linked to Figure 4.12 of the photovoice and the narrative due to the four categories shown in Figure 4.12 being visible within the narratives.

Figure 4.24 shows how the environmental issues that the Grade 5 learners identified affecting them. This figure shows sixteen different responses. Some of the effects are health-related and others are not.

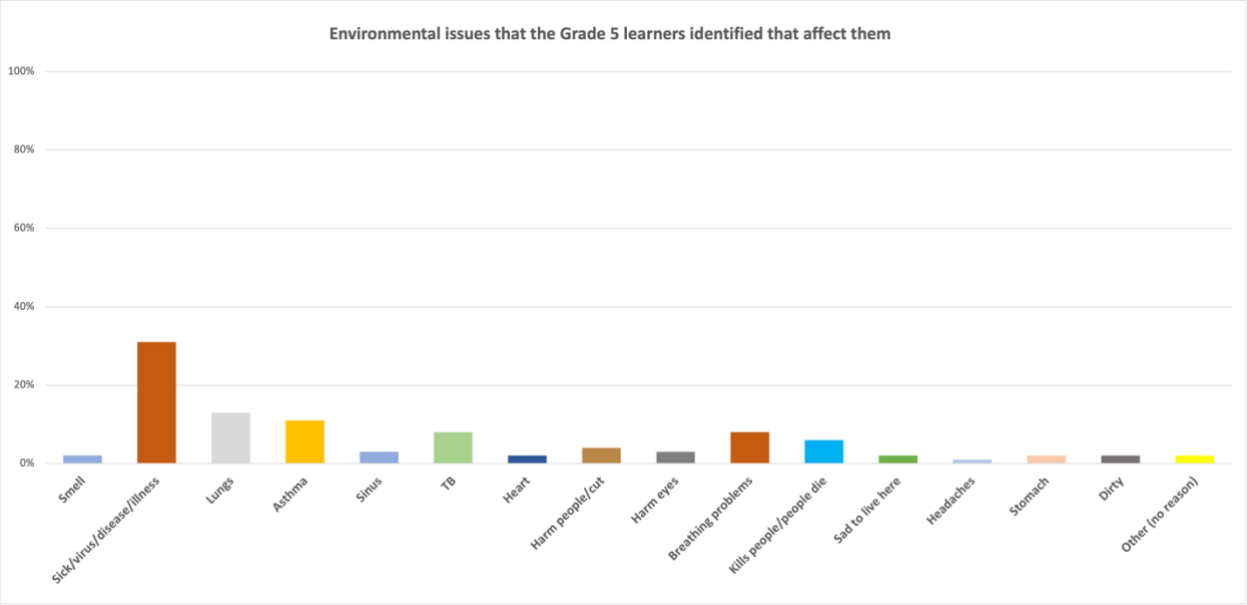


Figure 4.24: Environmental issues that the Grade 5 learners identified that affect them

In the narratives, the Grade 5 learners identified sixteen effects, twelve of which are health-related, such as sickness/virus/illness (31%). Learner (L50) said: “This make my family sick”, and L5: “I see land pollution we can get all kinds of viruses if could make you dirty”, was some of the responses of the environmental issues within the community that can make them sick. These responses can be linked to most of the environmental issues named by the Grade 5 learners. Next was lungs at 13%. L2: “I think its and environmental issue because it can hurt body parts such as lungs and heart” and L3: “This air pollution destroy our lungs”. These learners responded that environmental issues can cause lung problems. Both of these issues were also related to air pollution photos and for that reason are directly linked to air pollution. Next was asthma at 11%. L42: “It affects my family bad because they we, we will get sick like asthma and TB” and L8: “Air pollution so we will have asthma and sinus”. Some of the Grade 5 learners responded with a similar response to these that air pollution causes asthma and TB. Next was sinus (3%). L4: “It affects people by getting sinus and getting asthma”, and L32: “It causes sinus”. Some of the learners responded that environmental issues cause sinus issues, these issues can also be linked to air pollution. Next was TB (8%). L30: “I think this is the environmental issue because people can get TB, asthma”, and L31: “It causes TB and it affect people to sick or die”. Some learners responded that TB is caused by environmental issues and can lead to death, TB was also one of the issues that can be linked to air pollution. Next was heart (2%). L27: “Heart disease", and L2: “I think its and environmental issue because it can hurt body parts such as lungs and heart”. A small percentage of the learners responded and said heart problems or disease are due to environmental issues, this issue can be linked to air pollution. Next was harm people/cut (4%).

L:10 said: “The bottle might cut my leg/feet or hands be affected with various diseases”, and L36: “Might damage people”. Some of the learners related the materials within the photo to environmental issues and to possibly getting hurt. Next was harm eyes (3%). L20: “It affect us by having eyes issues”, and L44: “Can affect children because it is dangerous and affect eyes”. A small percentage of the learners responded that environmental issues can harm their eyes. Next is breathing problems at 8%. L11: The smoke affects my lungs. Difficulty breathing, asthma, TB, and L 22: ”Short breath”. Some of the learners responded that they have breathing problems (respiratory issues) and this was related to air quality photos. Respiratory problems can also be directly linked to air pollution. Next was killing people/people die (6%). L28: “Have asthma and TB and die”, and L13: “It affects me because people can be killed by one of these things. Some of the learners' responses were much more serious and they responded that environmental issues can cause death. Next was headaches at 1%. L19: “It affects us by making us sick and headache”. Very few learners responded that the environmental issues are giving them headaches. Lastly was stomach at 2%. L24: “Illness of stomach” and L44: “Burn my stomach” responded that some environmental issues can cause stomach problems. These were all of the health-related responses given by the Grade 5 learners.

The other four effects named are not health-related, namely smell (1%), L1: “It affect us with the smell”. Some learners responded that environmental issues cause a bad smell within the environment. Next was sad to live here (2%). L12: “Sad because the smoke will affect your lungs” and L14: “It affects me because it is a sad and dry play”. Some of the learners responded that it was sad to live in the environment they live in and that it is sad because the environmental issues make them sick. Next was dirty (2%). L16: “The environment is so dirty” and L39: “Will make the environment look unclean and unhealthy”. Some learners responded that the environment is dirty or unclean and that this is unhealthy. Lastly was Other (3%). L33: “The pollution put bees in my house”, and L39: “It affected me so bad because this thing is not right on me”. The responses given by the learners were possibly a response due not to understanding the question.

The Grade 5 learners' responses to the narrative are shown in Figure 4.25. Analysis of the data gathered shows that the twelve effects that are linked to health issues constitute 92% of all the health effects that were named. The other 8% of the effects named are not related to health. This reveals that the Grade 5 learners perceive the greatest effect that environmental issues have on them is health-related. Some of the data from the narrative are very similar to the data gathered from Question 6 Figure 4.6 and Question 8 Figure 4.8 of the pre- and post-questionnaire. Figure 4.24 can be linked to the two questions mentioned due to those questions having similar responses to the narrative, regarding the effects they have on the environment and human health.

The next Figure 4.25 shows how the environmental issues that the Grade 5 learners identified affect their family members. The percentage is shown in different colours.

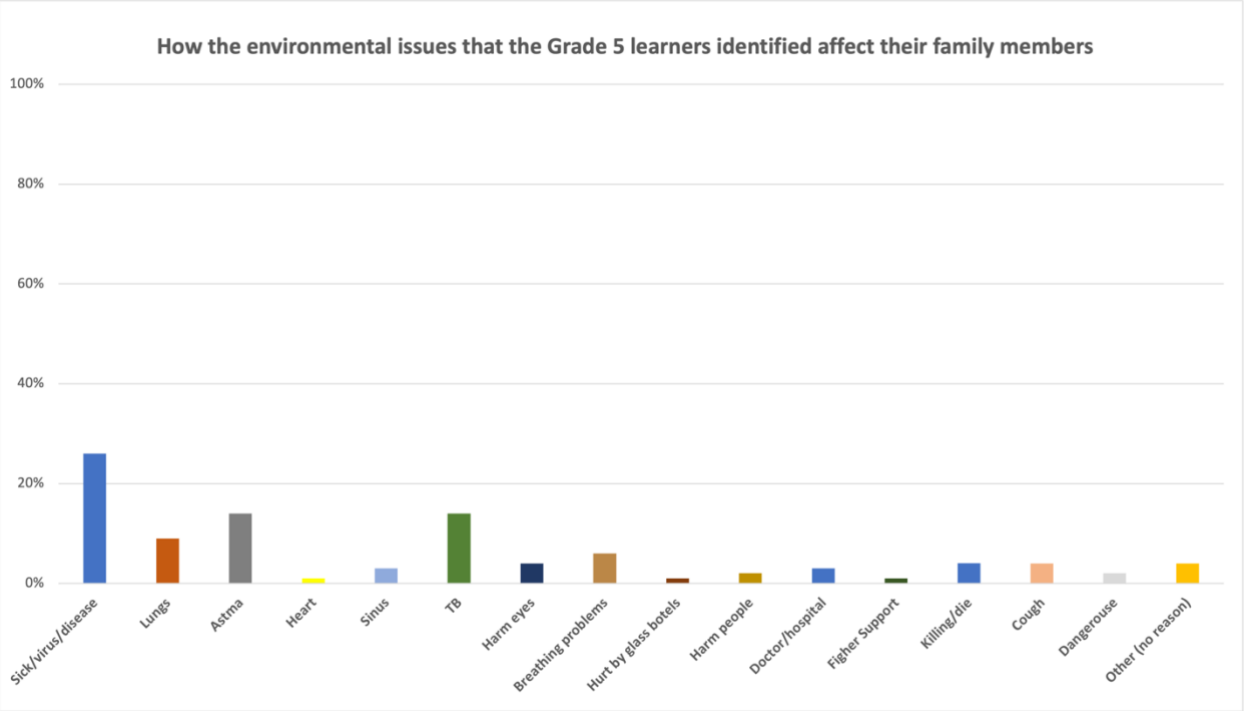


Figure 4.25: How the environmental issues that the Grade 5 learners identified affect their family members.

Figure 4.25 shows the environmental issues that the Grade 5 learners identified that affect their family members. The Grade 5 learners named sixteen examples of ways they are affected by these environmental issues. Thirteen of their responses can be directly linked to health issues, namely sickness/virus/illness (26%), lungs (9%), asthma (14%), heart (1%), sinus (3%), TB (14%), harm eyes (4%), breathing problems (6%), hurt by glass bottles (1%), harm people (2%), doctor/hospital (3%), killing/die (4%) and cough (4%). Most of the ways that these environmental issues affect the Grade 5 learners and their family members were listed at Figure 4.24 and are similar too. The only responses not listed above are doctor/hospital (3%). L65 said: “It affects us in a way that it could even get us to the hospital” and L69 said: “It affect me and my family because we maybe can get asthma and TB because of the smoke and one day we may end up in the hospital”. Some of the Grade 5 learners responded in a way that shows they understood the importance of environmental issues and that they understand that the issues can possibly send them to the hospital. Next was cough at 4%. L37 said: “My family cough and have eye problems”, and L62 said: “My family always couth”.

Two of the other effects can be indirectly related to health issues, namely firefighter support (1%). L6 said: “Air pollution give as sick and asthma or we will run or call firefighter come and support us”. This learner responded that they would need to call the fire department, this was on a photo of a field fire with another person standing near the flames of this fire.

Next was dangerous (2%); here there was no motivation except that it is dangerous. Lastly was Other (4%) where there was no motivation for this response. These responses were listed above at Figure 4.25.

When analysing the data, the fifteen health-related effects make up 94% of all named effects. The “Other” (4%) are not related to health. 2% of the Grade 5 learners did not name the environmental issues that affect their family members. This analysis reveals that the Grade 5 learners perceive the greatest influence that environmental issues have on them as health-related. Some of the data from the narrative are very similar to the data gathered from Question 6 Figure 4.6 and Question 8 Figure 4.8 of the pre- and post-questionnaire within both Question 6 and Question 8, the participants responded with similar health-related ways they are being affected. The responses that the Grade 5 learners and their parents/guardians gave to these two questions were very similar to the response they gave in the narrative Figures 4.18 and 4.25 show that the participants frequently gave the same response to multiple questions, for example, if asked how the environmental issue affects them they can reply: “It makes me sick, gives me asthma. ”If asked how does this issues affect your family, they can replay: “they get sick with asthma.” If asked what health effect does this environmental issue causes, they can replay, “Asthma”.

4.6 CONCLUSION

To conclude, the quantitative data for this study consist of the $PM_{2.5}$ air quality data that was gathered from June 2018 to August 2020. This data showed that the WHO air quality standards and the National Environmental Ambient Air Quality Act are often exceeded within the community where the Grade 5 learners and their family members live. This data also indicates that the months that the air quality levels exceed these standards are during the coldest months of the year. This can be due to poverty and the people living within this community doing what they feel they have to keep warm, cook, and get rid of waste. During the pre- and post-questionnaire, many air quality issues were listed and during the pre- and post-photovoice activity, any air quality issues were captured.

The pre- and post-questionnaires contained both quantitative and qualitative data. These questions within the questionnaire were used to gather detailed insight. In this data analysis phase of the study, the researcher was able to identify different environmental issues, their causes, the effects they have, and what the participants thought could be possible ways of improving these environmental issues. In the analyses, it was clear that the participants have some form of understanding of environmental issues. The researcher was able to show that the participant's awareness and perceptions improved from the pre-questionnaire to the post-questionnaire. This is not only an indication of the importance of environmental education but also serves as proof that environmental education can make a change within society. In the questionnaires, multiple responses could be linked to the poor air quality that the $PM_{2.5}$ data illustrated.

The photovoice activity gathered qualitative data. In the analyses of the photos, there was a clear link that the participants were able to identify the environmental issues within their community. After the analyses, the researcher was able to link multiple photos to some responses gained during the pre- and post-questionnaires. 20% of all photos taken were of air pollution and could be linked to not only the $PM_{2.5}$ data but also some of the responses to the air quality issues within the pre- and post-questionnaires.

The photovoice narratives completed by the Grade 5 learners could also be linked to the $PM_{2.5}$ data when the Grade 5 learners responded with air quality related responses. The same link was made between the photo narratives and the pre- and post-questionnaire responses.

The next chapter will present a conclusion of the study with limitations of this research study and recommendations for future studies.

CHAPTER 5
CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS

5.1 INTRODUCTION

Globally, access to education is a fundamental human right. Not only can the lives of individuals but also the economy and the world we live in be changed with the correct leaders in education (UNESCO *et al*., 2014:32). In order to acquire skills, beliefs, attitudes, and devotion that can be applied to safeguard the environment, environmental education gives learners the chance to become familiar with real-world environmental issues, specifically in their immediate community. Environmental education can be incorporated into formal education to make people aware of environmental issues in their communities and to establish how they perceive environmental issues (UNESCO, 2010). When looking at the Geography curriculum and the themes that are taught within it, air quality is not a distinct theme that is covered by the Geography teachers when they discuss air pollution in Grade 5. Because of this, communities and learners may not be aware of air quality and the full effects of air pollution.

Communities will encounter numerous difficulties regarding improving air quality if the issues are not addressed and if learners are not encouraged to become concerned citizens and are not made aware of air quality (Percival, 2017:52). Air quality could be improved by making national changes, focusing more on it, and raising awareness with the National Curriculum and Assessment Policy Statement (DBE, 2011; Stilgoe, 2009:49). Large segments of the population in South Africa are vulnerable to industrial, domestic, and oftentimes both sources of air pollution within peri-urban communities. Such communities are affected by several issues as a result of exposure to both sources (Diab *et al*., 2006). According to the National Environmental Air Quality Act, 2004 (Act no. 39 of 2004), priority management areas have been established in South Africa due to the country's extremely poor air quality.

The aim of the study was to establish how environmental education influences awareness and perceptions of air quality in Grade 5 learners and their parents/guardians. The purpose of this chapter is to present and discuss the major findings of this study in order to address the objectives of the study, posed in Chapter 1:

- To describe the context of air quality in a peri-urban settlement.
- To establish how aware Grade 5 learners and their parents/guardians are of air quality.
- To establish the perceptions of Grade 5 learners and their parents/guardians of air quality.

The major finding of the study is discussed in Section 5.2. The limitations of the study are then discussed in Section 5.3, which is followed by Section 5.4's recommendations from this study for future research studies. In Section 5.5, the study's concluding remarks are presented.

5.2 MAJOR FINDINGS IN THIS STUDY

This section presents the major findings of the study, which are consistent with the empirical objectives outlined in Chapter 1 (Section 1.6.1). The major findings of this study are discussed by referring to the three research objectives.

5.2.1 The context of air quality in the peri-urban settlement that was researched

In order to answer the research question about the context of air quality in the peri-urban settlement, the researcher first had to do air quality monitoring using the guidelines of the National Environment Protection (Ambient Air Quality) Measure (EPA, 2018). In this study, $PM_{2.5}$ data were collected within the community. The reason for $PM_{2.5}$ being collected as evidence is pointing to high levels of health effects when in contact with $PM_{2.5}$ (Xing *et al*., 2016:72). The data that was collected during the air quality monitoring phase was analysed and illustrated using descriptive statistics. Descriptive statistics is the first step in data analyses (Mondal *et al*., 2022:70). The findings are shown in Section 4.2, Figure 4.1 and Table 4.1 the air quality data is shown in micrograms. Figure 4.1 and Table 4.1 also show when the air quality measurements within the community exceeded the national standards set by the National Environmental Air Quality Act, 2004 (Act no. 39 of 2004) and the World Health Organization (WHO) air quality standards. The World Health Organization (WHO) air quality standards is exceeded very often during the six coldest months of the year. National Environmental Air Quality Act, 2004 (Act no. 39 of 2004) is not exceeded as often as the WHO air quality standards due to the air quality act having a much higher level of exceedance. When analysing the data, it is clear that the community faces air quality issues and the people living within this community would be greatly impacted by this issue. Section 4.2, 4.3, 4.4, and 4.5 can be linked when comparing the actual air quality of the community, with not only the responses the participants gave during the questionnaires but also the photos taken, and the narrative written.

5.2.2 How aware Grade 5 learners and their parents/guardians are of air quality

Pre- and post-questionnaires were used to establish how aware Grade 5 learners and their parents/guardians are of air quality. In this study, quantitative data and qualitative data were gathered from the pre- and post-questionnaires. The questions used had different objectives to collect and gather data and answer some of the research questions. Questions number 2,3,5 and 7 within the pre- and post-questionnaires, were used to establish how aware Grade 5 learners and their parents/guardians are of air quality. These four questions collected quantitative data. The addendum contains the pre- and post-questionnaires. In the data analyses, a cross-table method was used. The following sections elaborates on the finding of the data gathered within the four questions: Section 4.3.2 Question 2; Section 4.3.3 Question 3; Section 4.3.5 Question 5; and Section 4.4.7 Question 7.

When studying the results for the four questions as a whole, it is clear that the Grade 5 learners and their parents/guardians are aware of air quality from their responses in both the pre- and post-questionnaires. There is also a clear indication of greater awareness within the Grade 5 learners and their parents/guardians' responses regarding air quality from the pre-questionnaires to the post-questionnaires because they were able to identify more examples of environmental issues in their living environment. This greater awareness, from the responses, was made after environmental education lessons took place. For this reason, it can be said that environmental education can have an influence on the participants taking part in the study due to the situated learning theory of Lave and Wenger. The Grade 5 learners used prior knowledge that they have of some real-life situations regarding environmental issues. They then completed an activity while learning and gaining new knowledge during the photovoice activity that they completed with their parents/guardians. This new knowledge was taught to the Grade 5 learners by the teacher. This theory applies not only to the teachers and the Grade 5 learners but the parents/guardians of the Grade 5 learners that gained new knowledge from the Grade 5 learners.

Another finding that can be made between the awareness of the Grade 5 learners and their parents/guardians when studying the analyses for the photovoice activity in Section 4.4, Figure 4.11, shows the percentage of environmental issues that can be linked to air quality, and Figure 4.12 that shows exactly what issues the Grade 5 learners and parents/guardians identified as air quality issues. 20% of all photos taken identified air quality as an environmental issue within the community.

The narratives that the Grade 5 learners wrote show that the learners are aware of air quality because their examples are smoke, fire, burning rubbish, burning fields, and deforestation that lead to more dust in the air. In the narratives, it is clear that the Grade 5 learners are aware of air quality and air quality issues within their community because they wrote about how air quality affects them and their family members. Most of the responses that the Grade 5 learners used in the photovoice narrative were health-related and can be directly linked to air quality issues, for example, asthma, respiratory problems, cough, lungs, and sinus. These are only some of the effects that were named by the Grade 5 learners.

5.2.3 The perceptions of grade 5 learners and their parents/guardians of air quality

In this research study, it was important to understand that multiple participants can have different perceptions of air quality. Based on the interpretive research paradigm the qualitative side of the study was used to establish the perceptions of Grade 5 learners and their parents/guardians of air quality. The questionnaires and photovoice activities helped the researcher to gain an understanding of the perceptions of the participants. To establish the perceptions of Grade 5 learners and their parents/guardians of air quality, the following questions were asked to assist with this analysis: Section 4.3.1 Question 1; Section 4.3.3 Question 3; Section 4.3.4 Question 4; Section 4.3.6 Question 6; Section 4.4.8 Question 8; and Section 4.4.10 Question 10, elaborate on the findings of the data gathered within the four questions. The major findings from the results of the six questions asked during the pre- and post-questionnaire were the responses that the Grade 5 learners and the parents/guardians gave helped the researcher to better understand their perceptions regarding air quality. In the pre-questionnaire, the Grade 5 learners and the parents/guardians have a basic understanding of air quality and for this reason, the researcher made the link that the participants perceived air quality to be an environmental issue that they identified by listing only air pollution, mines, fires, and deforestation. In the pre-questionnaire, the participants do not see air quality to be the most important issue they face. After environmental education took place, the responses of the Grade 5 learners and their parents/guardians changed. In the post-questionnaire, both the Grade 5 learners and their parents/guardians understood air quality more than before because within the responses there were much more references to air quality issues listed, like acid rain, climate change, over population, growing technology, and poverty. These are only some of the responses.

In questions where the participants were asked about how the environmental issues will influence them or their family members, the participants were much more vocal regarding the effects and more specific. Their examples were also more detailed during the responses, for example, the

learners and the parents/guardians said their health is being affected (asthma, respiratory problems, sinus, heart problems, sickness, and eye problems). This can be linked to their perceptions being influenced by environmental education due to there being a change within the responses from the post-questionnaire after environmental education took place. Situated learning within this study promotes critical thinking, and emotional relationships by exposing learners to working together with parents/guardians through completing activities and working as a community.

5.2.4 How environmental education influences awareness and perceptions of air quality in Grade 5 learners and their parents/guardians

The aim of the study was to establish how environmental education influences awareness and perceptions of air quality in Grade 5 learners and their parents/guardians. The achievement of the overall aim of the study was done by achieving the three objectives. In two of the three objectives, there were an indication that environmental education had an influence on both the awareness and the perception of the Grade 5 learners and their parents/guardians. In answering the main research question, namely how can environmental education influence the awareness and perception of air quality in Grade 5 learners and parents/guardians, the researcher had to take into account all of the data gathered and analysed during the pre- and post-questionnaires, the photovoice activity, and the narrative. The main goal for environmental education as one can deduce from above, is to educate the participant on the real-world issues that the community face and how they feel and experience these issues. In the case of this study, the researcher made the conclusion that the Grade 5 learners' and the parents/guardians' awareness and perception were influenced due to the participants gaining an understanding and new knowledge regarding air quality after the intervention of environmental education.

5.3 LIMITATIONS FROM THIS STUDY FOR FUTURE RESEARCH STUDIES

This study established how environmental education can influence the awareness and perceptions of air quality in Grade 5 learners and their parents/guardians. As with any other study that is conducted the study had some limitations. These limitations may provide possible areas for improvement for any future studies. A single case study was conducted. As a result, emphasis should be placed on projecting the findings to the entire population. Within Section 1.7, Section 3.2, Section 3.9.2, and Section 3.10.2, the researcher discussed how and why a single case study was used. A multimethod research approach was used during this study. For future studies, a multimethod approach can be used but improvements can be made. In the pre- and post-

questionnaires, the researcher was not always clear when asking a question and this in some cases made the conclusion of the data analyses difficult. In the pre- and post-photovoice activity for the Grade 5 learners, the researcher gave each child one disposable camera. For future studies, the researcher will suggest that all learners should get a separate pre- and post-photovoice camera and should not use one camera to conduct both activities. Doing this can cause confusion between the pre- and post-photovoice activities in such a way that the researcher and the participants take longer to identify which photos were taken during which activity. The same can be said for the pre- and post-photovoice narrative. It is the researcher's suggestion for future studies that the pre-photovoice photos should be developed immediately after the activity and returned to the learners to complete the narrative. After the post-photovoice photos have been taken they should also be developed immediately for the narrative to be completed so that the time lapse is reduced. This will help prevent challenges regarding if the photos and the narratives were taken before or after the environmental education lessons.

5.4 RECOMMENDATIONS FROM THIS STUDY FOR FUTURE RESEARCH STUDIES

It is recommended that the air quality data analysis for future studies be done differently. The air quality data used for this study were collected for two years that did not coincide with the photovoice activity because of the pandemic. It is recommended that the two should be synchronised. It is also recommended that the analysed data should use another program other than Excel. For future studies, the researcher suggests that the data is analysed using a form of programming, for example, python, this will make the data analyses and creation of graphs much easier.

5.5 CONCLUSION

The study has revealed, after a literature review and empirical study, that environmental education can influence the awareness and the perception of not only the Grade 5 learners but also of their parents/guardians. If the school curriculum and environmental education can implement more themes regarding real-world issues that communities face, like air quality, the participants involved in real word teaching and learning activities can not only be made more aware and their perceptions changed, but they can become open-minded citizens that are vocal about the

environment. The findings of this study show the importance of environmental education about air quality awareness and perceptions in teaching and learning.

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ADDENDUM 1

PRE- AND POST-QUESTIONNAIRE BOTH FOR THE GRADE 5 LEARNERS AND THEIR PARENTS/GUARDIANS

QUESTIONNAIRE ON
ENVIRONMENTAL EDUCATION'S INFLUENCE ON AWARENESS AND PERCEPTION OF AIR QUALITY IN GRADE 5 LEARNERS AND THEIR PARENTS/GUARDIANS

QUESTIONNAIRE FOR GRADE 5 LEARNERS AND THEIR PARENTS/GUARDIANS

(For official use only): Questionnaire No: | | | |

Dear Learner and Parent/Guardian

You are being invited to take part in a research study that forms part of a Masters Study. Please take some time to read the information presented here, which will explain the details of this study. Please ask your teacher, the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand. It is very important that you are completely happy and clearly understand what this research is about and how you will be involved. Also, your involvement is entirely voluntary and you are free to say that you do not wish to take part. If you say no, this will not affect you negatively in any way at all. You are also free to leave the study at any time, even if you do agree to take part now.

What is this research study all about?

The reason for the research is to identify how environmental education can influence awareness and perception of air quality within the Grade 5 learners and their parents/guardians. We would like to learn more about the influence that environmental education can have on the awareness and perception of air quality within a peri-urban community. The information collected will be used to report on the research and may be submitted to a scholarly journal for publication.

INSTRUCTIONS FOR THE COMPLETION OF THE QUESTIONNAIRE

- Do NOT write your name. This will mean your honest answer will not affect you or your school negatively.
- Please give truthful answers because privacy of your answers is guaranteed and assured.
- Lastly, it is important to read the questions before answering it.

Thank you very much for completing the questionnaire!

1/3

ENVIRONMENTAL ISSUES

1. What do you understand by the term environmental issues?

_____

_____

2. Where did you FIRST hear about environmental issues? (Mark with a X or ✓)

School	
Television	
Newspaper/Magazine	
Radio	
Friend/Family	
Other (Please motivate)	

3. Name three environmental issues within your community.

1. _____

2. _____

3. _____

4. What are the causes of the three environmental issues named in Question 3 within your community?

1. _____

2. _____

3. _____

5. Do these environmental issues affect you or your family members?

YES		NO		I don't know	

6. How do these environmental issues affect you or your family members?

1. _____

2. _____

3. _____

7. Do these environmental issues affect your health or your family member's health?

YES		NO		I don't know	

8. How do these environmental issues effect your health or your family member's health?

_____

_____

_____

9. Can these environmental issues be improved?

YES		NO		I don't know	

10. What changes can you make in your living environment (community) to improve these environmental issues?

_____

_____

_____

The end

3/3

ADDENDUM 2

PHOTOVOICE NARRATIVE

Take a close look at the picture below and write a small paragraph regarding what you see in the photo.

- What type of environmental issue do you see ?
- Why do you think this is an environmental issue?
- How does this environmental issue affect you ?
- How does this environmental issue affect your family?

Thank you !

Each Grade 5 learner received a colour photo from the photos taken

ADDENDUM 3

LETTER FROM THE LANGUAGE EDITOR

Olivier Language Practitioner

Editing and Translation Service

Date: 23 November 2022

Title: Environmental education's influence on awareness and perception of air quality in Grade 5 learners and their parents/guardians

Author: Albertha Bezuidenhout

Student number: 22967397

Editor: Willemien Olivier

This paper was proofread
by
a proofreader

LETTER OF CONFIRMATION OF ENGLISH EDITING

This is to confirm that the paper with the provisional title, Environmental education's influence on awareness and perception of air quality in Grade 5 learners and their parents/guardians, to be submitted by Albertha Bezuidenhout of North-West University, has been edited for language by Olivier Language Practitioner, Willemien Olivier. The document needed only a few amendments. Neither the research content nor the author's intentions were altered in any way during the editing process.

The editor guarantees the quality of the English language in this paper, provided the editor's changes are accepted and further changes made to the paper are checked by the editor.

Willemien Olivier

Honours Degree Translation Studies (2017) UNISA
Editing and Translation Service: Olivier Language Practitioner since 2008

Willemien Olivier
Olivier Language Practitioner
Translation, proofreading and editing service
Cell phone: *079 978 9901*
E-mail address: *willemienoli4@gmail.com*

ADDENDUM 4

ETHIC APPROVAL LETTER

Private Bag X6001, Potchefstroom
South Africa 2520

Tel: +2718 299-1111/2222
Web: http://www.nwu.ac.za

North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics Office (NWU-EMELTEN-REC)
Tel: +2718 299 4707
Email: lukas.meyer@nwu.ac.za

12 March 2019

Dear Dr L.O. De Sousa

CONDITIONAL APPROVAL OF YOUR RESEARCH ETHICS APPLICATION BY THE NWU-EMELTEN-REC

Ethics number: NWU-00256-18-S2

Kindly use the ethics reference number provided above in all correspondence or documents submitted to the NWU-EMELTEN-REC secretariat.

Study title: Environmental education's influence on awareness and perception on air quality in Grade 5 learners and their parents/guardians

Study leader/supervisor: Dr. L.O. De Sousa

Student: Ms. A Bezuidenhout

Application type: Single study

Risk level: Greater than minimal risk for child participants with the prospect of direct benefit

You are kindly informed that your application was first reviewed at the NWU-EMELTEN-REC meeting held on 5 November 2018 and was conditionally approved at a meeting held on 11 March 2019 (see conditions at the end of the letter).

The commencement date for this study is 12 March 2019 dependent on fulfilling the conditions indicated below. Continuation of the study is dependent on receipt of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation up to a maximum period of one year when extension will be facilitated during the monitoring process.

After ethical review:

Translation of the informed consent document to the languages applicable to the study participants should be submitted to the NWU-EMELTEN-REC (if applicable).

The NWU-EMELTEN-REC requires immediate reporting of any aspects that warrants a change of ethical approval. Any amendments, extensions or other modifications to the proposal or other associated documentation must be submitted to the NWU-EMELTEN-REC prior to implementing these changes. Any adverse/unexpected/unforeseen events or incidents must be reported on either an adverse event report form or incident report form.

A monitoring report should be submitted within one year of approval of this study (or as otherwise stipulated) and before the year has expired, to ensure timely renewal of the study. A final report must be provided at completion of the study or the NWU-EMELTEN-REC must be notified if the study is temporarily suspended or terminated. The monitoring report template is obtainable from the NWU-EMELTEN-REC Office at Ethics-EMELTEN-mon@nwu.ac.za. Annually a number of studies may be randomly selected for an external audit.

ADDENDUM 5

RESPONSE LETTER FROM DBE WITH PERMISSION

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	**18 May 2021**
Validity of Research Approval:	**08 February 2021– 30 September 2021** **2019/90AA**
Name of Researcher:	**Bezuidenhout A**
Address of Researcher:	**Van Walbeek Street**
	Vanderbijlpark
	S.E.6,1900
Telephone Number:	**081 736 9809**
Email address:	**Alberthabezuidenhout12@gmail.com**
Research Topic:	**Environmental education's influence on awareness and perception of air quality in Grade 5 learners and their parents/guardians**
Type of qualification	**Master's in Education**
Number and type of schools:	**1 Primary schools**
District/s/HO	**Gauteng West**

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

18/05/2021

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

1. *Letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

1. *Letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*
2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. ***Because of COVID 19 pandemic researchers can ONLY collect data online, telephonically or may make arrangements for Zoom with the school Principal. Requests for such arrangements should be submitted to the GDE Education Research and Knowledge Management directorate. The approval letter will then indicate the type of arrangements that have been made with the school.***
4. ***The Researchers are advised to make arrangements with the schools via Fax, email or telephonically with the Principal.***
5. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
6. *A letter / document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
7. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
8. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
9. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
10. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
11. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
12. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
13. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
14. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
15. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
16. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

.....

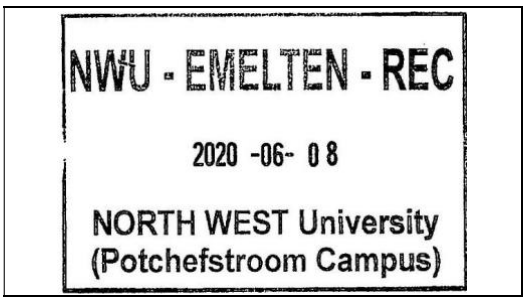
Mr Gumani Mukatuni
Acting CES: Education Research and Knowledge Management

DATE: ...18/05/2021.....

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

ADDENDUM 6

LETTER TO PRINCIPAL



Environmental education's influence on awareness and perception of

This study has been approved by the Ethics committee, Ethics number: (NWU-00256-18-S2) of the Faculty of Education of the North-West University and will be conducted according to the ethical guidelines of this committee.

The aim of the study is to **establish how environmental education can influence awareness and perception of air quality Grade 5 learners and their parents/guardians.**

- To establish how aware learners and guardians are of air quality.
- To analyse the perceptions of learners and guardians of air quality.
- To establish how the GLOBE environmental education program can be used by teachers to teach about air quality through the curriculum.

The purpose of the research at your school is to master the aim highlighted in bold above, namely, establish how environmental education can influence awareness and perception of air quality Grade 5 geography. We would like to learn more about the influence that environmental education can have on the awareness and perception of air quality. The data collected will be used to report on the research and may be submitted to a scholarly journal for publication. The teacher's participation is **entirely voluntary** and they are free to decline participation. If they decline, this will not affect them negatively in any way whatsoever. They are also free to withdraw from the study at any point, even if they initially do agree to take part.

The teachers, parents and learners will all receive letters informing them about the research. The teachers will be requested to sign an informed consent letter. Parents will also be requested to sign an informed consent letter and learners will be requested to sign an informed assent letter. One researcher from the North-West University will be taking part in the research and will be conducting the workshop virtually with the teachers.

The teachers at your school who will form part of the study are requested to attend a virtual workshop regarding environmental education focused on air quality and to interact with the researcher. The researchers will not take part in the lesson or interact with the learners. Depending on what is decided as best, the teachers will take part in the workshop using their private phones or laptop, or they will meet at the school and use one laptop and data projector so that they can take part in the workshop together adhering to the social distancing protocols. The questionnaires and photovoice activity will be stored in a locked cupboard at my Study Leaders office at the North-West University. The identity of the teachers will be kept confidential using pseudonyms. There are no foreseeable risks involved in the participation of the schools in the study. Owing to the COVID-19 pandemic I would like to inform you that when any meeting is called or documents are delivered or collected from your school that the responsible persons will adhere to the government protocols regarding, hand sanitising, social distancing, and the wearing of masks when in public.

The teachers will benefit from their own discussions because they are planning for their own lessons. Learners will experience direct benefits from the enriched learning activities that their teachers will present.

Yours sincerely

Albertha Bezuidenhout

DECLARATION BY PRINCIPAL AS PARTICIPANTS:

By signing below, I ..... agree to take part in the research study entitled:

Environmental Education's influence on awareness and perceptions of air quality in Grade 5 geography.

I declare that:

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be treated in a negative way if I do so.
- I may be asked to leave the study before it has finished, if the researcher feels it is in the best interest, or if I do not follow the study plan, as agreed to.

Signed at (*place*) ..... on (*date*) ..... 20.....

....

Signature of participant **Signature of witness**

DECLARATION BY PERSON OBTAINING CONSENT

I *(name)* ..... declare that:

- I clearly and in detail explained the information in this document to .....
- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I gave him/her time to discuss it with others if he/she wished to do so.

Signed at (*place*) ..... on (*date*) ..... 20.....

....

Signature of person obtaining consent **Signature of witness**

DECLARATION BY RESEARCHER

I *(name)* ..... declare that:

- I explained the information in this document to ..... **or** I had it explained by ..... who I trained for this purpose.
- I did/did not use an interpreter
- I was available should he/she want to ask any further questions.
- The informed consent was obtained by an independent person.
- I am satisfied that he/she adequately understands all aspects of the research, as described above.
- I am satisfied that he/she had time to discuss it with others if he/she wished to do so.

Signed at (*place*) ..... on (*date*) ..... 20.....

....

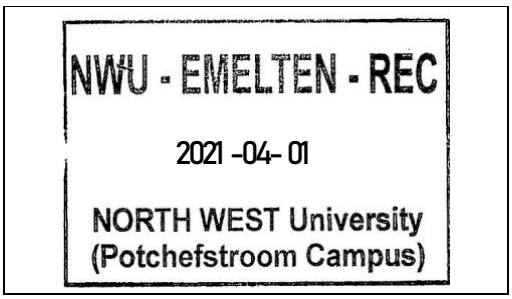
Signature of researcher **Signature of witness**

ADDENDUM 7

LETTER TO TEACHERS WITH CONSENT

Private Bag X1290, Potchefstroom
South Africa 2520
Tel: +2718 299-1111/2222
Fax: +2718 299-4910
Web: http://www.nwu.ac.za

The Faculty of Health Sciences Ethics Office of the North-West University is acknowledged for the use of their document with minor adjustments made by the North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics Committee (NWU-EMELTEN-REC).



INFORMED CONSENT DOCUMENTATION FOR TEACHERS

TITLE OF THE RESEARCH STUDY: **Environmental education's influence on awareness and perception of air quality in Grade 5 learners and their parents/guardians**

ETHICS REFERENCE NUMBER: NWU-00256-18-S2

PRINCIPAL INVESTIGATOR: Dr LO de Sousa

POST GRADUATE STUDENT: Albertha Bezuidenhout

ADDRESS: Van Waalbeek street 12
S.E. 6
Vanderbijlpark
1900

CONTACT NUMBER: 081 736 9809

You are being invited to take part in a **research study** that forms part of a Masters study Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about and how you might be involved. Also, your participation is **entirely voluntary**, and you are free to say no to participate. If you say no, this will not affect you negatively in

any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part now.

This study has been approved by the **North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics Committee (NWU NWU-00256-18-S2)** and will be conducted according to the ethical guidelines and principles of Ethics in Health Research: Principles, Processes and Structures (DoH, 2015) and other international ethical guidelines applicable to this study. It might be necessary for the research ethics committee members or other relevant people to inspect the research records.

What is this research study all about?

The purpose of the research is to establish how environmental education can influence awareness and perception of air quality of Grade 5 learners and their parents/guardians. We would like to learn more about the influence that environmental education can have on the awareness and perception of air quality within a peri-urban community. The data collected will be used to report on the research and may be submitted to a scholarly journal for publication.

Why have you been invited to participate?

You have been invited to be part of this research because you are a Grade 5 teacher within the Wedela peri-urban settlement of Carletonville in Gauteng. You will unfortunately not be able to participate in this research if you are not a Grade 5 teacher within the Wedela peri-urban settlement of Carletonville in Gauteng.

What will be expected of you?

As a teacher who teaches Grade 5 within the Wedela peri-urban settlement of Carletonville in Gauteng you are requested to allow a researcher of the North-West University Potchefstroom Campus to interact with yourself and to use the class activities and photovoice to gather data. You are requested to attend a virtual workshop regarding environmental education focused on air quality and to take part in an air quality protocol. Depending on what is decided as best, the teachers will take part in the workshop using their private phones or laptop, or they will meet at the school and use one laptop and data projector so that they can take part in the workshop together, adhering to the prescribed COVID-19 research protocols and procedures such as sanitizing, wearing of face masks and social distancing. The workshop with teachers will be conducted at a place and time convenient for them at the school, after school teaching hours. The researchers also request you to include your new knowledge on air quality in your lesson planning. The researchers will not take part in the lesson or interact with the learners. As researcher the researchers will only make notes and gather data. Learners will take part in the teaching and learning experience as usual. The researchers will not interfere with any teaching or learning experience. Your identity will be kept confidential through the use of pseudonyms. There are no foreseeable risks involved in the participation of the schools in the study. Owing to the COVID-19 pandemic I would like to inform you that when any meeting is called or documents are delivered or collected from your school that the responsible persons will adhere to the government protocols regarding, hand sanitising, social distancing, and the wearing of masks when in public.

Will you gain anything from taking part in this research?

As a teacher you will benefit from the air quality protocol that you will take part in. That new knowledge can be used to enrich your own subject's lessons. There is no other direct gain for you. Learners will experience direct benefits from the enriched learning activities that their teachers will present. The researchers will gain new knowledge about the influence environmental education can have on the awareness and perception of air quality in Grade 5 geography.

Are there risks involved in you taking part in this research and what will be done to prevent them?

We foresee minimal risks to you as a teacher. Prevailing COVID-19 restrictions and regulations will be adhered to and the prescribed COVID-19 research protocols and procedures will be implemented throughout your participation in this study. Lessons will take part as normal. However, we will monitor the process at all times to be mindful of any unforeseen risk. There are more gains for yourself as a teacher in joining this study than there are risks because as the teacher you will be gaining new skills and knowledge that you will share with the learners.

How will we protect your confidentiality and who will see your findings?

Your identity will be withheld at all times. All your contributions will be dealt with in a group context and not individually.

What will happen with the findings or samples?

The findings of this study will only be used to report on the research and may be submitted to a scholarly journal for publication these findings will be shared with all participants in the form of letter.

How will you know about the results of this research?

We will give you the results of this research when we have published our findings in a scholarly journal. You will be informed of any new relevant findings by the research and you will be invited to the gathering at the end of term three where the findings of the research will be shared with parents/learners and their Grade 5 learners.

Will you be paid to take part in this study and are there any costs for you?

No, you will not be paid to take part in the study. Should the workshop take place at the school, refreshments will be served in COVID-19 safe, sealed containers during the workshop. There will thus be no costs involved for you, if you do take part in this study.

Is there anything else that you should know or do?

- You can contact Miss Albertha Bezuidenhout at 081 736 9809 or alberthabezuidenhout12@gmail.com if you have any further questions or have any problems. Alternatively, you can contact Dr de Sousa, the Principal Investigator, at 0182994727 or Luiza.DeSousa@nwu.ac.za
- You can also contact the Health Research Ethics Committee via Mrs Villera le Rouxat 018 299 4707 or villera.leroux@nwu.ac.za if you have any concerns that were not answered about the research or if you have complaints about the research.
- You will receive a copy of this information and consent form for your own purposes.

Declaration by participant

By signing below, I ..... agree to take part in the research study titled: **Environmental education's influence on awareness and perception of air quality in Grade 5 learners and their parents/guardians**

I declare that:

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be handled in a negative way if I do so.
- I may be asked to leave the study before it has finished, if the researcher feels it is in the best interest, or if I do not follow the study plan, as agreed to.

Signed at (*place*) ..... on (*date*) ..... 20....

....

Signature of participant **Signature of witness**

Declaration by person obtaining consent

I *(name)* ..... declare that:

- I clearly and in detail explained the information in this document to

  .....

- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I gave him/her time to discuss it with others if he/she wished to do so.

Signed at (*place*) ..... on (*date*) ..... 20....

.....

Signature of person obtaining consent

Declaration by researcher

I *(name)* ..... declare that:

- I explained the information in this document to .....
- I did/did not use an interpreter
- I encouraged him/her to ask questions and took adequate time to answer them.
- The informed consent was obtained by an independent person.
- I am satisfied that he/she adequately understands all aspects of the research, as described above.
- I am satisfied that he/she had time to discuss it with others if he/she wished to do so.

Signed at (*place*) ..... on (*date*) ..... 20....

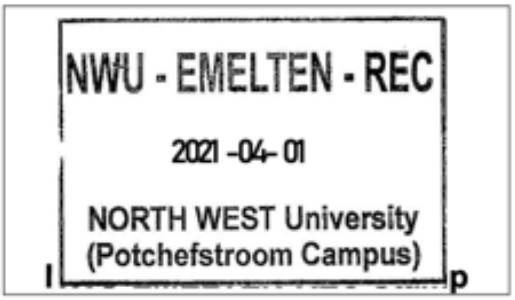
.....
Signature of researcher

ADDENDUM 8

LETTER TO PARENTS/GUARDIANS WITH CONSENT

Private Bag X1290, Potchefstroom
South Africa 2520
Tel: +2718 299-1111/2222
Fax: +2718 299-4910
Web: http://www.nwu.ac.za

The Faculty of Health Sciences Ethics Office of the North-West University is acknowledged for the use of their document with minor adjustments made by the North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics Committee (NWU-EMELTEN-REC).



INFORMED CONSENT DOCUMENTATION FOR PARENTS/GUARDIANS

TITLE OF THE RESEARCH STUDY: Environmental education's influence on awareness and perception of air quality in Grade 5 learners and their parents/guardians

ETHICS REFERENCE NUMBER: NWU-00256-18-S2

PRINCIPAL INVESTIGATOR: Dr LO de Sousa

POST GRADUATE STUDENT: Albertha Bezuidenhout

ADDRESS: 12 Van Waalbeek Street
S.E. 6
Vanderbijlpark
1900

CONTACT NUMBER: 081 736 9809

Your child is being invited to take part in a **research study** that forms part of a Masters study. Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand. It is very important that you are completely happy and clearly understand what this research is about and how you will be involved. Also, your child's involvement is **entirely voluntary,** and you are free to say that you do not wish your child to take part. If you say no, this will not affect you, or your child negatively in any way at all. Your child is also free to leave the study at any time, even if you do agree for your child to take part now.

This study has been approved by the **North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics Committee (NWU NWU-00256-18-S2)** and will be directed according to the ethical rules and principles of Ethics in Health Research: Principles, Processes and Structures (DoH, 2015) and other international ethical rules applicable to this study. It might be necessary for the research ethics committee members or other relevant people to check the research records.

What is this research study all about?

The reason of the research is to identify how environmental education can influence awareness and perception of air quality within the Grade 5 learners and their parents/guardians. We would like to learn more about the influence that environmental education can have on the awareness and perception of air quality within a peri-urban community. The information collected will be used to report on the research and may be submitted to a scholarly journal for publication.

Why have you been asked to give permission for your child to take part?

You have been asked to give permission so that your child may take part in this research because you are the parent/guardian of a Grade 5 learner within the Wedela peri-urban settlement of Carletonville in Gauteng. Your child will unfortunately not be able to take part in this research if you are not a parent/guardian of a Grade 5 learner within the Wedela peri-urban settlement of Carletonville in Gauteng.

What will be expected of you?

We at the North-West University Potchefstroom Campus have asked your child's teachers to teach about air quality in their lessons. Your child's Geography teacher has been asked to include two one-page documents with questions (a pre and post questionnaire) as part of a teaching and learning activity that you and your child will complete apart, before the research starts and when it ends. Your child will also be given two throwaway (disposable) cameras that can only be used once, to take part in a photo-voice activity. You will be expected to supervise your child when he/she takes the photographs at home. You will also be expected to complete your own one-page document with questions (pre and post questionnaire) twice this year, once in the second term and a second time in the third term. The researchers will not take part in the lesson or interact with the learners. The researchers will not interfere with any teaching or learning time. Your real name will be kept private through the use of numbers that will be given to your document. There are no foreseeable risks for you or your child taking part in the study. Owing to the COVID-19 pandemic I would like to remind you to adhere to the government protocols regarding, hand sanitising, social distancing, and the wearing of masks when in public.

Will you gain anything from taking part in this research?

At the end of the research you will gain new knowledge about the air quality in your community and ideas will be shared with you as to how the community can improve the air quality. The teachers will benefit from their own discussion because they are planning for their own lessons. Learners will experience direct benefits from the enriched learning activities that their teachers will present.

Are there risks involved for you or your child taking part in this research and what will be done to prevent them?

We expect no foreseeable risks to you as participant or your child. Your child will take part in a lesson as usual with his/her teacher. However, we will monitor the process at all times to be aware of any surprising risk. There are more gains for yourself and your child in joining this study than there are risks because the teacher will be carrying on with the curriculum content.

How will we protect your and your child's identity and who will see your answers?

The pre and post questionnaires that you will complete will be saved and kept private and will be kept in a locked cupboard at my Study Leader's office at the North-West University. Your name and your child's name will be kept private at all times. All your feedback will be dealt with in a group situation and not alone. No names will be used.

What will happen with the feedback received from you or your child in this research?

Your feedback and your child's feedback in this study will only be used to report on the research and may be submitted to a scholarly journal for publication. These findings will be shared with you at the end of the third term during a feedback gathering.

How will you know about the results of this research?

We will give you the results of this research when we have published our findings in a scholarly journal. You will be informed of any new relevant findings by the research. We will present the findings at a school gathering at the end of the third term where your child's photos will be displayed, and you will receive information about how you can improve your communities air quality.

Will you or your child be paid to take part in this study and are there any costs for you or your child?

No, you or your child will not be paid to take part in the study. You and your child will have no travel expenses and do not need to be refunded for traveling. There will thus be no costs involved for you or your child, if you and your child do take part in this study.

Is there anything else that you should know or do?

- You can contact Miss Albertha Bezuidenhout at 081 736 9809 or alberthabezuidenhout12@gmail.com if you have any further questions or have any problems.
- You can contact Dr Luiza de Sousa (Principal Investigator) Luiza.DeSousa@nwu.ac.za if you have any further questions.
- You can also contact the Health Research Ethics Committee via Mrs Villera le Roux at 018 299 4707 or I Villera.Leroux@nwu.ac.za if you have any concerns that were not answered about the research or if you have complaints about the research.
- You will receive a copy of this information and consent form for your own purposes.

Declaration by participant

By signing below, I ..... agree that I and my child will take part in the research study titled: Environmental education's influence on awareness and perception of air quality in Grade 5 learners and their parents/guardians

I declare that:

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered.
- I understand that taking part in this study is **voluntary** and me and my child have not been pressurised to take part.
- I and my child may choose to leave the study at any time and will not be handled in a negative way if I or my child do so.
- I and my child may be asked to leave the study before it has finished, if the researcher feels it is in our best interests, or if I or my child do not follow the study plan, as agreed to.

Signed at (*place*) ..... on (*date*) ..... 20....

....

Signature of parent/guardian **Signature of witness**

Declaration by person obtaining consent

I *(name)* ..... declare that:

- I clearly and in detail explained the information in this document to

  .....
- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I gave him/her time to discuss it with others if he/she wished to do so.

Signed at (*place*) ..... on (*date*) ..... 20....

.....

Signature of person obtaining consent

Declaration by researcher

I *(name)* ..... declare that:

- I explained the information in this document to .....
- I did/did not use an interpreter
- I encouraged him/her to ask questions and took adequate time to answer them.
- The informed consent was obtained by an independent person.
- I am satisfied that he/she adequately understands all aspects of the research, as described above.
- I am satisfied that he/she had time to discuss it with others if he/she wished to do so.

Signed at (*place*) ..... on (*date*) ..... 20....

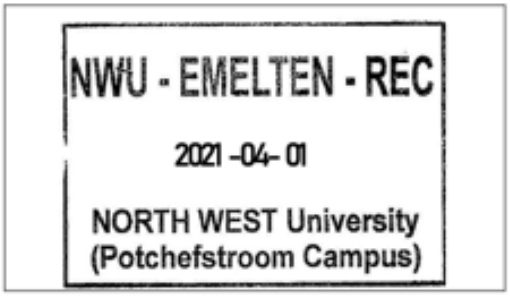
.....
Signature of researcher

ADDENDUM 9

LETTER TO LEARNERS WITH ASSENT/CONSENT

Private Bag X1290, Potchefstroom
South Africa 2520
Tel: +2718 299-1111/2222
Fax: +2718 299-4910
Web: http://www.nwu.ac.za

The Faculty of Health Sciences Ethics Office of the North-West University is acknowledged for the use of their document with minor adjustments made by the North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics Committee (NWU-EMELTEN-REC).



INFORMED ASSENT DOCUMENTATION FOR LEARNERS

TITLE OF THE RESEARCH STUDY: Environmental education's influence on awareness and perception of air quality in Grade 5 learners and their parents/guardians

ETHICS REFERENCE NUMBER: NWU-00256-18-S2

PRINCIPAL INVESTIGATOR: Dr Luiza de Sousa

POST GRADUATE STUDENT: Albertha Bezuidenhout

ADDRESS: 12 Van Waalbeek Street
S.E. 6
Vanderbijlpark
1900

CONTACT NUMBER: 081 736 9809

You are being invited to take part in a **research study** that forms part of a Masters study. Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand. It is very important that you are completely happy and clearly understand what this research is about and how you will be involved. Also, your involvement is **entirely voluntary,** and you are free to say that you do not wish to take part. If you say no, this will not affect you negatively in any way at all. You are also free to leave the study at any time, even if you do agree to take part now.

This study has been approved by the **North-West University Education, Management and Economic Sciences, Law, Theology, Engineering and Natural Sciences Research Ethics Committee (NWU NWU-00256-18-S2)** and will be directed according to the ethical rules and principles of Ethics in Health Research: Principles, Processes and Structures (DoH, 2015) and other international ethical rules applicable to this study. It might be necessary for the research ethics committee members or other relevant people to check the research records.

What is this research study all about?

The reason of the research is to identify how environmental education can influence awareness and perception of air quality of Grade 5 learners and their parents/guardians. We would like to learn more about the influence that environmental education can have on the awareness and perception of air quality within a peri-urban community. The information collected will be used to report on the research and may be submitted to a scholarly journal for publication.

Why have you been invited to participate?

You have been asked to be part of this research because you are a Grade 5 learner within the Wedela peri-urban settlement of Carletonville in Gauteng. You will unfortunately not be able to take part in this research if you are not a Grade 5 learner within the Wedela peri-urban settlement of Carletonville in Gauteng.

What will be expected of you?

As a Grade 5 learner who goes to school within the Wedela peri-urban settlement of Carletonville in Gauteng you are asked to allow a researcher of the North-West University Potchefstroom Campus to use the class activities and photovoice to collect information from you. As a learner you will take part in the lesson your teacher presents, aligned to your curriculum. Your Geography teacher has been asked to include two one-page documents with questions (a pre and post questionnaire) as part of a teaching and learning activity that you will complete apart, before the research starts and when it ends. You will also be given two throwaway (disposable) cameras that can only be used once, to take part in a photovoice activity. Your parent/guardian will be expected to supervise you when you take the photographs at home. You will also be expected to complete your own one-page document with questions (pre and post questionnaire) twice this year, once in the second term and a second time in the third term. The researchers from North-West University Potchefstroom Campus will collect the information from you class activities. Teachers are asked to go to a workshop about environmental education focused on air quality and to work together with the researcher. The researcher will help your teacher with the planning of the lesson. The researcher will not take part in the lesson or interact with you. The researcher will only make notes and collect information. Your name will be kept private through the use of numbers that will represent your name. There are no likely risks for your taking part in the study. Owing to the COVID-19 pandemic I would like to remind you to adhere to the government protocols regarding, hand sanitising, social distancing, and the wearing of masks when in public.

Will you gain anything from taking part in this research?

As a learner you will experience direct benefits from the enriched learning activities that your teachers will present according to your planned classroom curriculum activities.

Are there risks involved in you taking part in this research and what will be done to prevent them?

We expect minimal risks to you as a participant. However, we will monitor the process at all times to be aware of any unforeseen risk. There are more gains for you as a participant in joining this study than there are risks because your teaching will benefit the learners and the researchers who want to understand the influence environmental education can have on your awareness and perception of air quality. You will be asked to complete two one-page documents with questions (a pre and post questionnaire) as part of your teaching and learning activity in Geography. You will be given two throwing away cameras and asked to take photos as taught by your teacher under your parent's supervision.

How will we protect your identity and who will see your answers?

The two one-page documents with questions (a pre and post questionnaire) and photovoice activity from the research will be saved and kept private and will be kept in a locked cupboard at my Study Leaders office at the North-West University. Your name will be kept private at all times. All your feedback will be dealt with in a group situation and not alone. No names will be used.

What will happen with the feedback or examples received from you in this research?

Your feedback in this study will only be used to report on the research and may be submitted to a scholarly journal for publication these findings will be shared with you at the end of the third term during a feedback gathering.

How will you know about the results of this research?

We will give you the results of this research when we have published our findings in a scholarly journal. You will be informed of any new relevant findings by the research. We will present the findings at a school gathering at the end of the third term where your photos will be displayed, and you will receive a talk about how you can improve your communities air quality.

Will you be paid to take part in this study and are there any costs for you?

No, you will not be paid to take part in the study. You will have no travel expenses because your activities take place at school and at home. There will thus be no costs involved for you if you do take part in this study. A small token of appreciation will be given to you at the end of the research.

Is there anything else that you should know or do?

- You can contact Miss Albertha Bezuidenhout at 081 736 9809 or alberthabezuidenhout12@gmail.com if you have any further questions or have any problems.
- You can also contact Dr Luiza de Sousa (Principal Investigator) Luiza.DeSousa@nwu.ac.za if you have any further questions.
- You can also contact the Health Research Ethics Committee via Mrs Villera le Roux at 018 299 4707 or Villera.Leroux@nwu.ac.za if you have any concerns that were not answered about the research or if you have complaints about the research.
- You will receive a copy of this information and consent form for your own purposes.

Declaration by participant

By signing below, I ..... agree to take part in the research study titled: Environmental education's influence on awareness and perception of air quality in Grade 5 learners and their parents/guardians

I declare that:

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be handled in a negative way if I do so.
- I may be asked to leave the study before it has finished, if the researcher feels it is in my best interest, or if I do not follow the study plan, as agreed to.

Signed at (*place*) ..... on (*date*) ..... 20....

....

Signature of participant **Signature of witness**

Declaration by person obtaining assent

I *(name)* ..... declare that:

- I clearly and in detail explained the information in this document to

  .....
- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I gave him/her time to discuss it with others if he/she wished to do so.

Signed at (*place*) ..... on (*date*) ..... 20....

.....

Signature of person obtaining assent

Declaration by researcher

I *(name)* ..... declare that:

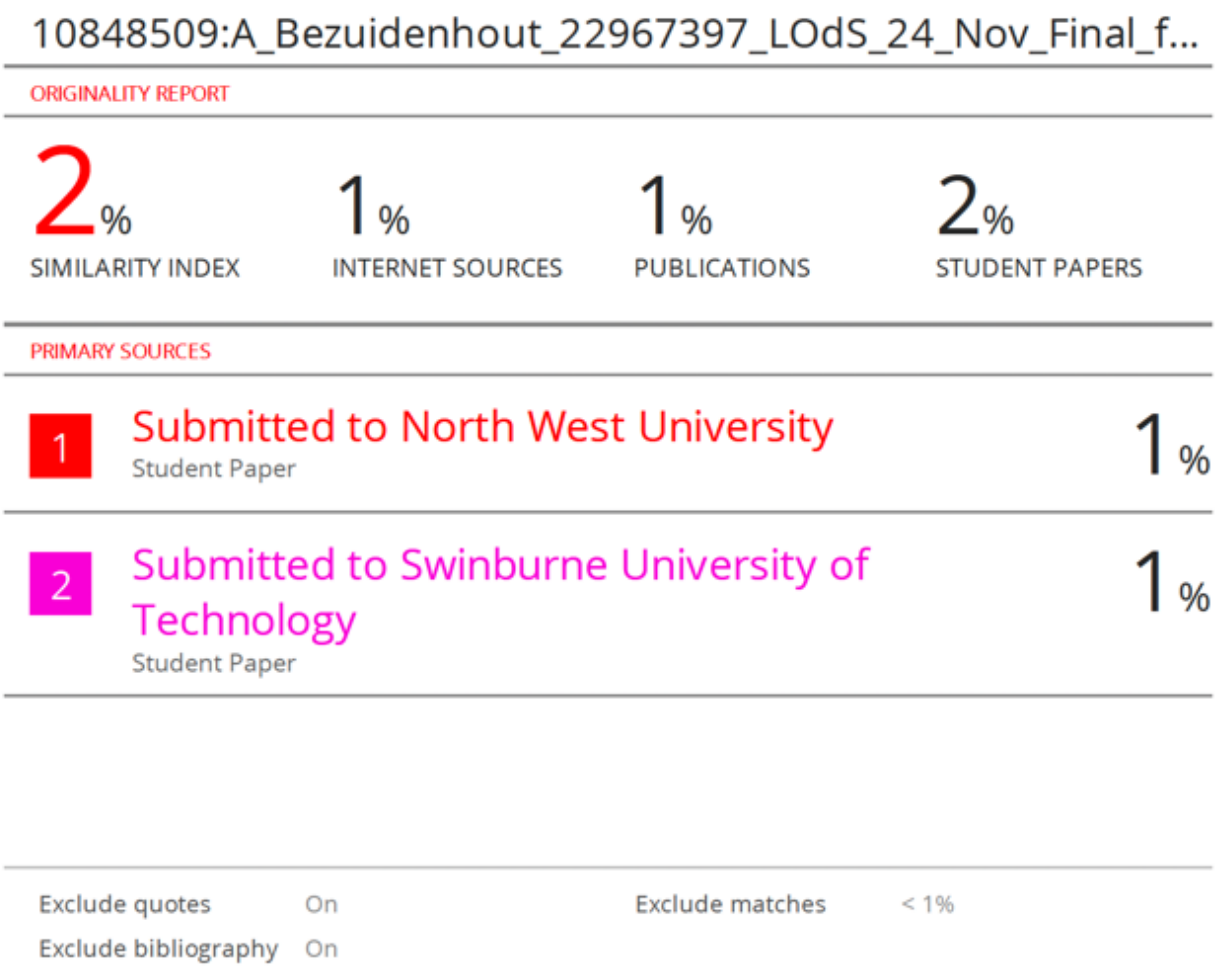
- I explained the information in this document to .....
- I did/did not use an interpreter
- I encouraged him/her to ask questions and took adequate time to answer them.
- The informed consent was obtained by an independent person.
- I am satisfied that he/she adequately understands all aspects of the research, as described above.
- I am satisfied that he/she had time to discuss it with others if he/she wished to do so.

Signed at (*place*) ..... on (*date*) ..... 20....

.....
Signature of researcher

ADDENDUM 10

TURNITIN SUMMARY



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ORIGINALITY REPORT

2%	1%	1%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to North West University Student Paper	1%
2	Submitted to Swinburne University of Technology Student Paper	1%

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	On		