KNOWLEDGE, ATTITUDE AND PRACTICE OF COAL MINEWORKERS PERTAINING TO OCCUPATIONAL HEALTH AND SAFETY AT THE LEEUWPAN MINE IN MPUMALANGA PROVINCE, SOUTH AFRICA

By

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DECLARATION

I, **Khuthalo Mavhunga (Student No: 11605341)**, declare that this study entitled ***"Knowledge, attitude and practice of coal mineworkers pertaining to occupational health and safety at the Leeuwpan mine in Mpumalanga Province, South Africa"*** is my own work, and has not been submitted in whole, or in part, for another degree in any institution.

I declare that the information cited from the published and unpublished work written by others has been acknowledged in the text and a bibliography has been provided.

MAVHUNGA K.L.

SIGNATURE **DATE**

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DEDICATION

To my mom and dad (Tshifhiwa and Joseph) who recognised my potential to succeed academically in my early childhood and persisted in nurturing it even when circumstances opposed this endeavour- I will forever be grateful for your love and belief in me.

To my supervisors (Dr Ramakuela and Prof. Akinsola) whose patient support, energy and correction were significant in the shaping of this dissertation into what it is today-Words fail to express my sincere gratitude.

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To the National Research Foundation (NRF), whose continuous financial support of research in our country is a pivotal anchor of our nation's growth- You are much appreciated.

Last but not least: To Jesus Christ my personal Lord and Saviour, the source from which all good things emanate- Am grateful for your mercy and the opportunity to make a difference in this world each day that I live.

ABSTRACT

The occupational health and safety of coal mine workers is one of the major occupational challenges in the mining industry. Coal mine workers face the looming perils of potential falls of volatile rocks, the ergonomic challenges caused by bending and lifting heavy objects in their daily work, the challenges caused by inhaling coal mine dust which can cause coal workers' pneumoconiosis (CWP) and a plethora of other hazards in both underground and open cast mines on a daily basis. The aim of the study is to assess the knowledge, attitude and practice of coal mineworkers pertaining to occupational health and safety at the Leeuwpan mine in Mpumalanga province of South Africa. The study adopted a quantitative, cross sectional descriptive design. Self-reported questionnaires with closed-ended questions were administered to the eligible participants. The study targeted the 3200 coal mineworkers who were employed at the Leeuwpan mine in Lephalale. A sample of 356 mineworkers was used as derived from Slovin's formula and data was collected over a period of 5 days at the Leeuwpan mine. Measures to ensure validity and reliability were ensured and ethical considerations were observed. The Statistical Package for Social Sciences (SPSS) version 23.0 was used to analyse the data. Results and recommendations are based on the findings of the study.

Keywords: Coal mineworkers, Occupational health, Practices, Knowledge, Attitude

LIST OF ABBREVIATIONS

BP	: British Petroleum
CDC	: Centre for Disease Control
CWP	: Coal Worker's Pneumoconiosis
HBM	: Health Belief Model
HPCSA	: Health Profession Council of South Africa
KAP	: Knowledge, Attitude and Practices
MHSA	: Mine Health and Safety Act
NIHL	: Noise Induced Hearing Loss
PDM	: Personal Dust Monitor
PMF	: Progressive Massive Fibrosis
PPE	: Personal Protective Equipment
PTB	: Pulmonary Tuberculosis
RPE	: Respiratory Protective Equipment
US	: United States
USA	: United States of America

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1. INTRODUCTION

1.1. Background of the study

High injury experience rates in mines can be attributed to unsafe conditions, unsafe acts or a combination of both factors (Reason, 2016). Unsafe conditions can often be attributed to insufficient mine design, inadequately maintained equipment, inadequate supervision, unanticipated geological conditions or even a combination of these factors. This study focuses particularly on unsafe actions and not unsafe conditions. According to Paul (2009), unsafe actions contribute –whether directly or indirectly- to about 90 percent of all occupational accidents. Cheng, Wu, Lin and Feng (2010), postulate that more studies are devoting more attention to studying behavioural patterns in the accident causation process and thus, the study of behavioural patterns of workers in high-risk occupational workplaces like mines is acquiring popularity in the development of safety performance.

While working in mines, coal mineworkers face a plethora of dangers primarily because coal mines are not the safest occupational spaces (Margolis, 2010). The threat of injury in coal mines is always looming. Coal miners find themselves at risk of acquiring respiratory diseases and disorders because of the high levels of dust and other chemical particles which are present in coal mine facilities. These respiratory diseases include Coal Worker's Pneumoconiosis (CWP) also known as black lung, Progressive Massive Fibrosis (PMF) and Pulmonary Tuberculosis (PTB) amongst others (Santo Tomas, 2011). The threat of physical and ergonomic risks is also constant considering the fact that objects and equipment can fall on the miners from above, and the roof itself can collapse or cave in (Hermanus, 2007).

The effect of coal pollutants on the coal mineworker's body affects all major body organs and primarily, have effect on three major systems in the human body, namely: respiratory, cardiovascular and nervous systems (Santo Tomas, 2011). Air pollutants produced by coal combustion have negative effect on respiratory system and can cause or exacerbate asthma, lung cancer and black lung. The cardiovascular system is affected because coal combustion can lead to arterial occlusion and congestive heart failures amongst other things (Santo Tomas, 2011). The nervous system is primarily affected because of exposure to high levels of mercury in coal mines. (Lopez-Anton, Yuan, Perry & Marot-Valer, 2010; Yudovich & Ketris, 2005)

The Asian coal industry is dominated by China which is one of the countries with the highest production and consumption of coal in the world. It is also a country with the largest number of accidents in coal mines (Lui, Xiao & Wang, 2015). According to the Chinese Daily Report, there were 1201 coal mine accidents in China in 2011, and 1973 casualties resulted from these accidents, therefore, the mortality rate per million ton of coal production was 0.564 (Shi, 2012). Though China still has one of the largest fatality rates in coal mines, it is fair to highlight that these have been on the decline, partly because of the improved training of coal mine workers on occupational safety. Before this, the number of fatalities in China's coal mines accounted for 80 percent of the global number (Chen, Xu & Fen, 2015; Bian, 2010). The State Administration of Coal Mine Safety (SACMS) reported that from 2001 to 2010, there were 28 868 coal mine accidents in China and 47 875 people died in these accidents (Chen et al, 2015). In 2013, there were more than 1000 fatalities in Chinese coal mines (Chen *et al.*, 2015). It is fair to note that China has been doing a lot to curb the scourge of injury and fatalities in their coal mines (Lui *et al*., 2015) including regulations, technological advancement and safety research which has been the key contributor of previously lacking knowledge (Geng & Saleh, 2015). Currently, most of the studies on coal mine safety have been conducted in China and extensive work has been done to improve knowledge of coal mineworkers and to ensure that the knowledge is applied correctly (Geng & Saleh, 2015).

The North American coal industry is dominated by the United States which has a vast supply of coal, and according to the 2008 BP Statistical review of World Energy, it has about 30 percent of the world's coal reserves (Hook & Aleklett, 2009). Data on fatalities in coal mines in America have been well documented since the 1900s and thus, continue to provide a wealth of knowledge on internal trends on safety amongst other things (Saleh & Cummings, 2011). Generally, the American coal mining industry has demonstrated great improvement in the reduction of fatalities in coal mines; from 2 642 fatalities in 1909, 293 in 1959, 222 in 1967 to 90 in 1999 and 53 in 2008. Another great achievement in the American coal mining industry is how they have managed to decrease the number of coal mine workers who died of CWP. Between 1995 and 2004, CWP claimed about 1000 American coal miners. It is important to note that these fatalities were at their highest in the early 1990s and decreased significantly with time (Mine Safety and Health Administration, undated). This trend could be attributed to technological advancements, improved enforcement of mine regulations and emphasis on improving the training of mineworkers which reduces the frequency of accidents/fatalities caused by error of mineworkers (Saleh *et al.*, 2011).

Ghana and South Africa are amongst the most significant coal producing countries in Africa. However, the Ghanaian mining industry is full of frequent accident manifestation which may be attributed to lack of technological advancement, apathy of mine companies towards safety and the almost none existent training of mineworkers generally (Amponsah-Tawiah, Ntow & Mensah, 2015). Majority of these occupational accidents are muscular and skeletal and the whole mining industry has been christened as a "hazardous sector". Ghana's coal mining industry generally suffers the high accident rate of most developing countries which are riddled with lack of adequate/recent equipment, corruption of government officials/inspectors, apathy of mining companies and inadequate training of mineworkers (Amponsah-Tawiah *et al.*, 2015). The inadequacy of training in the mines and the resultant insufficient knowledge in coal mineworkers cause the increase of avoidable accidents.

In South Africa, majority of currently functional coal mines are in Mpumalanga, with a few others in Limpopo, Eastern Cape and Free State (Hancox & Getz, 2014). According to the Department of Minerals Resources Inspectorate annual report of 2012-2013, Pulmonary Tubercolosis (PTB) is the leading occupational disease in coal mines. It was reported to have affected 249 coal workers in 2011. It was closely followed by Noise Induced Hearing Loss (NIHL) which affected 158 coal mineworkers and Coal Workers' Pneumoconiosis (CWP) which affected 87 coal mine workers in 2011. From 2010 to 2011, the report showed a decrease in most occupational diseases affecting coal mine workers with the only exceptions being Siliconiosis and Pulmonary Tuberculosis (PTB). In both 2010 and 2012, there were 12 fatalities in coal mines in South Africa. In 2010, 273 coal mine accidents were reported in South African coal mines and 241 for the subsequent year. The coal sector occupational diseases increased by 46 percent from 356 in 2010 to 521 in 2011. The increase was largely due to the increase of cases of NIHL and PTB. South Africa is also one of the countries that has shown improvement in safety, however, what is disturbing is that a large percentage of accidents in South African mines can be attributed to miner error and thus, the knowledge, attitude and daily practices of mine workers are important components to investigate because they provide the fundamental information that is necessary for improving worker training and reducing mineworker errors.

1.2. Problem Statement

It is a well-accepted fact that mining in general is not the safest occupational space to labourers. In 2012, about 112 miners died in mines in South Africa. Eleven of these fatalities were in coal mines. There was a total of more than 3000 major injuries in mines in South Africa in the same year. More than 260 of these major injuries occurred in coal mines (Furter, 2013). Each year, coal miners are getting infected by occupational diseases like CWP and PTB even though, to a large extent, these diseases can be avoidable through the proper use of PPE and proper training of coal mine workers.

Between 2008 and 2015, the safety performance of Exxaro mines (which include the Leeuwpan mine in Delmas) has since been better than most of its counterparts in the coal mine industry (Exxaro 2014 Supplementary report, 2015). In this report, Exxaro also reported that they had zero fatalities in the period June 2014 to December 2015 and had an 11% improvement in their lost-time injury frequency (LTIFR). Exxaro states that their targets for the above-mentioned period were zero fatalities and an LTIFR rate 0.15 percent per 200 000 hours worked. Exxaro achieved an LTIFR of 0.17 percent in 2015 which was 0.02 percent above the 0.15 they had targeted. The 0.17 LTIFR rate however, is still above the industry average which is currently at 0.26 percent and way above the industry's Recordable Case Rate (RCR) which is currently above 0.50 percent (as shown by the red line in the diagram below). The industry's recordable case rate table clearly demonstrates that Exxaro mines have better safety records than almost all of their counterparts in the industry (Exxaro 2014 Supplementary report).

All the facts about the good safety standards that Exxaro mines are achieving led the researcher to ask what Exxaro could be doing correctly that many of its counterparts are not doing. Many researchers, including Lui and Li (2011) and Paul (2007), seem to answer this question by propagating the notion that sufficient training on occupational health and safety can improve the rate of accidents caused by coal mineworker decision errors. Perhaps there is something different that Exxaro mines are doing to empower or develop their workers with regard to occupational health and safety. If the assertions by Paul (2007), and Lui and Li (2011) are applicable in this case; then the coal mineworkers in Exxaro should have a high level of knowledge of occupational health and safety issues, good attitude towards occupational health and safety and their practices should reflect their adherence to occupational health and safety standards.

1.3. Rationale of the study

The researcher's pursuit for literature on the knowledge, attitude and practice of coal mineworkers yielded no results in the Mpumalanga province and at the Leeuwpan mine in Delmas. This clearly demonstrates that there is a gap of knowledge in the field of occupational health and safety issues pertaining to coal mine workers. The significantly above average safety performance of Exxaro mines also justifies a study of their mine workers because such results imply that they may have a highly efficient occupational health and safety programme and exploring it may be beneficial to the rest of the industry.

1.4. Significance of the study

The results of this study are expected to be useful in improving the safety of coal mineworkers in the Leeuwpan mine and possibly other mines also, by making them aware of detrimental attitudes and practices they might have with regards to occupational health and safety.

Therefore, this study may also provide vital information about coal mine workers to mine managers and supervision staff who have not only the ability, but also the authority to design supervision systems. Lenne, Salmon, Lui and Trotter (2012) highlight that one of the major reasons why human error is a significant factor in accidents in coal mines is the fact that mineworkers are not effectively supervised and managed in mines. They emphasise that a more robust supervision system and more effective corrective measures for non-compliance be given to coal miners.

The study may also be useful in providing relevant information to regulatory bodies, policy developers and government officials about coal mineworkers and therefore, may form part of the knowledge base that prompts and informs policy adjustment and strategy development. The study is also expected to prompt other researchers to do more studies that focus on the occupational safety of coal mineworkers.

1.5. Aim of the study

To assess the knowledge, attitude and practice of coal mineworkers pertaining to occupational health and safety at the Leeuwpan mine in Mpumalanga Province, South Africa.

1.6. Objectives of the study

- To assess coal mineworkers' knowledge of occupational health and safety at the Leeuwpan mine in Mpumalanga Province, South Africa
- To describe coal mineworkers' attitude towards occupational health and safety at the Leeuwpan mine in Mpumalanga Province, South Africa
- To describe the practices of coal mineworkers regarding occupational health and safety procedures at the Leeuwpan mine in Mpumalanga Province, South Africa
- To explore the factors that affect attitude and practices of coal mineworkers pertaining to occupational health and safety.

1.7. Definition of terms

Occupational health and safety

Occupational health is a discipline that endeavors to prevent and manage injuries, disability and illnesses in occupational spaces; and again, endeavors to promote the health and productivity of workers, their families, and communities (ILO, 2005).

In this study however, occupational health and safety focuses on 4 areas of occupational health which are fundamental to this study (Occupational Hazards; Personal Protective Equipment; Mine Health and Safety Act; and Occupational illnesses, especially respiratory illnesses).

Knowledge

Knowledge is information derived from professional literature of a field of knowledge, observations, research, evidence and real-life experience (Kirch, 2008).

In this study, knowledge refers to the information that the coal mineworkers have concerning occupational health and safety, regardless of whether the knowledge was attained through training, experience, study and/or any other means.

Attitude

Attitude refers to complex state of mental organization and perception of object, subject or individual which reinforces strong beliefs and/or values and may at times invoke strong feelings and reflects a person's state of mind towards an issue (Kirch, 2008).

In this study, attitude refers to the how the coal mineworkers perceive occupational health and safety issues and the thoughts, feelings or beliefs that perception invokes in them.

Practice

Practice refers to the customary, habitual, or expected procedure for executing a particular task which is acquired through continuous practice. (Oxford, 2014).

In this study, practice refers to the behaviour that coal mine workers exhibit pertaining to occupational health and safety within the mine.

2. LITERATURE REVIEW

2.1 History of Coal mining in South Africa

Coal mining in South Africa began in 1870 as a means to supply energy to the Kimberley diamond fields. The coal to help supply energy in the diamond fields primarily came from the Eastern Cape in the Molteno-Indwe coalfields. When the Witwatersrand gold deposits were discovered in the Highveld, it meant that new sources of coal in the central basin had to be put into production to supply energy for mining the gold (Peatfield, 2003). Besides having some of the largest mineral deposits in the world, South Africa is also one of the leading producers of diamond, gold, vanadium, coal and precious metals like platinum (Prevost, 2004). The mining industry is again an integral contributor to the South African economy. In 2009, the mining industry contributed R437 200 billion to the South African economy (Statistics South Africa, 2014) and was the biggest contributor.

2.2. Significance of the coal mining industries

Statistics South Africa (2009) reported that coal has become the largest contributing mineral commodity to the South African economy. In 1993, gold contributed about R115 billion (about 51 percent of overall mining value) whilst coal contributed about R37 billion (about 17percent of overall mining value). However, in 2013, gold contributed an estimated R31 billion (about 18.5 percent of the overall mining value) while coal contributed about R51 billion (about 21 percent of the total mining value), making coal the leading commodity in the South African economy (GCIS, 2013). Not only this, South Africa is the fourth largest coal producer in the world and this demonstrates the significance of the coal industry to this nation (GCIS, 2013).

The significance of the coal industry in South Africa is not solely because it is the primary energy source, but also because it is a significant employer in South Africa. Out of the 535 457 employees employed by the mining industry in 2012, more than 91 000 were employed in the coal industry. This meant that the coal industry hired about 17 percent of the mining workforce.

It is important to note that in the period 2002 and 2012, when employment in other mining sectors has been decreasing; coal has been having a significant surge. From 2002 to 2012, employment in the coal mining industry rose by 75 percent (GCIS, 2013). This was during the period when other historically significant mining sectors in South Africa- such as gold were suffering from job cuts. In this same period, gold suffered a 29 percent decrease in its workforce percentage and only platinum had a slightly greater increase (78 percent) than coal (GCIS, 2013).

2.3. Knowledge of key aspects of occupational health and safety

In this study, four aspects were identified as major areas of knowledge for coal mineworkers. These areas include knowledge of occupational hazards in coal mining, knowledge of PPE and the appropriate use thereof, knowledge of respiratory diseases and knowledge of the Mine Health and Safety act.

2.3.1. Occupational hazards in Coal mining

Coal mines are full of a plethora of occupational and environmental hazards (Chong & Heng, 2017). Physical hazards, chemical hazards, safety hazards and ergonomic hazards are discussed in detail:

2.3.1.1. Physical hazards

Noise: When coal mineworkers are exposed to exceedingly loud noises, as is usually the case in coal mines, they can end up having Noise-Induced-Hearing-Loss (Accut & Hattingh, 2011). Coal mines are usually confined spaces and the workers have to cope with different noise sources including equipment used for drilling, cutting and transporting coal and rock (Edwards, Dekker, Frantz, Van Dyk & Banyini, 2011).

Vibration: Exposure of workers to hazardous vibration occurs in 2 general ways. The first is known as whole body vibration which occurs when the whole body of the coal miners is vibrating. This vibration can occur in various ways. For example, a coal mine worker's body may be supported on a surface of an object that is vibrating such as when they are working near an industrial machine that vibrates or when they are on-board in a transport underground (ILO, 2006). Another form of hazardous vibration in coal mining is hand-transmitted vibration. This type of vibration may occur when a coal mineworker is using a device or machinery that transmits vibration to the body through the hand when the device is grasped or pushed (ILO, 2006).

Heat and cold stress: Heat and cold are both real hazards for coal mineworkers. This is due to the fact that temperature and humidity can be unusually high. Workers in open cast mines can be exposed to high radiant heat (Alimohamadi, Falahati, Farshad, Zokaie & Sardar, 2015). Heat and humidity can also be a hazard because coal mineworkers work with PPE on and may have to work at a high rate (CDC, 2011). Coal mineworkers may also be exposed to very low temperatures

at other times. High winds in open cast mines and working with bare hands for long periods makes coal mineworkers susceptible to cold temperatures which are health hazardous (CDC, 2011).

2.3.1.2 Chemical hazards

Chemicals in the workplace: In a coal mining environment, there are many chemicals present in the form of a liquids, solids and gases. These substances may present a hazard if they come into contact with the body or are absorbed into the body. There are various ways through which absorption through the body can occur, including through the skin, ingestion through the mouth and inhalation (Accutt & Hattingh, 2011).

Inhalable agents (Gases, vapours dust and fumes): The production of coal generates different types of inhalable agents which are in the form of gases, vapours, dust, fumes and smoke (Petsonk, Rose & Cohen, 2013). These agents may contain different irritants, chemical asphyxiants, fibrogens, allergens, carcinogens and systemic toxicants. The most common of the airborne contaminants are respirable coal dust and crystalline silica, generated from fractured rock in the mine (Petsonk, Rose & Cohen, 2013). The pulmonary system can be affected drastically by exposure to harmful agents such as coal mine dusts which may result in diseases like pneumoconiosis and pulmonary dysfunctions. Some chemical agents that coal miners inhale may even cause organ damage and lung cancer. Other inhalable agents that can cause harm include asphyxiates which displace oxygen and can be potentially fatal (ILO, 2006). Ventilation current can carry airborne contaminants from one section of the mine to another. This situation is further exacerbated by the fact that coal mine spaces are confined. Another source of hazardous inhalable agents in coal mines are the diesel exhausts from various machinery that use diesel in the mine. Solvents, polyurethane sprays, roof glues, emulsion fluids, and other products used in coalmines may also contain such hazards (CDC, 2011).

2.3.1.3. Safety Hazards

Falling material: Falling of materials in a coal mine is a common hazard (Amponsah-Tawaiah *et al*., 2016). This is because roofs of mines are supported by columns and other mechanisms. The most common falls are falls of coal mine roofs, coal faces (headings) and sides (ribs) (ILO, 2006).

Slips, trips and falls: Falls, slips and trips are also a common hazard in coal mines (Accut & Hattingh, 2011). This is because underground coalmine walkways can be obstructed with the

debris of material that was spilled during the transportation, materials and supplies cluttering confined workspaces, debris from coal sides, sloped and wet floors (ILO, 2006).

2.3.1.4. Ergonomic hazards

One of the factors that make coal miners vulnerable to ergonomic hazards is the fact that their work usually requires long-lasting repetitive work movements and awkward postures which may result in musculoskeletal injuries (Accut & Hattingh, 2011). Ergonomic hazards are again exacerbated by the fact that coal mineworkers may have to carry heavy physical loads which may cause excessive stress on the body (Accut & Hattingh, 2011). Therefore, every mine, including Grootegeluk mine; should emphasize the importance of correct posture for lifting and carrying heavy objects as part of their training to avoid spinal injuries to mineworkers.

2.3.2. Knowledge of the appropriate use of Personal Protective Equipment (PPE)

Due to the inherent hazardous nature of coal mining, the knowledge about PPE and the appropriate use of it is crucial. PPE is the second aspect of knowledge to be discussed in this study.

2.3.2.1. General provisions/principles of effective PPE in coal mining

Although different nations may have varying standards and regulations on PPE, there are fundamental principles that are generally accepted. PPE should be viewed as supplementary protection because a coal mining environment is inherently hazardous. The choice of what PPE is necessary is one that should be inclusive of all stakeholders. PPE should generally be sufficient for giving reasonable protection in cases where hazards could not be controlled, illuminated and minimized. According to the expert panel of the ILO (2006), the following principles are fundamental in the planning/using of PPE:

- PPE should be compliant with national standards and criteria approved by the relevant authority in a country and should be replaced as prescribed in the standards that regulate the use of PPE in that country.
- Those who decide what PPE should be used must be properly trained and must ensure that the PPE is correctly fitted on the workers and is adequate for eliminating or minimizing the effect of the hazards in that particular workspace.
- The user of the PPE should examine it periodically to make sure that is in good condition.
- PPE should be ergonomic and should not hinder necessary practical movement of the worker nor restrict the workers' field of vision, hearing and other sensory functions.

- Employers should ensure that workers who use PPE are correctly trained on its use and the reason for its necessity.
- PPE should only be used for the period of time indicated by its manufacturers.
- Due to the fact that PPE may be contaminated by hazardous materials, it should not be stored, laundered, cleaned or kept at a coal miner's home.

2.3.2.2. Different types of PPE

PPE is one of the most important aspects of occupational health and safety in a mining environment like the Leeuwpan mine. PPE refers to all the equipment that protect the coal mineworkers from hazards that are present in the mine (ILO, 2006). Assessing the knowledge, attitude and practices of mineworkers regarding PPE at the Leeuwpan mine forms an important part of this study. If mineworkers know their PPE, how to use it and have a positive attitude towards their PPE, they may be able to avert most of the hazards that they may encounter at the mine. Improper use or lack of use of PPE may prove to be detrimental to the health of the mineworkers. The literature below briefly describes some of the most important items of PPE used in coal mines and highlights how the items can help the mineworkers avoid hazards.

Head protection

The helmet is the most common form of head protection for coal mineworkers and protects them from head injury. It is necessary that coal mineworkers are made aware of the fact that they need to have their helmets on at all times while in the mine. An important principle for maintaining helmets include making sure that if it sustains a heavy blow, it should be discarded, even if there is not apparent evidence of damage. Again, if a crack or split appears on the helmet, it should be discarded. Special helmets which cover the face may be required for coal mineworkers working in an area susceptible to rock and coal outbursts. Another important aspect on the issue of helmets is the fact that it may be necessary that they are designed with chin strap and incorporated with a sweatband (CDC, 2011).

Face and eye protection

Face shields and eye protectors are necessary in coal mining because they protect miners from flying particles, fumes, dust and chemical hazards. Goggles and shields are also pieces of headgear that are necessary, especially for coal miners who deal with welding and cutting. With the use of face and eye protection, due attention should be paid to comfort and efficiency. Face protection should be adjustable so that the worker will remain comfortable at all times (ILO, 2006).

Upper and lower limb protection

Upper and lower limb protection gear refers to gear that is used to protect the hands (upper limbs) and the legs (lower limbs). Hands and feet generally require protection from physical and chemical hazards. Besides full protection, comfort and mobility are the other issues to consider when PPE is being designed or chosen. In coal mines, the coal mineworkers need to ensure that their boots are tightly strapped and that the trousers' legs are pulled over the top of the boots. Boots should be designed to be as slip protective as possible. Knee protectors may be necessary, especially where the work may require the coal mineworker to kneel (ILO, 2006).

Respiratory protective equipment (RPE)

Respiratory equipment may sometimes be necessary in a coal mine. To accommodate for different facial types, there should be a variety of sizes and models. Workers should be fit-tested for respirators. It is necessary that respirators are cleaned and sanitized periodically. Coal mine workers also require training, not only on the use of respirators, but also on how to inspect them to ensure that they are in proper working condition (ILO, 2006).

2.3.3. Knowledge of respiratory disease

According to CDC (2011), there is overwhelming evidence to support the notion that lung function can be severely impaired due to exposure to coal mine dust. Coal mine dust and crystalline silica dust remain the two exposures that pose the greatest hazard in coal mines. CDC (2011) confirmed that the temporal pattern of lung function decline was different when comparing experienced miners to newly employed miners. This phenomenon is attributed to the so called healthy worker survival effect. A study undertaken on new coal miners in China also confirmed that new coal mine workers had a higher level of lung function decline which later began to decline at a lesser rate once they had been in the mine for a longer period. Although CWP has been found to be prevalent amongst coal mine workers (Battelli, Ghanem, Kashon, Barger, Ma & Simoskevitz, 2008), recent studies in South Africa and in the USA confirmed the prevalence of emphysema and chronic bronchitis amongst coal miners and related this prevalence to dust exposure (CDC, 2011). Coal residues consist of a mixture of substances, including carbon, hydrogen, nitrogen, oxygen, sulfur, small mineral particles, and inorganic compounds in the ash. Besides just pneumoconiosis and other respiratory diseases that coal miners can be at risk of include progressive massive fibrosis, bronchitis, and loss of lung function (CDC, 2011).

McIvor and Johnston (2016) revealed that coal workers' pneumoconiosis (CWP), otherwise notoriously known as black lung, is the leading cause of death due to occupational illness amongst coal miners in the United States of America (USA). The basic cause of CWP is excessive exposure to high levels of respirable coal mine dust. Reports from studies and United States (US) government agencies show that there has been a decline in the cases of CWP since 1970 (CDC, 2011; Antao, Petsonk, Sokolow, Wolfe, Pinheiro, Hale & Attfield, 2005). Regardless of this decline, many new cases of CWP continue to be diagnosed in the US, and CWP still continues to take hundreds of lives every year (Petsonk, Rose & Cohen, 2013).

The development of a personal dust monitor (PDM) has the potential to be an integral part of the USA's strategy to control CWP. This device was developed through the collaboration of various government and scientific agencies and its primary function is to give coal miners immediate feedback of the level of respirable coal dust in the air they are breathing at that particular moment. It is expected thereafter, that the miners themselves will then use the correct PPE and make all the necessary adjustment to protect their health (Petsonk, Rose & Cohen, 2013; Volkwein, Vinson, Page, McWilliams, Joy, Mischler & Tuchman, 2006). As with all new technology, it is pivotal that it is thoroughly tested and that these tests are documented and published. The challenge PDMs provide is that miners need to be trained on how to appropriately use the information they provide so that the necessary adjustments can be made to the workplace and to the procedures of the workplace (Blackley, Halldin, Wang & Laney, 2014).

2.3.4. Mining Health and Safety Act

One of the most important things that a coal mine worker has to be thoroughly acquainted with in order to ensure their safety in a mining environment is the Mining Health and Safety Act. The Mining Health and Safety Act not only provides for the enforcement of health and safety measures in mines but aims also to promote the culture of health and safety. The act explicitly outlines the duties and roles of mine owners, mine managers, health and safety representatives and mineworkers with regard to ensuring the safety of all personnel in the mine. According to the act, it is the duty of both the employer and the employees to identify health hazards and eliminate or control them. The act again aims to provide for effective monitoring systems and inspections.

One aspect of the act is that coal miners should be keenly aware of is their own duties in connection to health and safety in the mine which are specified in section 23 of the act. This section of the act emphasises the fact that the mine worker has a duty to protect their own health and safety (section 22A). The individual miner can only be able to accomplish this if they have

thorough knowledge and training on health and safety and are able to identify hazards with ease and act swiftly and decisively. The ability to identify hazards and to act responsibly ensures compliance with section 22(b) which emphasises that the mine worker has a duty to act responsibly so that other personnel within the mine remain safe. Section 22 (c) of the act emphasises the fact that coal mine workers must use and take proper care of protective clothing, and other health and safety facilities and equipment provided for the protection, health or safety of that employee and other employees. It is important for the mine workers to know that the protective gear can help protect them and thus, use it is for their own benefit. Other parts of section 22 of the act require the mine workers to report promptly to a supervisor any situation which the miner believes may present a risk to the health or safety of himself and other miners and compliance to health and safety measures (Section 22 f).

It is again very important that coal mine workers attain thorough knowledge of section 23 of the Mining Health and Safety Act which gives coal miners the right to evacuate any working place if they deem it unsafe and dangerous. This is an important right for the mine workers to know so that they do not ignorantly endanger themselves or allow themselves to be obliged by supervisors to work in those unsafe areas of the mine. It is important therefore, for the coal miners to acquire knowledge of the fact that they have the right to leave a working area if they have reasonable justification that it poses a risk and if they are instructed to do so by a health and safety representative (section 23(1) b).

Though it is primarily the right of the mine owner to ensure the safety of the mine (section 2), it is important to understand that the act gives the right to appoint an individual to perform any of the functions or obligations that the act imposes on him (Section4). More often than not, mine owners appoint mine managers to perform these duties on their behalf. It is therefore, imperative that coal mine workers have the knowledge of what this appointed individual's obligations are pertaining to their health and safety.

Coal miners need to have knowledge of the fact that one of the first obligations the act puts on the mine manager is to ensure that all the miners are supplied with all the necessary health and safety facilities and equipment (Section 6 (1) a) and that this equipment is given to the mine workers when it is still in good working condition and good hygienic condition (Section 6(1) b). It is important also for the mineworkers to have knowledge of the fact that section 6(2) of the act requires the mine manager to have sufficient quantities of all necessary personal protective

equipment (PPE). Mine managers therefore, cannot be excused by law from not having extra equipment. This is because the PPE that the coal miners are using may get damaged or become too unhygienic to use and thus, may need to get new PPE immediately. It is again important in this regard for coal miners to know that section 24 of the act explicitly states that they should not pay for the PPE. It is also important for miners to know Section 6 which demands that the manager should ensure that they have sufficient knowledge on the use of the PPE supplied to them. Thus, it is well within their rights to receive or to ask to be given training on the use of all PPE that they have to use.

It is again imperative for coal mine workers to know that it is the duty of the mine manager to provide health and safety training because if miners are better trained in these aspects, it decreases the chances of injury and loss of life. This obligation is made clear in Section 10 (a) which obliges mine managers to provide coal miners with any information, instruction, training or supervision that is necessary to enable them to perform their work safely and without risk to health. Again, the act obliges the mine manager to ensure that the mineworkers become familiar with work-related hazards and risks and the measures that must be taken to eliminate, control and minimize those hazards and risks (Section 10.1(b)). Knowledge of all hazards in the workplace is fundamental to identifying any risk to exposure for the coal mineworker and subsequently knowledge of the measures that need to be taken helps them protect themselves and their health. It is also important to note that the act deems it necessary that the mineworker not only knows the risks, but also knows how to deal with those risks (Section 10(2; a; i)). According to the act, it is again necessary for the manager to ensure that mine workers have knowledge of relevant emergency procedures that they may be required to do when a necessary situation arises (Section 10.2b). Section 10(3) makes it very clear that the knowledge on emergency procedures and training on how to eliminate, control and minimize hazards and risks must be provided to mine workers at the appropriate times. These appropriate times in the act are: before the mineworker even begins to work, at the intervals determined by the mine manager in consultation with the health and safety committee, before the nature of the work the mineworker performs daily is changed and before there is any significant change in the procedures, before significant changes to mine ventilation layout, before significant changes to equipment and before significant changes to mining methods (Section 10, 3 a-d). The clear deduction that can be made from these aspects of the act is that prior knowledge is always deemed as necessary. No mine worker can be expected to be safe if they use equipment or apply procedure without proper

training and no mineworker can deal with impending emergency situations without these very vital trainings.

2.4. Coal miners' attitude towards occupational health and safety

2.4.1. Factors affecting coal miners' attitude towards occupational health and safety

There are several factors that affect the attitude of coal mineworkers to occupational health and safety. Job dissatisfaction, negative affectivity and social occupational support where identified for this study.

2.4.1.1. Job dissatisfaction

Job dissatisfaction generally describes the overall feelings that a worker has towards their job. A coal mine worker with high job satisfaction will have a positive attitude towards their job and subsequently towards the occupation safety procedures and regulations in their job (Maiti and Paul, 2007). Studies like those of Wooden (1994) and that of Maiti and Paul (2007) also corroborate the above notion. Therefore, what this literature simply states is the fact that if a coal mineworker is unpleased with any aspect of their job (e.g. salary, working hours, availability of the appropriate working equipment or etc.), they are more likely to develop a negative attitude towards the job and this may lead to a compromise of safety standards.

2.4.1.2. Negative affectivity

Negative affectivity refers to the negative experience of negative emotional states and lack of emotional stability. Individuals with high negative affectivity are highly and easily tense, nervous, depressed and insecure (Boyes, Carmody, Clarke & Hasking, 2017). One of the key emotional features in these types of individuals is the ability to experience discomforting anxiety and chronic negative moods. When analysing individuals with negative affectivity, it is important to not just look at the emotion, but to also scrutinize the cognitive/mental aspects of their personality (Boyes *et al*., 2017). It is reported that one of the key cognitive characteristics of individuals with negative affectivity is that they can be highly introspective and may have the tendency to dwell on negative aspects of the world around them. This may have adverse effects in a coal mine environment which is usually noisy, irritating and stressful. The combination of natural negative affectivity and a stressful occupation can easily cause an individual with negative affectivity to quickly develop a negative attitude towards the job and subsequently, the occupational health and safety

procedures may quickly be viewed as an inconvenience. Generally, all negative personality variables such as negative affectivity and impulsiveness have a strong positive relationship with work injuries (Paul, 2009). Generally, what this factor highlights is that if a mineworker already has underlying emotional problems; the stressful nature of working conditions in the mine may exacerbate those problems and that may lead to the individual developing a negative attitude to the job. If this occurs, safety is one of the aspects that may be viewed as cumbersome.

2.4.1.3. Social occupational support

Social occupational support can broadly be defined as referring to the availability of assistance from supervisors, co-workers and management in times of need (Beehr, Bowling & Bennett, 2010). This support can be in various forms including information and empathetic listening amongst other things. Workers generally require support during times of difficulty, injury, failure and many other instances (Beehr *et al*., 2010). According to Paul (2009), there is a considerable amount of evidence to suggest that work-related accidents may increase if there is poor interaction between management or supervisors and the workers. This demonstrates the importance of staff support from management and supervisors. An important aspect of staff support is that the coal miners should be provided with information that can help them make safer occupational decisions. Paul's assertions in this regard are corroborated by various studies including that conducted by Maiti, Chatterjee and Bangdiwala and also a study conducted by Crisera, Martin and Prather which reported that supervisory support and co-worker support both have a negative relationship with injury (Paul, 2009). The conclusion that can be drawn from these studies is that when workers are supervised and supported better by supervisory staff, managers and co-workers, it affects attitude and subsequently occupational behaviour positively.

2.5. Coal miners' behaviour/practices with regard to occupational health and safety

2.5.1. Factors affecting behaviour/practices of coal mineworkers

Several factors may affect the practices of coal mineworkers in mines. Age, experience, risk-taking behaviour and masculinity/gender were identified for this study.

2.5.1.1. Age

According to Paul and Matiti (2007), the relationship between age and safety performance has been an area of great interest since the concept of accident proneness was first proposed by

Greenwood and Woods in 1919. The initial school of thought seemed to be that older mine workers practise safer occupational behaviour and take less risks than their younger counterparts. Matiti and Paul (2007) show that a perfect example of this was the 1982 study done by the National Academy of Science which looked at the relationship between age and various accident rates for 15 of the largest underground coal producing companies in the USA. The study showed that older coal mine workers practise safer occupational behaviour. The 1965 Durry study and the 1986 Bennett and Passmore study seem to corroborate these findings (Paul & Matiti, 2007). However, the Shafai-Sahrai study of 1973 and the Root study of 1981 oppose these postulations and asserts the opposite trend and further state that older workers tended to be fatigued, and because of reduced reflex action, they could be unable to avoid an accident even when they fully perceived the circumstances. Matiti and Paul (2007) again show that a study by Maiti and Bhattacharjee (1999) found no relation between age and safety performance. According to Nielson (2012), young males in the high-risk occupations are more prone to normalizing high risk behaviour if it is viewed as 'acceptable' in the normal day to day culture of an institution. Young males are also more likely to succumb to the institution's pressure to produce more than their older counterparts. If the findings of the above stated literature prove to be accurate for the setting of this study, then this study is expected to yield results that show riskier behaviour being exhibited by younger coal mineworkers at the Leeuwpan mine.

2.5.1.2. Experience

Reason (2016) describes experience as the amount of time an employee has engaged in his/her work and again emphasizes that experienced workers are assigned to jobs that have high accident risks. Paul and Matiti (2007) show that studies' results on this matter differ but with the greater majority of studies corroborating the notion that more experienced coal mine workers practise safer occupational behaviour such as taking less risks. The case study by Ghosh, Bhattacharjee and Chau (2004) which was conducted in coal mines also suggests that the more experienced workers are more knowledgeable and are better at avoiding and controlling occupational hazards. This therefore predicts that the findings of this study will also show that the experienced coal mineworkers at Leeuwpan mine would be found to be more cautious and the less experienced workers would be found to be a bit more cavalier with regards to occupational behaviour.

2.5.1.3. Risk taking behaviour

Unsafe behaviours such as taking unnecessary risks are thought to contribute directly or indirectly to 90% of all workplace accidents. A safe work behaviour is important since it helps workers maintain a safe work culture, which in turn reduces injuries (Reason, 2016). Risk taking behaviours are the behaviours in which the doer voluntarily participates in actions that may have a significant degree of risk (Paul & Maiti, 2007). This statement highlights the fact that coal mine workers can deliberately engage in behaviours such as taking short cuts that they know may possibly put them at risk to injury or fatality. One of the factors that differentiates the practices of coal mine workers is their willingness to take chances. Some workers would rather avoid risk at nearly all cost while others may be more than willing at any point in time to take shortcuts (Reason, 2016). Risky behaviour may perhaps be driven by the perception that it can be more convenient than safe practices. For example, a coal mineworker decides to use a blasting technique that may help them achieve the targets faster but this type of behaviour may put the individual and the rest of his colleagues at great risk. Generally, workers that practice risky behaviour are more prone to accidents than those that are cautious and follow all the procedures correctly (Reason, 2016).

2.5.1.4. Masculinity and gender

Masculinity is defined as a configuration of practices that are organized in relation to the structure of gender identities and relationships (Stergiou-Kita, Mansfield, Bezo, Colantonio, Garritano, Lafrance, Lewko, Mantis, Moody, Power, Theberge, Westwood & Travers, 2015). Masculinity demands that a male demonstrates four key characteristics and attitudes to prove their 'maleness'. This includes the notion that he should, for example, reject any characteristic that is associated with femininity such as being emotionally sensitive. He should also demonstrate unshakeable strength or unwavering toughness and should be defiant to those in authority and be willing to use violence when necessary (Stergio-Kito *et al*., 2015).

In a high risk occupational setting such as a coal mine, the enactment of dominant norms of masculinity can be problematic because it exposes men to significant risks of injury and fatalities. In 2012, 92 percent of all occupationally related injuries reported in the USA were male (Stergiou-Kita *et al*., 2015). It is however, necessary to balance this statement with the reality of gender segregation of occupations and gendered division of labour which is still present in the USA. Generally, males still occupy jobs that place them in greater risk for injury than females. This is specifically true for a sector like mining (Duplesis, 2013). According to Ness (2012) and Verdonk *et al*. (2010); males are less likely to ask for assistance when it may be necessary even if not

doing so may have adverse effects on their health, wellbeing and comfort. Charles and Walters (2008) also highlight that males are even reluctant than females to engage in discussions concerning matters of their health. Furthermore, O'Brien *et al*. (2005) state that men are less likely to attend to serious health and body symptoms and may generally convince themselves that it is necessary or normal for a male to endure high degrees of pain. This assertion seems to be generally true for most occupational sectors, but also specifically, the same observations were made in previous studies of the mining sector (Stergiou-Kita *et al*., 2015). This fact is also corroborated by a study by Campbell which specifically reaches the same conclusion with regard to dominant norms of masculinity applying to the mining sector (Stergiou-Kita *et al*., 2015).

Four themes in masculinity that affect the attitude and practices of coal mineworkers

a) Celebration of heroism, physical strength, toughness and stoicism

Hyper masculinity and heroic behaviours have been identified in studies that were conducted in male dominated occupations including mining (Stergiou-Kita *et al*., 2015). These findings are corroborated by the Forestell study (2006) that alluded to the fact that males in male dominated occupations displayed the above-mentioned traits of masculinity. These heroic behaviours in the workplace are seen to reinforce their male pride and earn the approval of their male counterparts (Stergiou-Kita *et al*., 2015). A study by Campbell in 1997 corroborates these findings by demonstrating that males in the South African gold mines had exhibited great bravery by facing their fears because those are the societal expectations imposed on them (Stergio-Kita *et al*., 2015). These males go to the extent of displaying physical strength in their occupations while putting themselves at risk as a means of proving their masculinity (Ibanez & Narocki, 2011; Alston & Kent, 2008). The literature above demonstrates that a positive attitude towards safety can be severely compromised in an occupational environment where physical strength and toughness are celebrated. Therefore, if coal mineworkers at the Leeuwpan mine were eager to demonstrate their toughness to their colleagues, then their behaviour towards health and safety would be expected to be fairly cavalier and indifferent.

b) Acceptance and normalization of risk

Stergiou-Kito *et al*. (2015) postulate that emphasis on strength, toughness and dominant masculinities affects how risks are perceived by men, and in turn, accepted and normalized in the workplace context (p. 5). Stergiou-Kito's assertion is further corroborated by studies like that of Breslin and Posser (2007) which highlight that males in high risk occupations like mining often

feel the need to accept the risks in their work, endure pain without complaint and be silent about work complaints to prove their worth in the male dominated occupation. According to the study completed by Wicks in 2003 amongst mine workers, risk-taking and getting injured on the job are viewed as a normal part of the job (Stergio-Kito *et al*., 2015). According to Stergio-Kito *et al*. (2015), the initial acceptance of risks can be further normalized through institutionalized practices that reproduce and reinforce normative gender expectations (p. 6, 2015). Part of the normalization of risk in certain high-risk occupations like mining is the expectation that true masculine males should view risk as normal or just an issue of their own personal responsibility and not view health and safety as a collective responsibility in which management also has an explicit role. Ajslev, Lund and Moller (2013) describe how established working-class masculinities, which typically emphasize strength stamina and the ability to withstand physical pain in combination with increased time and productivity pressures, increase the prevalence of musculoskeletal occupational injuries amongst men (p, 2013). This construct therefore, implies that if the coal mineworkers at Leeuwpan mine view risk as an acceptable and normal part of their work that cannot be avoided, they will become apathetic in their implementation of safety standards and that may lead to more avoidable incidents in the mine occurring.

c) Acceptance and normalization of work injury and pain

Themes of masculinity also impose upon males in male dominated occupations the expectation to endure physical pain and injuries without complaint. (Hammond, Lilley, Pope, Ribbans & Walker, 2013). In some of these occupations, pain is not necessarily considered as a critical indicator of the need to take time off unless it adversely impedes or restricts the worker. (Hammond *et al*., 2013). Masculinity and its various forms as exhibited in this manner is of course, detrimental to workers health. Ajslev *et al*. (2013) corroborate this notion when they describe how established working-class masculinities - which typically emphasize strength stamina and the ability to withstand physical pain - in combination with increased time and productivity pressures, increase the prevalence of musculoskeletal occupational injuries amongst men (p. 5). Similar to the previous construct, if the coal mineworkers at Leeuwpan mine believe that injury at their occupation is unavoidable, they will be more cavalier in the way they implement health and safety standards.

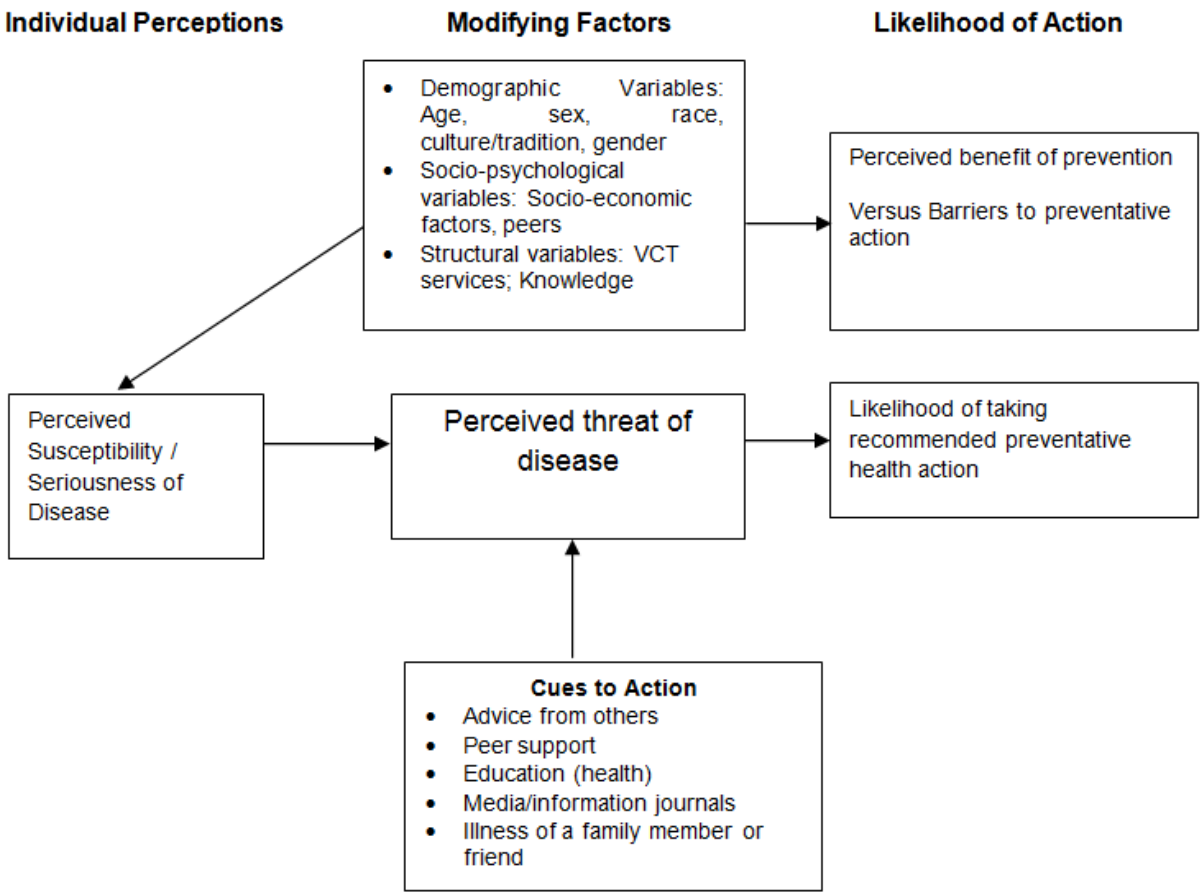
d) Displays of self-reliance, resistance to assistance, resistance to authority and occupational health and safety practices

The most common way of proving masculinity in most societies is displaying self-reliance and what many may view as a defiant attitude. The notion of self-reliance basically requires that a male should be able to do everything on his own without requiring much assistance from authority. In fact, resisting an authority figure may form part of what a male may be expected to exhibit in order to prove his masculinity to himself and other male counterparts (Stergio-Kito *et al*. 2015). Unfortunately, part of the authority structures that have to be resisted include occupational health and safety bodies/personnel that may be in a better position to advise and ensure that the coal mineworkers remain injury free. A desire to demonstrate self-reliance therefore, may impede males' request for assistance pertaining to their health and safety needs. Worse than that, norms of masculinity may also dictate that males refuse to or reluctantly comply with medical treatments or prevention measures in their place of work (Stergio-Kito *et al*., 2015; Charles & Walters, 2008). This is further evidenced by studies that explain how males may resist medical treatment or surveillance because they do not want to appear to be weak or appear to be wasting time on 'minor issues' (Verdonk, Seesing & de Rijk, 2010). Displays of self-reliance and resistance to assistance from supervisors may therefore, cause workers at the Leeuwpan mine not to apply health and safety standards fully and correctly.

2.6. Theoretical framework

2.6.1. Health Belief Model

The Health Belief Model (HBM) is a framework designed to give a comprehensive picture of behaviour and possible reasons for non-compliance with recommended health action (Tarkang & Zotor, 2015). The HBM suggests that an individual's belief in a personal threat together with the individual's belief in the effectiveness of the proposed behaviour is a good predictor of how an individual will behave. According to the HBM, knowledge is directly associated with the individual's perception of a disease and indirectly associated with the likelihood of performing a behaviour due to those perceptions (Tarkang & Zotor, 2015).



Conceptual model of the Health Belief Model (Tarkang & Zotor, 2015)

2.6.1.1. Constructs of HBM

Perceived susceptibility

Perceived susceptibility refers to an individual's belief about the chances of contracting a condition or the possibility of that individual to be at potential risk for danger or hazard (Tarkang & Zotor, 2015). HBM suggests that if an individual generally believes that they are not immune to a particular hazard or health condition, there is then a good possibility that they will take action that may enable them to avert the danger (Li, Yang, Zhang, Fisher, Tian & Sun, 2015).

Perceived severity

In this construct of the HBM, it is postulated that when an individual realizes that they are susceptible to a particular health hazard, it does not necessarily mean that they will take all the

actions necessary to avert the danger (Tarkang & Zotor, 2015). However, if the individual perceives that the hazard generally has serious physical and social implications; he or she may be motivated to take due action to avert the danger (Li *et al*., 2015).

Perceived barriers

Perceived barriers basically refer to the individual's belief in the tangible and psychological costs of the advised behaviours (Julinawati, Cawley, Domegan, Brenner, & Rowan, 2013). If an individual thinks that the prevention or elimination of the hazard will cost him/her more than they are willing to pay emotionally, physically, financially or otherwise (Guvenc,Seven & Akyuz, 2016), then they may not have the motivation to change their practice (Farooqui, Hassali, Knight, Shalfie, Farooqui, Saleem & Aljadhey, 2013). Examples of perceived barriers include financial cost, duration, complexity of the necessary preventative action and accessibility to the services that would support maintaining the required action (Tarkang & Zotor, 2015).

Perceived benefits

Perceived benefit is one of the other great motivators for changing of behaviour. Perceived benefits basically imply that the individual needs to believe that the preventative action they take will in actual fact eliminate or prevent the perceived hazard from occurring (Guvenc *et al*., 2016). It is this belief that gives the individual confidence and motivation to take evasive actions.

Cues to action

According to Tarkang and Zotor (2015), cues to action refers to the events, experiences, personal (physical symptoms of a health condition), interpersonal or environmental (media, publicity) that motivate an individual to take action. Basically, cues to action are factors that can help the person shift from desiring to do the preventative action to actually doing that action (Guvenc *et al*., 2016).

Self-efficacy

Self-efficacy refers to the strength of the individual in his or her ability to conquer a challenging situation or overcome obstacles and setbacks (Guvenc *et al*., 2016). It is necessary, therefore, for the individual to believe that they are capable of taking corrective measures that can alleviate danger and not fall into a victim mentality that may leave them thinking that they are unable to overcome (Li *et al*., 2015).

Reason for Selecting the Health Belief Model

The Health Belief Model was selected as the appropriate underlying theory for this study due to the fact that it emphasizes the subject's perceptions of reality as being the number one influencer of behaviour. It postulates that the subject does not necessarily view the world objectively, but according to their own personal perception of it (Li *et al*., 2015). Therefore, to fully understand how the subject perceives a particular aspect of reality, there must be a thorough assessment of what they know about it and how they believe it affects them. The Health Belief Model emphasizes that if one understands the limits of the knowledge of the subject, they could be able to establish the pillars on which their beliefs and attitudes rest upon and that would subsequently explain the reason for the manifesting behaviour (Guvenc *et al*., 2016). In this study, in order to understand the reasons for the practices of coal mineworkers toward occupational safety, it was important to first establish what they know about occupational safety and what is their attitude based on that knowledge.

3. METHODOLOGY

3.1 Research design

This study applies a quantitative approach. The design of the study is cross-sectional. Cresswell (2013) describes a quantitative study as one that aims to describe and explain a phenomenon through the collection of numerical data; which is in turn, analysed through mathematically based methods. Cross-sectional studies generally aim to find the prevalence of a problem, phenomenon and attitude through the recording of data without any manipulation of the study environment and it generally describes the characteristics that exist in a community (Brink, 2006).

3.2. Setting of the study

The setting of the study is the Leeuwpan coal mine in Limpopo province. The Leeuwpan mine is operated by Exxaro and is in Delmas in Mpumalanga. This open-cast mine employs about 1200 workers and produces 26Mtpa final coal products using a conventional truck and shovel operation.

3.3.1. Study Population

Brink (2006) defines population as the entire set of objects or people which is the focus of the research and about which the researcher wants to determine some characteristics. The population for this study were 460 full time coal mineworkers who worked in the coal mine at Leeuwpan Exxarro coal mine. All the workers who go underground and extract the coal formed part of the population from which the sample was taken.

3.4.1. Sample and sampling

Sample refers to the people that are chosen for participation in a study because they are eligible for the study. A sample comprises of the elements of the population considered for actual inclusion in the study (De Vos *et al*., 2011). Sampling is necessary because in most cases, it is not possible or practical to study all the members of a population (Babbie, 2007).

Coal mineworkers who work to extract coal at the Leeuwpan mine in Delmas were sampled as participants. The participants were above 18 years of age. Race, nationality and ethnicity did not form part of the inclusion criteria.

3.4.2. Sample size

The size of the sample was calculated using Slovin's formula {n=N/ (1+Ne2)}, where N is the total of coal mineworkers at Leeuwpan mine, n is the sample size and e is the accepted level of error. In this study e is 0.05.

n = N / [1 + N(e)2]
n = 460 / [1 + 460(0.05)2]
n = 460 / [1 + 460(0.0025)]
n = 460 / [1 + 1.15]
n = 460 / [2.15]
n = 213.95
n = 213

3.5. Data collection instrument

Brink (2006) defines a research instrument as a device used to collect data in research studies. A self- administered questionnaire was used for the study. Participants were advised not to write their name on the questionnaires to protect their privacy. General rules on the completion of the questionnaire and the importance of filling in all the questions were outlined. The questionnaire was developed by the researcher and aligned to the study objectives and the literature review. Furthermore, it is divided into four sections. Section 1 required the participants to provide demographic information. Section 2 inquired about issues pertaining to their knowledge of occupational health and safety. Section 3 inquired about attitudes towards occupational health and safety while section 4 focused on the practices of the coal mine workers. The questionnaire was self-administered and contained a series of questions and statements which participants had to rate on a 5-point Likert scale

3.6. Data collection

The process of data collection is of critical importance to the success of a study. Without high quality data-collection techniques, the accuracy of the research conclusions can be easily challenged. The researcher informed the potential participants about the purpose of the study prior to attaining their consent to participate in the study (Brink, 2006). Data was collected within a space of 2 days and the availability of the mineworkers determined the duration of data collection. The researcher collected the data with the help of research assistants. The data was

collected at the different posts where coal mineworkers were stationed within the mine at Leeuwpan. The questionnaires were designed in English and translated to Zulu. The questionnaires were distributed by the researcher and assistants to the participants for completion. Participants who were not able to read and write effectively were assisted by the researcher and the assistants who was equally trained for the task. In this case, it is important that the assistants are made aware that they should not lead the participants in any direction in terms of answering the set questions. Their role also included translating the instructions on the questionnaires from English to vernacular and helping the participants understand the correct meaning of the questions.

3.7. Validity and reliability

3.7.1. Validity

Validity refers to the instrument's ability to measure correctly and accurately the construct or trait that it is designed to measure (Babbie, 2010; Polit & Beck, 2010).

The researcher worked closely with supervisors, who through their experience and expertise, assisted the researcher to ensure that the research instrument was valid and not irrelevant or contradictory to the objectives of the study. To ensure validity, the questionnaire was constructed after extensive review of relevant literature as well as instruments from similar studies conducted nationally and internationally. Validity was also ensured by aligning the flow of the questions in the instrument with the study objectives. The questionnaires were also scrutinized and amended by staff from the University of Venda Department of Public Health and members of the Higher Degrees Committee (HDC) of the School of Health Sciences. The researcher modified the instrument according to the feedback received.

A pre-test was done at the Makhado coal mine using 30 participants to ensure the validity of the instrument. A pre-test is basically a small-scale assessment of a particular research. In instances where the pre-test proved that the instrument was not sufficient, necessary adjustments were made in collaboration with the supervisors. The researcher also used face validity to ensure that the instrument reflected the variables that it is designed to measure.

3.7.2. Reliability

Reliability is the extent to which a measure yields the same scores across different times, groups of people, or versions of the instrument. In general, reliability measures consistency. Test-retest was used to ensure reliability. Test-retest refers to a way of administering a research instrument twice to the same people, so as to compare the findings to ensure that the consistency of the data that the instrument yields is consistent. This was also achieved through using the pre-test study (Babbie, 2007) which was administered on 30 participants at the Makhado coal mine.

To ensure consistency and precision of results, a structured questionnaire was used to collect data from participants. Consistency in answering of the questions was assessed using test-retest technique.

3.8. Data analysis

Brink (2006) defines data analysis as the methods of organizing the raw data and displaying them in a pattern that will provide answers to the research questions. Data analysis entails categorizing, ordering, manipulating and summarizing the data and describing the data in meaningful terms. The researcher used SPSS version 23 (Statistical Products for Social Sciences 23) to analyse the data. The results are presented using graphs, tables and charts. Descriptive statistics is used to describe and analyse the data so that it can be meaningful to the readers of the research. Descriptive statistics includes measures such as frequency, distribution, measures of central tendency and dispersion (Brink, 2006). Inferential statistics was used to emphasize that the evidence contained in the sample are the true values of the population and thus, the results can be generalized. In this regard, it is important that chi-square is calculated.

3.9. Ethical considerations

According Brink (2006), ethics are a set of rules or standards that regulate people's lives and are used for decision making in order to ensure safety of participants. The researcher considered the following ethics: permission to conduct the study, non-maleficence, informed consent, confidentiality, anonymity and deception of participants.

3.9.1. Permission to conduct the study

The proposal was presented before the School Higher Degrees Committee and the University of Higher Degree Council for approval and quality control. Further submissions were made to the

University of Venda Research Ethics Committee for ethical clearance. After obtaining the ethical clearance, permission was sought from the Leeuwpan management in Delmas for permission to conduct the study at the mine.

3.9.2. Non-Maleficence

It is the researcher's duty to ensure that the participants are protected "within all possible reasonable limits from any form of physical discomfort that may emerge from the research project" (De Vos, Fouche & Delport, 2012, p 115). It is again the duty of the researcher to weigh up the benefits of the study or a procedure in it against the potential harm it may bring to the participants, especially on issues concerning emotional harm since it is sometimes difficult to predict (De Vos, Fouche & Delport, 2012). De Vos, Fouche and Delport (2012) emphasise that non-maleficence goes beyond "mere efforts to repair, or /attempt to minimize, such harm afterwards" (p. 115). The researcher ensured that the participants are protected from all possible harm by applying all the necessary methods of collecting data ethically. This is further reinforced by the fact the study will be supervised by experienced researchers. The researcher's methods and techniques were subjected to thorough scrutiny by the School Higher Degrees Committee and the panel from the Department of Public Health.

3.9.3. Informed consent

The fundamental principles of informed consent, in simplicity, rest on the notion that participants have the right to choose what should or should not happen to them during their participation in a study (De Vos, Fouche & Delport, 2012). Some of the essential aspects that participants have to comprehend fully before agreeing to give their consent include: the goals of the study, how long the participants will participate in the study, the procedures which will be followed in the study, dangers or risks of participation, the benefits of the study and the credibility of the researcher. (De Vos, Fouche & Delport, 2012).

3.9.4. Confidentiality and anonymity

The principle of confidentiality places a strong obligation on social workers to guard jealously the information that is confided to them (De Vos, Fouche & Delport 2012, p. 121) and therefore, it will be the duty of the researcher to ensure that the participants' data is kept and handled in a manner that will protect their confidentiality and privacy (Health Professions Council of South Africa, 2008).

3.9.5. Deception of Participants

Deception is fundamentally an act, verbal or written, that is done with the intention to mislead and misinform the participants (Struwig & Stead, 2001). If however, misinformation happens unwittingly and without the knowledge of the researcher at that present moment, then the rectification thereof has to be done as soon as such new information has come to the attention of the researcher (De Vos, Fouche & Delport, 2012).

3.10. Plan for dissemination of results

The findings of the study and the recommendations will be kept at the University of Venda library. The study findings will also be published in peer-reviewed and accredited national and international journals. The findings and recommendations of this study will also be presented at seminars and conferences. The findings will again be presented to the coal mineworkers at the mine where the study was conducted and they will also be made available to management and supervisors. Presentations of the findings of the study will also be done in other mines that may be prepared to host the researcher

CHAPTER 4

DATA ANALYSIS

4.1. Introduction

In this chapter, the findings of the study are presented according to the analysis of the data collected at Exxaro's Leeuwpan mine in Delma in Mpumalanga province.

4.1.2. Demographics

The frequency tables and graphs below show the distribution of demographic factors of participants according to age, gender, marital status, home language, qualification and experience. The demographic factors were also used in the cross-tabulation to investigate whether there was a relationship between them and any of the items in the questionnaires.

Table 1 represents the frequency distribution and the percentage of the gender of participants in the study

Gender frequency table

		Frequency	Percent
Valid	Male	89	89.0
	Female	11	11.0
	Total	100	100.0

Gender percentage graph 1

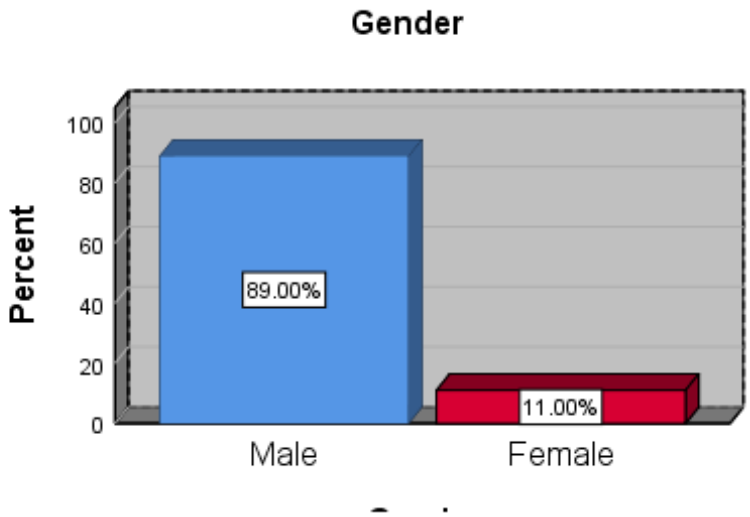


Table 2 represents the frequency distribution and the percentage of the gender of participants in the study.

Age Frequency table

		Frequency	Percent
Valid	Below 30	2	2.0
	Above 30	98	98.0
	Total	100	100.0

Age percentage graph 2

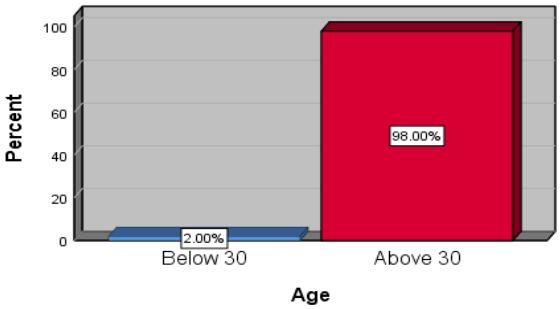


Table 3 represents the frequency distribution and the percentage of marital status of participants in the study

Marital status frequency table

		Frequency	Percent
Valid	Single	64	64.0
	Married	35	35.0
	Total	99	99.0
Missing	System	1	1.0
Total		100	100.0

Marital status percentage graph 3

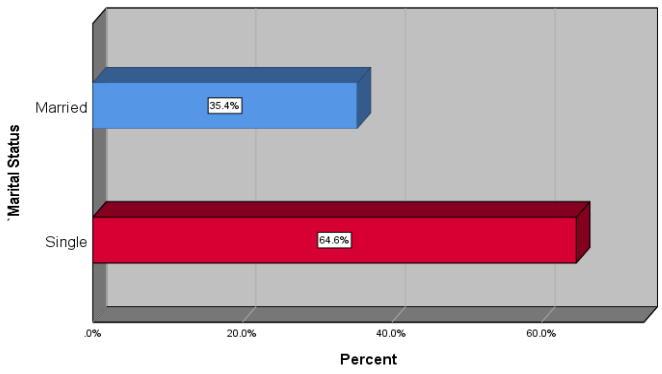


Table 4 represents the frequency distribution and the percentage of home language of participants in the study

Home language frequency table

		Frequency	Percent
Valid	Afrikaans	6	6.0
	English	3	3.0
	Ndebele	16	16.0
	Pedi	13	13.0
	Sotho	3	3.0
	Swati	2	2.0
	Tsonga	6	6.0
	Tswana	5	5.0
	Venda	3	3.0
	Xhosa	4	4.0
	Zulu	38	38.0
	Total	99	99.0
Missing	System	1	1.0
Total		100	100.0

Home language percentage graph 4

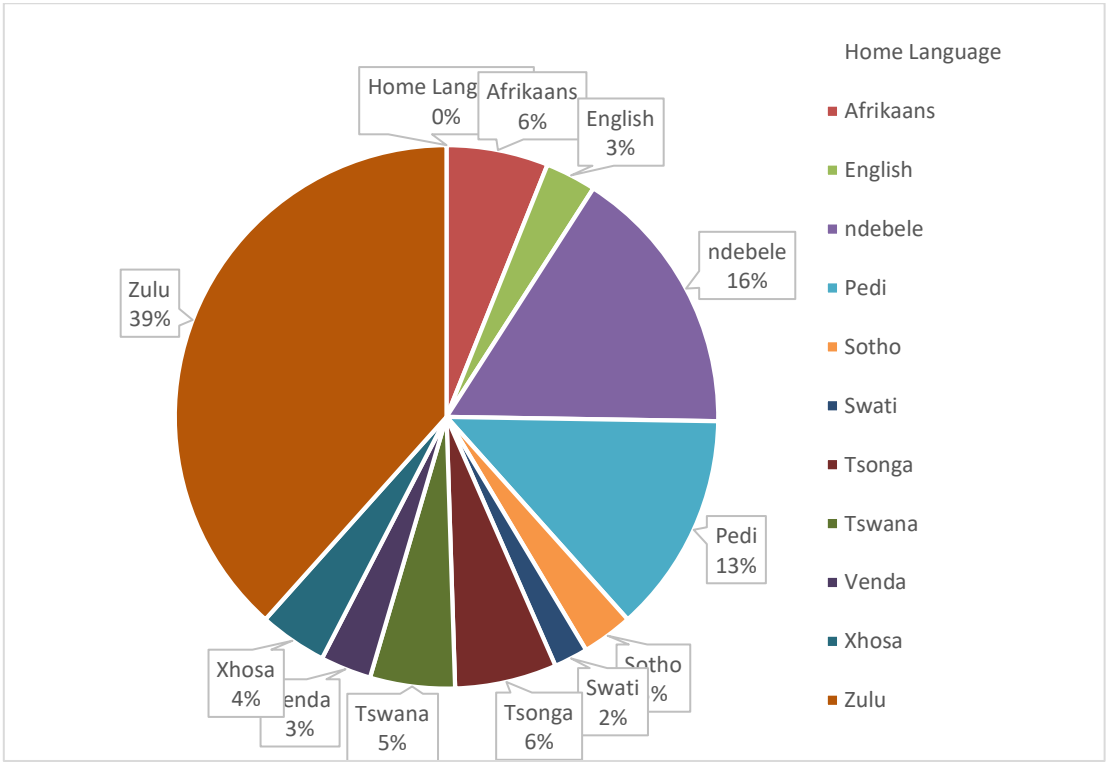


Table 5 represents the frequency distribution and the percentage of qualification of participants in the study

Qualification frequency table

		Frequency	Percent
Valid	None	48	48.0
	Qualified	49	49.0
	Total	97	97.0
Missing	System	3	3.0
Total		100	100.0

Qualification distribution graph 5

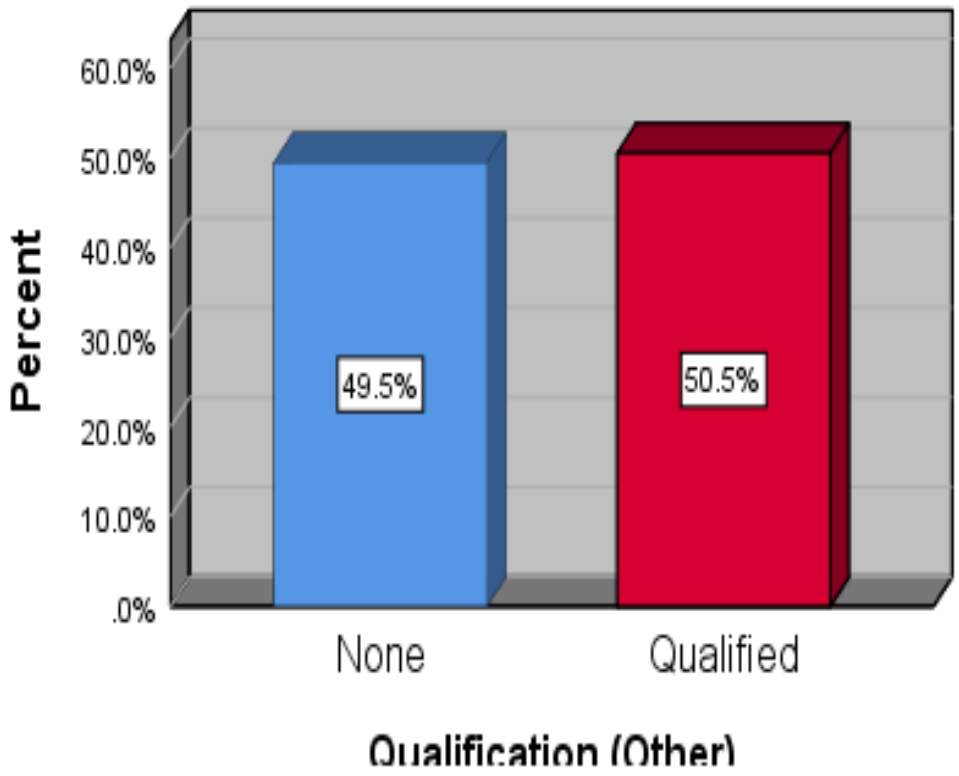
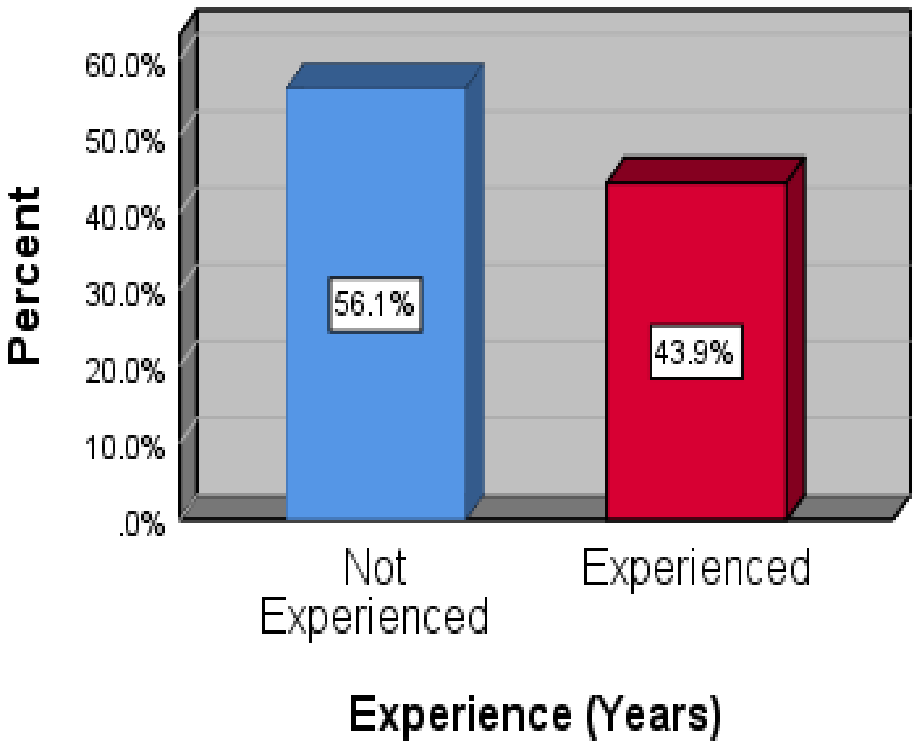


Table 6 represents the frequency distribution and the percentage of experience of participants in the study

Experience frequency table

		Frequency	Percent
Valid	Not Experienced	55	55.0
	Experienced	43	43.0
	Total	98	98.0
Missing	System	2	2.0
Total		100	100.0

Experience percentage graph 6



4.2. Knowledge of occupational health and safety

4.2.1. knowledge of occupational hazards

Table 7: Frequency distribution for items related to knowledge of occupational hazards.

The table below shows the frequencies, percentages, means and standard deviations for items related in the questionnaire related to knowledge of occupational hazards.

	Agree		Disagree		Statistics	
	Frequency	Percent	Frequency	Percent	Mean	Std. Deviation
I feel safe when I am underground	98	99.0%	1	1.0%	1.01	.101
Inhaling coal mine dust is dangerous	99	100.0%	0	0.0%	1.00	.000
Rocks can fall on you	77	89.5%	9	10.5%	1.10	.308
You can be tripped by rocks	93	96.9%	3	3.1%	1.03	.175
Bending to pick up heavy equipment can hurt your back	95	96.0%	4	4.0%	1.04	.198
Carrying heavy material cannot hurt my back	21	21.4%	77	78.6%	1.79	.412

Table 7.1.: Cross tabulation of items related to knowledge of occupational hazards vs. gender, age, qualification and Experience with Chi-square values and level of significance values

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square and significance value at 0.05			
			Male	Female	Below 30	Above 30	None	Qualified	Not Experienced	Experienced	Gender	Age	Qualification	Experience
I feel safe when I am underground	Agree	Count	87	11	2	96	48	47	54	42	**0.126**	**0.021**	**1.011**	**1.269**
		N %	98.9%	100.0%	100%	99.0%	100.0%	97.9%	100%	97.7%				
	Disagree	Count	1	0	0	1	0	1	0	1	**0.722**		**.315**	**.260**
		N %	1.1%	0.0%	0.0%	1.0%	0.0%	2.1%	0.0%	2.3%				
Inhaling coal mine dust is dangerous	Agree	Count	88	11	2	97	48	48	54	43		.		
		N %	100.0%	100.0%	100%	100%	100.0%	100.0%	100%	100.0%				
	Disagree	Count	0	0	0	0	0	0	0	0				
		N %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				
Rocks can fall on you when you are at the mine	Agree	Count	68	9	2	75	36	39	44	32	**1.175**	**.239**	**1.120**	**.018**
		N %	88.3%	100.0%	100%	89.3%	85.7%	92.9%	89.8%	88.9%				
	Disagree	Count	9	0	0	9	6	3	5	4	**.278**	**.625**	**.290**	**.893**
		N %	11.7%	0.0%	0.0%	10.7%	14.3%	7.1%	10.2%	11.1%				
You can be tripped by rock debris	Agree	Count	84	9	2	91	44	46	52	39	**.320**	**.066**	**.367**	**.669**
		N %	96.6%	100.0%	100%	96.8%	95.7%	97.9%	98.1%	95.1%				
	Disagree	Count	3	0	0	3	2	1	1	2	**.571**	**.797**	**.545**	**.413**
		N %	3.4%	0.0%	0.0%	3.2%	4.3%	2.1%	1.9%	4.9%				
Bending to pick up heavy equipment can hurt you back	Agree	Count	84	11	2	93	45	47	51	42	**.521**	**.086**	**1.043**	**.632**
		N %	95.5%	100.0%	100%	95.9%	93.8%	97.9%	94.4%	97.7%				
	Disagree	Count	4	0	0	4	3	1	3	1	**.470**	**.769**	**.307**	**.427**
		N %	4.5%	0.0%	0.0%	4.1%	6.3%	2.1%	5.6%	2.3%				
Carrying heavy material cannot hurt your back at all	Agree	Count	19	2	0	21	12	8	15	5	**.078**	**.557**	**1.123**	**3.815**
		N %	21.8%	18.2%	0.0%	21.9%	25.5%	16.7%	27.8%	11.6%				
	Disagree	Count	68	9	2	75	35	40	39	38	**.781**	**.456**	**.289**	**.051**
		N %	78.2%	81.8%	100 %	78.1%	74.5%	83.3%	72.2%	88.4%				

4.2.2. Knowledge of Mine Health and Safety Act

Table 8: Frequency distribution for items related to knowledge of the Mine Health and Safety Act.

The table below shows the frequencies, percentages, means and standard deviations for items related in the questionnaire related to knowledge of the Mine health and safety act.

Table representing knowledge of Mine Health and Safety Act	Agree		Disagree		Statistics	
Questions	**Frequency**	**Percent**	**Frequency**	**Percent**	**Mean**	**Standard deviation**
I know the mine health and safety act	92	95.8%	4	4.2%	1.04	.201
Mine health and safety act say I should mind my own safety only	22	23.4%	72	76.6%	1.77	.426

Table 8.1: Cross tabulation of items related to knowledge of Mine Health and Safety Act vs. gender, age, qualification and Experience with Chi-square values and level of significance values

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square and significance value at 0.05			
			Male	Female	Below 30	Above 30	None	Qualified	Not Experienced	Experienced	Gender	Age	Qualification	Experience
I know the mine health and safety act	Agree	**Count**	81	11	2	90	44	46	49	42	**.540**	**.089**	**.002**	**.692**
		N %	95.3%	100%	100%	95.7%	95.7%	95.8%	94.2%	97.7%	**.462**	**.766**	**.965**	**.405**
	Disagree	**Count**	4	0	0	4	2	2	3	1				
		N %	4.7%	0.0%	0.0%	4.3%	4.3%	4.2%	5.8%	2.3%				
Mine health and safety act says that I should mind about my safety only	Agree	**Count**	19	3	1	21	15	6	13	9	**.272**	**.806**	**5.275**	**.329**
		N %	22.6%	30.0%	50.0%	22.8%	33.3%	13.0%	26.0%	20.9%	**.602**	**.369**	**.022**	**.566**
	Disagree	**Count**	65	7	1	71	30	40	37	34				
		N %	77.4%	70.0%	50.0%	77.2%	66.7%	87.0%	74.0%	79.1%				

4.2.3. Knowledge of occupational/respiratory diseases

Table 9: Frequency distribution for items related to knowledge of occupational/respiratory diseases.

The table below shows the frequencies, percentages, means and standard deviations for items related in the questionnaire related to knowledge of occupational/respiratory diseases.

	Agree		Disagree		Statistics	
Questions	**Frequency**	**Percent**	**Frequency**	**Percent**	**Mean**	**Standard deviation**
I know of Black lung	79	84.0%	15	16.0%	1.16	.368
I know symptoms of Black lung	69	71.9%	27	28.1%	1.28	.452
I know about PTB	83	86.5%	13	13.5%	1.14	.344
I know symptoms of PTB	78	80.4%	19	19.6%	1.20	.399
I have witnessed a co-worker go to hospital	56	58.9%	39	41.1%	1.41	.495

Table 9.1: Cross tabulation of items related to knowledge of occupational/respiratory diseases vs. gender, age, qualification and Experience with Chi-square values and level of significance values

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square an significance value at 0.05			
			Male	Female	Below 30	Above 30	None	Qualified	Not Experienced	Experience	Gender	Age	Qualification	Experience
I know of Black lung	Agree	Count	68	11	2	77	40	37	44	35	**2.365**	**.388**	**.392**	**.358**
		N %	81.9%	100%	100%	83.7%	87.0%	82.2%	83.0%	87.5%				
	Disagree	Count	15	0	0	15	6	8	9	5	**.124**	**.533**	**.531**	**.550**
		N %	18.1%	0.0%	0.0%	16.3%	13.0%	17.8%	17.0%	12.5%				
I know symptoms of Black lung	Agree	Count	60	9	1	68	39	28	36	33	**1.814**	**.484**	**5.642**	**1.336**
		N %	69.8%	90.0%	50.0%	72.3%	83.0%	60.9%	67.9%	78.6%				
	Disagree	Count	26	1	1	26	8	18	17	9	**.178**	**.487**	**.018***	**248**
		N %	30.2%	10.0%	50.0%	27.7%	17.0%	39.1%	32.1%	21.4%				
I know about PTB	Agree	Count	73	10	2	81	42	38	44	38	**.210**	**.320**	**2.113**	**.281**
		N %	85.9%	90.9%	100%	86.2%	91.3%	80.9%	84.6%	88.4%				
	Disagree	Count	12	1	0	13	4	9	8	5	**.647**	**.572**	**.146**	**.596**
		N %	14.1%	9.1%	0.0%	13.8%	8.7%	19.1%	15.4%	11.6%				
I know symptoms of PTB	Agree	Count	68	10	2	76	38	37	43	34	**.868**	**.497**	**.445**	**.064**
		N %	79.1%	90.9%	100%	80.0%	82.6%	77.1%	81.1%	79.1%				
	Disagree	Count	18	1	0	19	8	11	10	9	**.352**	**.481**	**.505**	**801**
		N %	20.9%	9.1%	0.0%	20.0%	17.4%	22.9%	18.9%	20.9%				
I have witnessed a co-worker go to hospital	Agree	Count	49	7	1	55	28	25	29	26	**.564**	**.068**	**.768**	**.360**
		N %	57.6%	70.0%	50.0%	59.1%	62.2%	53.2%	55.8%	61.9%				
	Disagree	Count	36	3	1	38	17	22	23	16	**.453**	**.795**	**.381**	**.548**
		N %	42.4%	30.0%	50.0%	40.9%	37.8%	46.8%	44.2%	38.1%				

4.2.4. Knowledge of PPE

Table 10: Frequency distribution for items related to knowledge of PPE and the use thereof.

The table below shows the frequencies, percentages, means and standard deviations for items related in the questionnaire related to knowledge of PPE and the appropriate use thereof

	Agree		Disagree		Statistics	
Questions	**Frequency**	**Percent**	**Frequency**	**Percent**	**Mean**	**Standard deviation**
I know what PDM are	87	89.7%	10	10.3%	1.10	.306
Helmets keep me safe	93	94.9%	5	5.1%	1.05	.221
Boots are very important when am in the mine	95	96.9%	3	3.1%	1.03	.173
A torch is very important	79	84.9%	14	15.1%	1.15	.360
A helmet is very important	92	95.8%	4	4.2%	1.04	.201

Table 10.1: Cross tabulation of items related to knowledge of Mine Health and Safety Act vs. gender, age, qualification and Experience with Chi-square values and level of significance values

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square an significance value at 0.05			
			Male	Female	Below 30	Above 30	None	Qualify	Not Experienced	Experience	Gender	Age	Qualification	Experience
I know what PDM are	Agree	Count	77	10	2	85	43	41	46	40	**1.282**	**.235**	**1.606**	**.988**
		N %	88.5%	100%	100 %	89.5%	93.5%	85.4%	86.8%	93.0%				
	Disagree	Count	10	0	0	10	3	7	7	3	**.258**	**.628**	**.205**	**.320**
		N %	11.5%	0.0%	0.0%	10.5%	6.5%	14.6%	13.2%	7.0%				
Helmets keep me safe	Agree	Count	83	10	2	91	45	45	51	41	**.407**	**.110**	**.189**	**.040**
		N %	95.4%	90.9%	100%	94.8%	95.7%	93.8%	94.4%	95.3%				
	Disagree	Count	4	1	0	5	2	3	3	2	**.523**	**.740**	**.663**	**.841**
		N %	4.6%	9.1%	0.0%	5.2%	4.3%	6.3%	5.6%	4.7%				
Boots are very important when am in the mine	Agree	Count	84	11	2	93	46	46	53	41	**.391**	**.064**	**.323**	**.626**
		N %	96.6%	100%	100 %	96.9%	97.9%	95.8%	98.1%	95.3%				
	Disagree	Count	3	0	0	3	1	2	1	2	**.532**	**.800**	**.570**	**.429**
		N %	3.4%	0.0%	0.0%	3.1%	2.1%	4.2%	1.9%	4.7%				
A torch is very important	Agree	Count	71	8	0	79	37	40	46	32	**1.551**	**11.534**	**.392**	**1.255**
		N %	83.5%	100 %	0.0%	86.8%	82.2%	87.0%	88.5%	80.0%				
	Disagree	Count	14	0	2	12	8	6	6	8	**.213**	**.001,**	**.531**	**.263**
		N %	16.5%	0.0%	100.%	13.2%	17.8%	13.0%	11.5%	20.0%				
A helmet is very important	Agree	Count	81	11	2	90	45	44	52	39	**.540**	**.089**	**.000**	**.080**
		N %	95.3%	100%	100%	95.7%	95.7%	95.7%	96.3%	95.1%				
	Disagree	Count	4	0	0	4	2	2	2	2	**.462**	**.766**	**.98**	**.778**
		N %	4.7%	0.0%	0.0%	4.3%	4.3%	4.3%	3.7%	4.9%				

4.3. Attitude towards occupational Health and Safety

4.3.1. Attitude towards occupational hazards

Table 11: Frequency distribution for items related to attitude towards occupational hazards.

The table below shows the frequencies, percentages, means and standard deviations for items related in the questionnaire related to attitudes towards occupational hazards.

	Agree		Disagree		Statistics	
Questions	**Frequency**	**Percent**	**Frequency**	**Percent**	**Mean**	**Standard deviation**
I feel safe when I am in the mine precinct	14	20.0%	56	80.0%	1.80	.403
I don't worry about rocks falling	13	15.1%	73	84.9%	1.85	.360

Table 11.1: Cross tabulation of items related to attitudes towards occupational hazards vs. gender, age, qualification and Experience with Chi-square values and level of significance values

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square an significance value at 0.05			
			Male	Female	Below 30	Above 30	None	Qualified	Not Experienced	Experienced	Gender	Age	Qualification	
I feel safe when I am in the mine precinct	Agree	Count	13	1	0	14	10	4	8	5	**.046**	**.515**	**2.230**	**.020**
		N %	20.3%	16.7%	0.0%	20.6%	27.8%	12.9%	18.6%	20.0%	**.831a**	**.473**	**.135**	**.888**
	Disagree	Count	51	5	2	54	26	27	35	20				
		N %	79.7%	83.3%	100.%	79.4%	72.2%	87.1%	81.4%	80.0%				
I don't worry about rocks falling	Agree	Count	12	1	1	12	8	5	8	4	**.126**	**1.942**	**.738**	**.400**
		N %	15.6%	11.1%	50.0%	14.3%	19.0%	12.2%	16.3%	11.4%	**.723**	**.163**	**.390**	**.527**
	Disagree	Count	65	8	1	72	34	36	41	31				
		N %	84.4%	88.9%	50.0%	85.7%	81.0%	87.8%	83.7%	88.6%				

4.3.2. Attitude towards Mine Health and Safety Act

Table 12: Frequency distribution for items related to attitudes towards Mine Health and Safety Act.

The table below shows the frequencies, percentages, means and standard deviations for items related in the questionnaire related to attitudes towards the Mine health and Safety Act.

	Agree		Disagree		Statistics	
Questions	**Frequency**	**Percent**	**Frequency**	**Percent**	**Mean**	**Standard deviation**
I think mine health and safety act protects workers	86	87.8%	12	12.2%	1.12	.329
Mine health and safety act is not applicable to workers	12	12.4%	85	87.6%	1.88	.331

Table 12.1: Cross tabulation of items related to attitudes towards Mine Health and Safety Act vs. gender, age, qualification and Experience with Chi-square values and level of significance values

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square an significance value at 0.05			
			Male	Female	Below 30	Above 30	None	Qualified	Not Experienced	Experienced	Gender	Age	Qualification	Experience
I think mine health and safety act protects workers	Agree	Count	78	8	2	84	41	42	48	36	**2.604**	**.285**	**.335**	**1.017**
		N %	89.7%	72.7%	100%	87.5%	85.4%	89.4%	90.6%	83.7%	**.107**	**.594**	**.563**	**.313**
	Disagree	Count	9	3	0	12	7	5	5	7				
		N %	10.3%	27.3%	0.0%	12.5%	14.6%	10.6%	9.4%	16.3%				
Mine health and safety act is not applicable to workers	Agree	Count	11	1	0	12	9	3	7	4	**.123**	**.288**	**3.439**	**.398**
		N %	12.8%	9.1%	0.0%	12.6%	19.1%	6.4%	13.5%	9.3%	**.726**	**.591**	**.064**	**.528**
	Disagree	Count	75	10	2	83	38	44	45	39				
		N %	87.2%	90.9%	100%	87.4%	80.9%	93.6%	86.5%	90.7%				

4.3.3. Attitude towards occupational/Respiratory diseases

Table 13: Frequency distribution for items related to attitudes towards respiratory diseases.

The table below shows the frequencies, percentages, means and standard deviations for items related in the questionnaire related to attitudes towards respiratory diseases.

	Agree		Disagree		Statistics	
Questions	**Frequency**	**Percent**	**Frequency**	**Percent**	**Mean**	**Standard deviation**
I am afraid of Black lung	18	18.9%	77	81.1%	1.81	.394
I am afraid of PTB	11	11.3%	86	88.7%	1.89	.319
I will never have lung disease	15	15.8%	80	84.2%	1.84	.367

Table 13.1: Cross tabulation of items related to attitudes towards respiratory diseases vs. gender, age, qualification and Experience with Chi-square values and level of significance values

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square and significance value at 0.05			
			Male	*Female*	*Below 30*	*Above 30*	*None*	*Qualified*	*Not Experienced*	*Experienced*	*Gender*	*Age*	*Qualification*	*Experience*
I am afraid of Black lung	**Agree**	**Count**	17	1	0	18	12	5	8	8	**.398**	**.478**	**3.174**	**.274**
		N %	19.8%	11.1%	0.0%	19.4%	25.5%	11.1%	15.4%	19.5%	**.528**	**.490**	**.075**	**.601**
	Disagree	**Count**	69	8	2	75	35	40	44	33				
		N %	80.2%	88.9%	100%	80.6%	74.5%	88.9%	84.6%	80.5%				
I am afraid of PTB	**Agree**	**Count**	10	1	0	11	8	2	3	7	**.020**	**.261**	**3.750**	**3.014**
		N %	11.5%	10.0%	0.0%	11.6%	16.7%	4.3%	5.7%	16.7%	**.888**	**.609**	**.053**	**.083**
	Disagree	**Count**	77	9	2	84	40	44	50	35				
		N %	88.5%	90.0%	100%	88.4%	83.3%	95.7%	94.3%	83.3%				
I will never have lung disease	**Agree**	**Count**	14	1	1	14	10	4	8	6	**.282**	**1.798**	**3.033**	**.022**
		N %	16.5%	10.0%	50.0%	15.1%	21.7%	8.7%	15.4%	14.3%	**.596**	**.180**	**.082**	**.882**
	Disagree	**Count**	71	9	1	79	36	42	44	36				
		N %	83.5%	90.0%	50.0%	84.9%	78.3%	91.3%	84.6%	85.7%				

4.3.4. Attitude towards PPE and the use thereof.

Table 14: Frequency distribution for items related to attitudes towards PPE and the appropriate use thereof.

The table below shows the frequencies, percentages, means and standard deviations for items related in the questionnaire related to attitudes towards the Mine health and Safety Act.

	Agree		Disagree		Statistics	
Questions	**Frequency**	**Percent**	**Frequency**	**Percent**	**Mean**	**Standard deviation**
PPE keeps me safe	87	90.6%	9	9.4%	1.09	.293
Face masks are very helpful	83	87.4%	12	12.6%	1.13	.334
It is not dangerous to go underground without helmets	11	13.9%	68	86.1%	1.86	.348

Table 14.1: Cross tabulation of items related to attitudes towards PPE vs. gender, age, qualification and Experience with Chi-square values and level of significance values

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square an significance value at 0.05			
			Male	Female	Below 30	Above 30	None	Qualified	Not Experienced	Experienced	Gender	Age	Qualification	Experience
I know what PDM are	Agree	Count	77	10	2	85	43	41	46	40	**1.282**	**.235**	**1.606**	**.988**
		N %	88.5%	100%	100%	89.5%	93.5%	85.4%	86.8%	93.0%				
	Disagree	Count	10	0	0	10	3	7	7	3	**.258**	**.628**	**.205**	**.320**
		N %	11.5%	0.0%	0.0%	10.5%	6.5%	14.6%	13.2%	7.0%				
Helmets keep me safe	Agree	Count	83	10	2	91	45	45	51	41	**.407**	**.110**	**.189**	**.040**
		N %	95.4%	90.9%	100%	94.8%	95.7%	93.8%	94.4%	95.3%				
	Disagree	Count	4	1	0	5	2	3	3	2	**.523**	**.740**	**.663**	**.841**
		N %	4.6%	9.1%	0.0%	5.2%	4.3%	6.3%	5.6%	4.7%				
Boots are very important when am in the mine	Agree	Count	84	11	2	93	46	46	53	41	**.391**	**.064**	**.323**	**.626**
		N %	96.6%	100%	100%	96.9%	97.9%	95.8%	98.1%	95.3%				
	Disagree	Count	3	0	0	3	1	2	1	2	**.532**	**.800**	**.570**	**.429**
		N %	3.4%	0.0%	0.0%	3.1%	2.1%	4.2%	1.9%	4.7%				
A torch is very important	Agree	Count	71	8	0	79	37	40	46	32	**1.551**	**11.534**	**.392**	**1.255**
		N %	83.5%	100%	0.0%	86.8%	82.2%	87.0%	88.5%	80.0%				
	Disagree	Count	14	0	2	12	8	6	6	8	**.213**	**.001,***	**.531**	**.263**
		N %	16.5%	0.0%	100%	13.2%	17.8%	13.0%	11.5%	20.0%				
A helmet is very important	Agree	Count	81	11	2	90	45	44	52	39	**.540**	**.089**	**.000**	**.080**
		N %	95.3%	100%	100%	95.7%	95.7%	95.7%	96.3%	95.1%				
	Disagree	Count	4	0	0	4	2	2	2	2	**.462**	**.766a**	**.982**	**.778**
		N %	4.7%	0.0%	0.0%	4.3%	4.3%	4.3%	3.7%	4.9%				

4.3.5. Factors affecting attitude towards factors related to occupational health and safety

Table 15: Frequency distribution for items related to factors affecting attitudes towards occupational health and safety.

The table below shows the frequencies, percentages, means and standard deviations for items in the questionnaire related to factors affecting attitudes towards occupational health and safety.

	Agree		Disagree		Statistics	
Questions	**Frequency**	**Percent**	**Frequency**	**Percent**	**Mean**	**Standard deviation**
I love working as a coal mine worker	80	82.5%	17	17.5%	1.18	.382
I don't get paid enough to do this job	68	70.8%	28	29.2%	1.29	.457
I am easily irritated especially when I am working	28	29.8%	66	70.2%	1.70	.460
I only get irritated if I am provoked	57	61.3%	36	38.7%	1.39	.490
The noise of blasting and machinery is irritating	62	64.6%	34	35.4%	1.35	.481
When I am tired I get easily irritated	50	52.6%	45	47.4%	1.47	.502
Sometimes when I am alone I feel safe	35	36.5%	61	63.5%	1.64	.484
If I have any work-related problems I can easily talk to my supervisors	82	85.4%	14	14.6%	1.15	.355
If I report to my supervisors it is taken seriously	82	85.4%	14	14.6%	1.15	.355

Table 15.1: Cross tabulation of items related to factors affecting attitudes towards occupational health and safety vs. gender, age, qualification and Experience with Chi-square values and level of significance values

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square and significance value at 0.05			
			Male	Female	Below 30	Above 30	None	Qualified	Not Experienced	Experienced	Gender	Age	Qualification	Experience
I love working as a coal mine worker	Agree	Count	70	10	1	79	39	39	43	35	2.369	1.490	.208	.077
		N %	80.5%	100%	50.0%	83.2%	81.3%	84.8%	81.1%	83.3%				
	Disagree	Count	17	0	1	16	9	7	10	7	.124	.222	.649	.781
		N %	19.5%	0.0%	50.0%	16.8%	18.8%	15.2%	18.9%	16.7%				
I don't get paid enough to do this job	Agree	Count	63	5	1	67	34	31	36	30	1.122	.429	.271	.054
		N %	72.4%	55.6%	50.0%	71.3%	72.3%	67.4%	69.2%	71.4%				
	Disagree	Count	24	4	1	27	13	15	16	12	.289	.512	.603	.817
		N %	27.6%	44.4%	50.0%	28.7%	27.7%	32.6%	30.8%	28.6%				
I am easily irritated especially when I am working	Agree	Count	27	1	1	27	18	8	16	11	2.095	.399	5.697	.372
		N %	32.1%	10.0%	50.0%	29.3%	40.0%	17.4%	32.0%	26.2%				
	Disagree	Count	57	9	1	65	27	38	34	31	.148	.528	.017*	.542
		N %	67.9%	90.0%	50.0%	70.7%	60.0%	82.6%	68.0%	73.8%				
I only get irritated if is am provoked	Agree	Count	53	4	1	56	26	30	29	28	2.141	.110	.359	.541
		N %	63.9%	40.0%	50.0%	61.5%	59.1%	65.2%	59.2%	66.7%				
	Disagree	Count	30	6	1	35	18	16	20	14	.143	.740	.549	.462
		N %	36.1%	60.0%	50.0%	38.5%	40.9%	34.8%	40.8%	33.3%				
The noise of blasting and machinery is irritating	Agree	Count	56	6	1	61	32	28	33	28	.103	.190	.529	.105
		N %	65.1%	60.0%	50.0%	64.9%	68.1%	60.9%	63.5%	66.7%				
	Disagree	Count	30	4	1	33	15	18	19	14	.749	.663	.467	.746
		N %	34.9%	40.0%	50.0%	35.1%	31.9%	39.1%	36.5%	33.3%				
When I am tired I get easily irritated	Agree	Count	46	4	1	49	23	25	30	19	.715	.006	.174	1.705
		N %	54.1%	40.0%	50.0%	52.7%	50.0%	54.3%	58.8%	45.2%				
	Disagree	Count	39	6	1	44	23	21	21	23	.398	.940	.676	.192
		N %	45.9%	60.0%	50.0%	47.3%	50.0%	45.7%	41.2%	54.8%				
Sometimes when I am alone I feel safe	Agree	Count	31	4	1	34	17	16	21	13	.060	.162	.020	.895
		N %	36.0%	40.0%	50.0%	36.2%	36.2%	34.8%	40.4%	31.0%				
	Disagree	Count	55	6	1	60	30	30	31	29	.806	.688	.889	.344
		N %	64.0%	60.0%	50.0%	63.8%	63.8%	65.2%	59.6%	69.0%				
If I have any work related problems I can easily talk to my supervisors	Agree	Count	73	9	2	80	38	41	44	36	.188	.349	2.591	.418
		N %	84.9%	90.0%	100.%	85.1%	79.2%	91.1%	83.0%	87.8%				
	Disagree	Count	13	1	0	14	10	4	9	5	.664	.555	.107	.518
		N %	15.1%	10.0%	0.0%	14.9%	20.8%	8.9%	17.0%	12.2%				
If I report to my supervisors it is taken seriously	Agree	Count	73	9	2	80	37	42	44	36	.188	.349	4.796	.418
		N %	84.9%	90.0%	100%	85.1%	77.1%	93.3%	83.0%	87.8%				
	Disagree	Count	13	1	0	14	11	3	9	5	.664	.555	.029*	.518
		N %	15.1%	10.0%	0.0%	14.9%	22.9%	6.7%	17.0%	12.2%				

4.4. Practice of occupational health and safety

4.4.1. Practice of Occupational health and safety principles and Mine Health and Safety

Table 16: Frequency distribution for items related to practice of occupational health and safety principles and the Mine Health and Safety Act.

The table below shows the frequencies, percentages, means and standard deviations for items related in the questionnaire related to workers practice of occupational health and safety principles and the Mine health and Safety Act.

	Agree		Disagree		Statistics	
Questions	**Frequency**	**Percent**	**Frequency**	**Percent**	**Mean**	**Standard deviation**
I report every potential hazard I encounter	90	95.7%	4	4.3%	1.04	.203
If I notice danger I warn	89	92.7%	7	7.3%	1.07	.261
I report to supervisor if I notice hazard	90	96.8%	3	3.2%	1.03	.178
I report to my supervisor if I experience breathing problems	89	93.7%	6	6.3%	1.06	.245
I never miss my health check ups	93	98.9%	1	1.1%	1.01	.103

Table 16.1: Cross tabulation of items related to practices of occupational health and safety principles and the Mine Health and Safety Act vs. gender, age, qualification and Experience with Chi-square values and level of significance values

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square an significance value at 0.05			
			Male	Female	Below 30	Above 30	None	Qualify	Not Experienced	Experience	Gender	Age	Qualification	Experience
I report every potential hazard I encounter	Agree	Count	81	9	2	88	43	44	50	38	.442	.091	.001	.072
		N %	95.3%	100%	100%	95.7%	95.6%	95.7%	96.2%	95.0%				
	Disagree	Count	4	0	0	4	2	2	2	2	.506	.763	.982	.788
		N %	4.7%	0.0%	0.0%	4.3%	4.4%	4.3%	3.8%	5.0%				
If I notice danger I warn	Agree	Count	79	10	2	87	43	43	46	41	.878	.161	.132	5.851
		N %	91.9%	100%	100 %	92.6%	91.5%	93.5%	86.8%	100%				
	Disagree	Count	7	0	0	7	4	3	7	0	.349	.689	.716	.016,*
		N %	8.1%	0.0%	0.0%	7.4%	8.5%	6.5%	13.2%	0.0%				
I report to supervisor if I notice hazard	Agree	Count	80	10	2	88	44	43	49	39	.373	.068	.301	.142
		N %	96.4%	100 %	100 %	96.7%	95.7%	97.7%	96.1%	97.5%				
	Disagree	Count	3	0	0	3	2	1	2	1	.541	.794	.584	.706
		N %	3.6%	0.0%	0.0%	3.3%	4.3%	2.3%	3.9%	2.5%				
I report to my supervisor if I experience breathing problems	Agree	Count	80	9	2	87	42	44	50	38	.256	.138	.713	.543
		N %	94.1%	90.0%	100 %	93.5%	91.3%	95.7%	96.2%	92.7%				
	Disagree	Count	5	1	0	6	4	2	2	3	.613	.711	.398	.461
		N %	5.9%	10.0%	0.0%	6.5%	8.7%	4.3%	3.8%	7.3%				
I never miss my health check ups	Agree	Count	83	10	2	91	45	45	50	41	.120	.022	.989	.813
		N %	98.8%	100%	100%	98.9%	97.8%	100%	98.0%	100.0%				
	Disagree	Count	1	0	0	1	1	0	1	0	.729	.882	.320	.367
		N %	1.2%	0.0%	0.0%	1.1%	2.2%	0.0%	2.0%	0.0%				

4.4.2. Practice of correct use of PPE

Table 17: Frequency distribution for items related to practice of the correct use of PPE.

The table below shows the frequencies, percentages, means and standard deviations for items related in the questionnaire related to correct use of PPE.

	Agree		Disagree		Statistics	
Questions	**Frequency**	**Percent**	**Frequency**	**Percent**	**Mean**	**Standard deviation**
I always wear PPE	75	94.9%	4	5.1%	1.05	.221
If I feel hot I remove some parts of my PPE	23	24.7%	70	75.3%	1.75	.434
If my helmet has a crack I replace it	84	89.4%	10	10.6%	1.11	.310
If the lamp on my helmet is broken I have it changed	72	94.7%	4	5.3%	1.05	.225

Table 17.1: Cross tabulation of items related to practice of correct use of PPE vs. gender, age, qualification and Experience with Chi-square values and level of significance values

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square an significance value at 0.05			
			Male	Female	Below 30	Above 30	None	Qualify	Not Experience	Experience	Gender	Age	Qualification	Experience
I always wear PPE	Agree	Count	67	8	1	74	37	35	41	32	**.475**	**.054**	**.003**	**3.000**
		N %	94.4%	100.0%	100.0%	94.9%	94.9%	94.6%	91.1%	100.0%	**.491**	**.816**	**.957**	**.083**
	Disagree	Count	4	0	0	4	2	2	4	0				
		N %	5.6%	0.0%	0.0%	5.1%	5.1%	5.4%	8.9%	0.0%				
If I feel hot I remove some parts of my PPE	Agree	Count	22	1	0	23	13	9	16	7	**.993**	**.672**	**.963**	**1.939**
		N %	26.2%	11.1%	0.0%	25.3%	28.9%	20.0%	30.8%	17.9%	**.319**	**.412**	**.327**	**.164**
	Disagree	Count	62	8	2	68	32	36	36	32				
		N %	73.8%	88.9%	100.0%	74.7%	71.1%	80.0%	69.2%	82.1%				
If my helmet has a crack I replace it	Agree	Count	77	7	2	82	40	41	46	36	**1.405**	**.243**	**.401**	**.055**
		N %	90.6%	77.8%	100.0%	89.1%	87.0%	91.1%	88.5%	90.0%	**.236**	**.622**	**.526**	**.814**
	Disagree	Count	8	2	0	10	6	4	6	4				
		N %	9.4%	22.2%	0.0%	10.9%	13.0%	8.9%	11.5%	10.0%				
If the lamp on my helmet I have it changed	Agree	Count	67	5	1	71	36	33	41	29	**.297**	**.056**	**.792**	**.114**
		N %	94.4%	100.0%	100.0%	94.7%	92.3%	97.1%	95.3%	93.5%	**.586**	**.812**	**.374**	**.735**
	Disagree	Count	4	0	0	4	3	1	2	2				
		N %	5.6%	0.0%	0.0%	5.3%	7.7%	2.9%	4.7%	6.5%				

4.4.3. Factors affecting the practice of occupational health and safety

Table 18: Frequency distribution for items related to factors affecting practice of occupational health and safety.

The table below shows the frequencies, percentages, means and standard deviations for items related in the questionnaire related to factors affecting workers' practice of occupational health and safety.

	Agree		Disagree		Statistics	
Questions	**Frequency**	**Percent**	**Frequency**	**Percent**	**Mean**	**Standard deviation**
I do not engage in any activity that can put me in danger	78	83.0%	16	17.0%	1.17	.378
Young mineworkers take more risks	35	36.8%	60	63.2%	1.63	.485
Young miners take more risk than older miners	47	50.0%	47	50.0%	1.50	.503
If you have worked in the mine too long you can get used to risk	39	40.6%	57	59.4%	1.59	.494
Miners who have worked in the mines for too long take more risks	41	43.2%	54	56.8%	1.57	.498
Experienced mineworkers may engage in risky behaviour	42	45.2%	51	54.8%	1.55	.500
It is normal to take risks to finish early	16	16.7%	80	83.3%	1.83	.375
I take risks all the time	18	19.1%	76	80.9%	1.81	.396

Table 18.1: Cross tabulation of items related to factors affecting practise of occupational health and safety gender, age, qualification and Experience with Chi-square values and level of significance values.

			Gender		Age		Qualification (Other)		Experience (Years)		Chi-Square an significance value at 0.05			
			Male	Female	Below 30	Above 30	None	Qualify	Not Experienced	Experience	Gender	Age	Qualification	Experience
I do not engage in any activity that can put me in danger	*Agree*	Count	69	9	2	76	38	37	39	37	**.391**	**.419**	**.002**	**4.819**
		N %	82.1%	90.0%	100.0%	82.6%	82.6%	82.2%	75.0%	92.5%				
	Disagree	Count	15	1	0	16	8	8	13	3	**.532**	**.517**	**.961**	**.028***
		%	17.9%	10.0%	0.0%	17.4%	17.4%	17.8%	25.0%	7.5%				
Young mineworkers take more risks	*Agree*	Count	31	4	0	35	17	16	15	19	**.247**	**1.192**	**.047**	**3.025**
		%	36.0%	44.4%	0.0%	37.6%	37.0%	34.8%	28.8%	46.3%				
	Disagree	Count	55	5	2	58	29	30	37	22	**.619**	**.275**	**.828**	**.082**
		%	64.0%	55.6%	100.0%	62.4%	63.0%	65.2%	71.2%	53.7%				
Young miners take more risk than older miners	*Agree*	Count	44	3	0	47	22	22	26	20	**1.106**	**2.043**	**.010**	**.044**
		%	51.8%	33.3%	0.0%	51.1%	48.9%	47.8%	51.0%	48.8%				
	Disagree	Count	41	6	2	45	23	24	25	21	**.293**	**.153**	**.919**	**.834**
		%	48.2%	66.7%	100.0%	48.9%	51.1%	52.2%	49.0%	51.2%				
If you have worked in the mine too long you can get used	*Agree*	Count	35	4	2	37	17	20	19	19	**.002**	**2.985**	**.518**	**1.057**
		%	40.7%	40.0%	100.0%	39.4%	36.2%	43.5%	35.8%	46.3%				
	Disagree	Count	51	6	0	57	30	26	34	22	**.966**	**.084**	**.472**	**.304**
		%	59.3%	60.0%	0.0%	60.6%	63.8%	56.5%	64.2%	53.7%				
Miners who have worked in the mines for too long take more risks	*Agree*	Count	38	3	1	40	22	16	21	19	**.391**	**.039**	**1.614**	**.332**
		%	44.2%	33.3%	50.0%	43.0%	47.8%	34.8%	40.4%	46.3%				
	Disagree	Count	48	6	1	53	24	30	31	22	**.532**	**.843**	**.204**	**.565**
		%	55.8%	66.7%	50.0%	57.0%	52.2%	65.2%	59.6%	53.7%				
Experienced mineworkers may engage in risky behaviour	*Agree*	Count	39	3	0	42	21	18	24	17	**.563**	**1.683**	**.407**	**.188**
		%	46.4%	33.3%	0.0%	46.2%	46.7%	40.0%	47.1%	42.5%				
	Disagree	Count	45	6	2	49	24	27	27	23	**.453**	**.194**	**.523**	**.664**
		%	53.6%	66.7%	100.0%	53.8%	53.3%	60.0%	52.9%	57.5%				
It is normal to take risks to finish early	*Agree*	Count	14	2	0	16	8	6	7	8	**.089**	**.409**	**.288**	**.685**
		%	16.3%	20.0%	0.0%	17.0%	17.0%	13.0%	13.2%	19.5%				
	Disagree	Count	72	8	2	78	39	40	46	33	**.765**	**.523**	**.592**	**.408**
		%	83.7%	80.0%	100.0%	83.0%	83.0%	87.0%	86.8%	80.5%				
I take risks all the time	*Agree*	Count	15	3	0	18	10	8	10	8	**1.293**	**.484**	**.335**	**.009**
		%	17.6%	33.3%	0.0%	19.6%	22.2%	17.4%	19.2%	20.0%				
	Disagree	Count	70	6	2	74	35	38	42	32	**.255**	**.487**	**.563**	**.927**
		%	82.4%	66.7%	100.0%	80.4%	77.8%	82.6%	80.8%	80.0%				

CHAPTER 5:

DISCUSSIONS OF RESULTS AND CONCLUSIONS

5.1. Introduction

In this chapter, the findings obtained in the analysis of data are discussed and compared with others from published studies. This study was intended to assess the knowledge, attitudes and practices of coal mineworkers pertaining to occupational health and safety at the Lueewpan mine in Delmas, Mpumalanga province

5.2. Demographics

The distribution of the demographic factors is a key element in understanding the data that is being analyzed. In this study, males represented 89 percent of the gender distribution and the females formed the remaining 11 percent of the population. Participants who were over the age of 30 were 98 percent of the sampled population with the remaining 2 percent being under the age of 30. Participants who were married were 64 percent of the total sampled population while the remaining 36 percent were single. The single category included divorced and widowed participants. Majority of the participants were Zulu (38 %) and Ndebele (16%) first language speakers. Pedi speaking participants formed 13 percent of the total population followed by Tsonga and Afrikaans speakers who formed 6 percent of the total population. Venda (4%), Sotho (2%), Tswana (5%), English (3%) and Xhosa (4%) formed the remainder of the first language speaker population. Participants who had any post matric qualification formed 49 percent of the sampled population. In this study the demographic factors were also used for cross-tabulation to investigate whether there was a statistical relationship between any of them and the item that were being investigated in the questionnaire.

5.3. Knowledge of occupational health and safety

5.3.1. Knowledge of occupational Hazards

The study found that 99 percent of the workers at the Lueewpan mine reported that the mine precinct was not the place they could feel safe in. Furthermore, 100 percent of the workers reported that they viewed inhaling coal mine dust as dangerous. Again, 99 percent of the workers agreed that the possibility of being tripped by rock debris is always present while 76.8 percent of the workers reported that carrying heavy materials can be detrimental to their health and safety. According to these results, workers at Lueewpan have good knowledge of occupational hazards. These results are corroborated in Manuele's study (2010) which reported that workers in the

mining industry had reasonable knowledge of occupational hazards. These results however, are again corroborated by Bahn's study (2013) which was completed amongst mineworkers in Australia which also reported that the workers had good knowledge of occupational hazards

5.3.2. Knowledge of Mine Health and Safety act

Workers at the Lueewpan mine also reported that they knew about the Mine Health and Safety Act (95.8 percent). However, only 76.6 percent of them were able to correctly respond when asked if the act only required that each mine worker has to look out for his/her own safety only. The chi-square results showed that workers with post matric qualification believed they had good knowledge of the Mine Health and Safety Act (0.002 at 0.05 significance level). Lawrence's study (2004) amongst Australian mineworkers corroborates the results of this study in that he also found that majority of the coal mineworkers reported that they have knowledge of mining regulations but upon further investigation he found that they were not able to give correct answers about what the regulations stipulated and how they should be implemented. Lawrence (2004) blamed this lack of knowledge about regulation on ineffective communication methods of the act.

5.3.3. Knowledge of occupational (respiratory) diseases

The study found that only 84 percent of the mineworkers at the Lueewpan mine reported that they knew what Black lung is and only 71.9 of the workers reported that they knew what the symptoms of Black lung are. Luong and Matsunda (1998) found similar rates amongst Vietnamese coal mineworkers. Again, only 86.5 percent workers at Lueewpan mine reported that they knew what PTB is and only 80.4 percent of the miners reported that they knew what the symptoms of PTB are. These results are contradicted by Ehrlich, TeWaterNaude, Churchyard, Pemba, Delker, Vermeis and Myers (2006) who reported significantly lower knowledge levels of PTB amongst gold mineworkers. This study found that 58.9 percent of the mine workers reported that they have witnessed a fellow mine worker having to go to hospital due to an occupational sickness. The chi-square results in this study demonstrated that there was a significant association between the knowledge of the symptoms of Black lung and post matric qualification (0.018 at 0.05 significance level). Blackely, Halldin, Wang and Lacey (2014) also reported that workers who were more educated had more knowledge of respiratory and other occupational diseases and their symptoms and thus are in agreement with this finding. It is therefore reasonable to conclude that coal mineworkers at the Lueewpan mine had good knowledge of lung diseases even though there is a need for improvement

5.3.4. Knowledge of PPE and the use thereof

Pertaining to knowledge of PPE and the use thereof, 89.7 percent of the workers at the mine reported that they know what PDMs are and 94.9 percent of the workers reported that they believed helmets keep them safe when they are at the mine. The latter aspect may of course be influenced by the fact that the Lueewpan mine is an open cast mine and has very little, if any, of rock falls like those in underground mines. The apparent lack of knowledge on PDMs demonstrates that PDMs are not used at the Lueewpan mine even when there is significant amount of inhalable coal mine dust. Almost 96 percent of the coal miners viewed boots to be of significance when they are in the mine and less than 85 percent (84.9) reported that they did not think torches were necessary for the mineworkers in the mine. The latter aspect is again influenced by the fact that the mine is an open cast mine and there is usually always significant amounts of light for the coal mineworkers to do their work and thus they do not use torches during day shift though torches are used during the night shifts. Chi-square results showed that there was a statistical association between the perceived importance of torches at the mine to age (0.001 at 0.05 significance level). The majority of workers over the age of 30 (86.8%) perceived torches to be of importance while 100 percent of the workers below 30 reported that they did not view torches as being important in the open cast mine. Based on these results, a conclusion can be reached that the younger workers at Lueewpan do not have good knowledge of PPE and its use. Walker (2007) reported that there was good knowledge of PPE (Boots, helmets and face masks) and proper use in the mining industry in America which he attributed to increased consciousness and emphasis of occupational health and safety within the mining industry. However, the results of this study partially contradict Walker (2004) because the workers in Lueewpan demonstrated good knowledge of PPE in some aspects and yet showed lack of knowledge in other aspects.

5.4. Attitude towards occupational health and safety

5.4.1. Attitude towards occupational hazards at the mine precinct

This study found that majority (80%) of the coal mineworkers at Lueewpan affirmed that they felt that the mine precinct was not safe. Though not satisfactory, the findings of the study show that coal mineworkers at Lueewpan have a good appreciation for occupational hazards in the mine. This is in contrast with Barret, Haslam, Lee and Ellis (2005) whose assessment of workers in the industrial sector demonstrated a nonchalant and indifferent attitude towards the hazards. Barret et al (2005) attributed this nonchalant attitude to hazards to getting too used to the occupational setting. Chi-square results show a significant relationship between attitude to being in the mine

precinct to both gender and experience. Barret et al (2005) corroborate this finding in that they reported that young and inexperienced workers in an industrial setting showed little appreciation for workplace hazards.

5.4.2. Attitude towards the Mine Health and Safety Act

The study found that more than 87 percent (87.8%) of the coal mineworkers affirmed that they believed that the act helps protect mineworkers. Majority of the workers (87.6 percent) also affirmed that they believed that the Mine health and Safety Act was applicable to them as coal mineworkers. These results demonstrated that the workers had a good attitude towards the act. A similar conclusion was reached in Lawrence's study (2004). He found that Australian mine workers generally did not have a problem or a negative attitude towards regulation and legislation and perceived it a necessary tool for safety in the mine (Lawrence, 2004).

5.4.3. Attitude towards occupational diseases

Majority of the workers reported that they did fear the possibility of contracting Black lung (81 percent) with 84.2 percent of the workers affirming that they strongly feared the possibility of acquiring the lung disease. About 86 percent of the workers affirmed that they feared contracting PTB and more that 57 percent of these workers demonstrated that they strongly feared the possibility of contracting PTB at the mine. Majority of the coal mine workers (84.2 percent) also held a firm belief that it was generally possible to contract a lung disease. Thus, a conclusion can be reached that workers at Lueewpan exhibited an attitude of general reverence towards respiratory diseases. This finding is corroborated by findings by Blackely, Halldin, Wang and Lacey (2014) who found that coal mineworkers in Kentucky, Virginia and West Virginia demonstrated a reverential fear for acquiring respiratory diseases.

5.4.4. Attitudes towards PPE and the use thereof

The study found that 90.6 percent of the workers at the Lueewpan mine believed that PPE helps to keep them safe and thus was useful. The study again found that 87.4 of the coal mineworkers believed that wearing their face masks when they are at the mine precinct helps to protect them and is therefore helpful. Majority of the mineworkers also affirmed that it was dangerous to be at the mine precinct without their helmets. Generally, conclusions in these results could be reached that workers at Lueewpan have a good attitude towards occupational health and safety. This is in contrast with Rosenburg and Levenstein (2010) who reported that mine workers of all education levels exhibited a negative attitude towards PPE and found PPE to be "frequently uncomfortable,

is rarely fully protective, and is sometimes hazardous to the health of workers wearing the equipment for long periods of time" (pg. 240).

5.4.5. Factor affecting attitudes towards occupational health and safety

5.4.5.1. Job satisfaction

Majority of the coal mineworkers at Lueewpan affirmed that they loved working as coal mineworkers (82.5 percent) with 37 percent of the mineworkers confirming that they have a strong love for coal mine working. The study also found 70.8 percent of the mineworkers believed that they were being paid well for the job they were doing at the mine. The above results generally demonstrate that the workers at Lueewpan mine exhibit a high level of job satisfaction. Paul, Maiti, Dasqupta and Forjuoh (2005) reported that job satisfaction was a major predictor of attitude and practice of occupational safety. Again, Lui et al (2014) corroborated this study when they reported that there was a statistically significant relationship between income and risky behaviour amongst North east Chinese workers.

5.4.5.2. Negative affectivity

The study found that 29.8 percent of the workers at the mine viewed themselves as being generally irritable when they are working whilst 70.2 percent of the workers did not view themselves as being irritable when they are working. According to Paul, Maiti, Dasqupta and Fourjouhn (2005); irritability as a major aspect of negative affectivity, was an important indicator and predictor of risk taking behaviour and subsequently a negative attitude towards occupational health and safety. The study also showed strong significant statistical association found between workers feeling easily irritated whilst they were working to qualification (0.017 at 0.05 significance level). A study conducted by Lui, Wang and Chen (2014) which surveyed more than 2300 coal mine workers in North-east China failed to find any statistical association between educational levels and negative affectivity. The study also found that 64.6 percent of the coal mineworkers found the noisy machinery at the mine made them more susceptible to irritability. More than half of the participants (52.6 percent) reported that they believed they became susceptible to irritation when they were tired. The study also found that 36.5 of the coal mineworkers experienced feelings of loneliness when they were working which is corroborated by Lui et al (2014), whose study showed significant statistical association between loneliness and depression amongst majority of experienced workers who worked in coal mines.

5.4.5.3. Social occupational support

The study found that majority of the coal mineworkers at the Lueewpan mine reported that they find it easy to talk to their supervisors or occupational health staff when they experienced any work-related problems (85.4 percent). The study also found that coal mineworkers felt that their work-related concerns were taken seriously when they reported to supervisors or occupational health and safety staff (85.4 percent). From this study, a conclusion can be drawn that workers at Lueewpan believed that they had good social occupational support at the mine. According to Lui et al (2014), social occupational support was statistically associated with good occupational health and safety attitude.

5.5. Practice of occupational health and safety

5.5.1. Practice of occupational health and safety

A vast majority of the coal mineworkers (95.7 percent) at Lueewpan reported that they report every potential they encountered whilst 92.7 percent of the same workers affirmed that they warned their colleagues if they noticed any occupational hazard at the mine. The study found that there was significant statistical association between experience and workers warning their colleagues about a hazard (0.016 at 0.05 significance).

5.5.2. Practice of principles in the Mine health and safety act

The study found that there was significant statistical association between giving warnings to colleagues/fellow workers about hazards that a worker noticed to marital status (0.0001), highest grade passed (0.017) and experience (0.019) at 0.05 significance level. It was also apparent that most of the workers (96.8 percent) reported the hazards they noticed at the mine to the supervisor or occupational staff and 93.7 percent of the workers affirmed that they reported to supervisors or occupational health staff if they were experiencing breathing problems. Nearly all the workers at the Lueewpan mine reported that they never miss health check-ups (99 percent). Based on these findings it is justifiable to conclude that the workers at Lueewpan believed they practiced the principles outlined in the Mine health and safety act. This finding is in agreement with findings by Lawrence (2004) who reiterated that majority of mineworkers reported that they complied with occupational guidelines and regulations.

5.5.3. Practices related to use of PPE

Majority of the workers reported that they always wear PPE (94.9 percent).). Only 24.7 percent of the coal mineworkers at the Lueewpan mine reported that they remove parts of their PPE when they feel hot during the day. More than 89.4 percent of the coal mineworkers at Lueewpan

reported that they would replace their helmets if they found that it had a crack whilst 94.7 percent of the workers reported that they changed the lamp of their helmet if it was no longer functional. The above findings show that majority of workers at the Lueewpan mine demonstrated correct use and application of PPE. This finding contradicts Walker's finding (2007) who reported that workers required encouragement and supervision in order to use PPE consistently. These findings are also contrary to Rosenburg and Levenstein's findings (2010) who reported that workers' use of PPE was negatively affected by their negative attitude towards its comfort and usability.

5.5.4. Factors affecting occupational health and safety practices.

5.5.4.1. Age

Majority of the coal mineworkers at Lueewpan (83 percent) reported that they do not engage in any activity that can put them or their colleagues in danger. The study found that 50 percent of the coal mineworkers at Lueewpan were of the opinion that younger mineworkers took more risks than older workers. This perception is corroborated by the findings of a study by Cui, Tian, Qiao, Wang, Wang, Huang and Liu (2015) who identified several risk factors for occupational injury amongst coal mineworkers in China. In this study age was identified as one of the major risk factors. Studies by Mitchel (1988) and Chau (2014) also reported that workers who were below the age of 25 were more prone to occupational injuries.

5.5.4.2. Experience

The study found that only 45 percent of the coal mineworkers believed an individual who had many years of experience working in the mine was more prone to risk-taking behaviour. About41 percent of the workers believed that if a coal mineworker works at the mine for too long they can generally get used to it and might therefore be prone to risk-taking behaviour. The results of the study could not confirm any notions that support the belief that experienced mineworkers were more prone to risk taking behaviour. The results of the study were contrary to the findings in the study by Kunar, Bhattacherjee and Chau (2008) who categorically found that worker who had more experience in a mine took more risks.

5.5.4.3. General risk taking behaviour

According to the study, less than 17 percent of the participants agreed that sometimes they may take risks in order to finish early and only around 19 percent of the workers agreed to generally being risk takers. The findings of the study show that the workers at Lueewpan mine do not exhibit

general risk taking behaviour and according to Cui et al (2015) are less likely to incur injuries in the mine.

Chapter 6

Summary, Limitations and recommendations

6.1. Introduction

The purpose of this chapter is to present a summary of the major findings, to draw conclusions and to make recommendations including also areas which have been emanated or explored for future research based upon the findings.

6.2. Summary

According to the results o this study, the mine workers at the Leeuwpan Mine demonstrate good knowledge of PPE and its use. They also demonstrate lack of sufficient knowledge of health and safety legislation and subsequently an indifferent attitude and non-compliance just as the Health Belief Model implies when it postulates that the beliefs are one of the main determiners of behaviour. The study also showed that the workers did not have sufficient knowledge of some occupational sicknesses which subsequently affected their attitude and behaviour towards compliance. This is consistent with the HBM's notion of perceived severity.

6.3. Limitations

- Due to financial limitations the study was limited to only one coal mine.
- The sample size was also limited by University policy which limits the number of research assistant to two.
- Due to time constraints the number of participants that could be reached at the mine was less than what the researcher desired.

6.4. Recommendations

6.4.1. Recommendations to Exxaro Lueewpan Mine and coal mines in general.

- The mine should perform vigorous orientation of new coal mineworkers in which they are thoroughly trained in the use of PPE and made aware of the hazards in the mine.
- New and old mineworkers should be screened through psychometric tests for signs of negative affectivity and other personality assessments.
- Psychological support and counselling should be made available to coal mineworkers at the mine precinct to ensure that the coal mineworkers are at optimum mental health to perform their duties

- Health and safety staff should spend more time amongst the workers than in the office so they can get to have a better understanding of the challenges the miners have with regard to occupational health and safety issues.
- The mine should hold strategic timeous meetings/workshops/seminars with workers in which they are made conscious of potential dangers in the mine
- Mineworkers should be taught extensively about the respiratory diseases and their symptoms
- The mine should implement more comprehensive use of PDMs and face masks in the mine precinct

6.4.2. Recommendations to Department of Energy and Mineral Resources

- The department should change its current model of mine supervision and develop a model that is more robust and extensive
- The department should develop a strong statistical section that will use statistics and data gathered from different mines to identify trends
- The department should also establish a research team that looks into the latest health and safety methods and models from other countries and determine how some of those modes can be adapted to South Africa
- The department should enforce the use of PDMs in both open cast and underground coal mines.

6.4.3. Recommendations to coal mine-workers.

- Coal mine-workers should ensure that they are up to date with the latest safety standards and legislation
- Coal mine-workers should ensure their safety by wearing all required PPE at all necessary times.
- Miners should report to supervisors if they notice any hazard in the mine.
- Miners should ensure that their PPE is not damaged.

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APPENDIX A: QUESTIONNAIRE

Section 1: Social Demographic Characteristics

Instructions: Please carefully read before answering

- ✓ **Please answer all questions truthfully and honestly.**
- ✓ **If a mistake is made please alert the researcher before making changes.**
- ✓ **Do not hesitate to alert the researcher for any other query.**
- ✓ **Please use an X to mark all your answers in the appropriate boxes**

1. Gender — Male ☐ Female ☐

2. Age — Younger than 20 ☐ Between 20 and 30 ☐ Between 30 and 40 ☐ Above 40 ☐

3. Marital Status — Single: ☐ Married: ☐ Divorced; ☐ Widowed: ☐

4. Language — Home Language : …… Second Language : ……

5. Highest grade passed ……

6. Other qualification……..

7. How many years have you been working in the mine?……

SECTION 2: KNOWLEDGE OF OCCUPATIONAL HEALTH AND SAFETY

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
There are dangerous coal dust particles in the mine	☐	☐	☐	☐
Inhaling coal mine dust is dangerous	☐	☐	☐	☐
Rocks can fall on you if they are not properly supported underground	☐	☐	☐	☐
You can be tripped by debris if you don't watch where you are walking	☐	☐	☐	☐
Bending to pick up heavy material and equipment can hurt your back	☐	☐	☐	☐
Carrying heavy material cannot hurt my back at all	☐	☐	☐	☐
I know what the Mine Health and Safety Act expects me as a worker to do to ensure that I am safe.	☐	☐	☐	☐
The Mine Health and Safety Act says that I should mind about my safety only.	☐	☐	☐	☐
I know about Coal Mineworker Pneumoconiosis (Black Lung)	☐	☐	☐	☐
I know the symptoms of Black Lung	☐	☐	☐	☐
I know about PTB (Pulmonary tuberculosis)	☐	☐	☐	☐
I know very well the symptoms of PTB	☐	☐	☐	☐
I have witnessed a co-worker having to go to hospital because of lung disease	☐	☐	☐	☐
I know what Personal Dust Monitors (PDM) are.	☐	☐	☐	☐
Helmet keeps me safe when I am in the mine	☐	☐	☐	☐
Boots are very important when I am in the mine	☐	☐	☐	☐
A torch is very important when I am in the mine	☐	☐	☐	☐
A helmet is very important when I am in the mine	☐	☐	☐	☐

SECTION 3: ATTITUDE TOWARDS OCCUPATIONAL HEALTH SAFETY

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
I feel safe when I am at the mine precinct	☐	☐	☐	☐
I don't worry too much about rocks falling on me in the mine	☐	☐	☐	☐
I think the Mine Health and Safety Act helps protect us workers	☐	☐	☐	☐
The Mine Health and Safety Act is not applicable to workers	☐	☐	☐	☐
I am not afraid of Coal Mineworkers Pneumoconiosis (Black Lung) or other lung diseases	☐	☐	☐	☐
I am not afraid of Pulmonary Tuberculosis (PTB)	☐	☐	☐	☐
I will never have a lung disease even if I am working in the mine	☐	☐	☐	☐
Personal Protective Equipment (PPE) helps to keep me safe	☐	☐	☐	☐
Face mask is very helpful so that I don't inhale dangerous particles	☐	☐	☐	☐
It is not a very big problem to go underground without helmets	☐	☐	☐	☐
Factors affecting attitude				
I love working as a coal mineworker	☐	☐	☐	☐
I don't get paid enough to do this job	☐	☐	☐	☐
I am easily irritated especially when I am working	☐	☐	☐	☐
I only get irritated if I am provoked	☐	☐	☐	☐
The noise of machinery and blasting is irritating	☐	☐	☐	☐
When I am tired I get easily irritated	☐	☐	☐	☐
Sometimes when I am alone I feel sad	☐	☐	☐	☐
If I have any work-related problems, I can easily talk to my supervisors	☐	☐	☐	☐

If I report a problem to my supervisors, it is taken seriously	☐	☐	☐	☐

SECTION 4: PRACTICE OF OCCUPATIONAL HEALTH AND SAFETY

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
I report every potential hazard that I encounter in the mine	☐	☐	☐	☐
If I notice any kind of danger, I warn other miners	☐	☐	☐	☐
I report to supervisors if I notice a hazard	☐	☐	☐	☐
I report to my supervisor if I experience problems in my breathing	☐	☐	☐	☐
I never miss my health check-ups	☐	☐	☐	☐
I always wear all my PPE when I am underground	☐	☐	☐	☐
If I feel hot, I can remove some parts of my PPE	☐	☐	☐	☐
If my helmet has a crack, I don't use it again	☐	☐	☐	☐
If the lamp on my helmet is off, I get it replaced as soon as possible	☐	☐	☐	☐
I do not engage in any activity that can put me or any of my colleagues in danger	☐	☐	☐	☐
Young mineworkers (below 30) make more mistakes than older mineworker	☐	☐	☐	☐
Young mineworkers take more risks than older mineworkers	☐	☐	☐	☐
If you have worked in the mine for too long, you can get used to not following safety procedures	☐	☐	☐	☐
Miners who have worked in the mines for too long take more risks	☐	☐	☐	☐
Experienced mineworkers may engage in risky behaviour	☐	☐	☐	☐
It is normal to take risks so that we can finish early	☐	☐	☐	☐
I take risks all the time	☐	☐	☐	☐

APPENDIX B: CONSENT LETTER

My name is **Khuthalo Mavhunga**, student number 11605341. I am a Masters student at the University of Venda, studying for the Masters in Public Health (MPH). The title of my study is: **Knowledge, attitudes and practices of coal mineworkers pertaining to occupational health in at the Leeuwpan mine in Mpumalanga province.** You are hereby invited to participate in the study. The study has the following objectives: to investigate how much coal miners know about occupational health, what their attitude is toward occupational health and to investigate whether their practices adhere to occupational health standards. The study is intended to help coal mineworkers, mine companies, regulatory bodies and training institutes to get a better picture of coal mine workers so that occupational health standards may increase in coal mines.

If you consent to participate, be assured that all the information you give will be kept confidential and it will be stored and reported in a way that it cannot be traced back to you. Your participation in this study will be completely voluntary and if at any point you wish to withdraw your participation, you will be able to do so without any one asking you any questions. However, if you are willing to participate, kindly sign in the space below:

I…… have read and understood the consent and terms of this invitation to participate in this study. I hereby declare that I am voluntarily participating in this study.

Participant's signature:…….... Date:……...

Researcher's signature:…… Date:……

For more information contact **Email: khuthalo@gmail.com**
Cell : 076 777 8384

APPENDIX C: CONSENT FORM

Title of the study

Knowledge, attitudes and practices of coal mineworkers concerning occupational health safety at the Leeuwpan mine in Mpumalanga Province.

The study has been described to me in a language that I understand and I freely and voluntarily agree to participate. My questions about the study have been answered. I understand that my identity will not be disclosed and that I may withdraw from the study without giving a reason at any time and this will not negatively affect me in any way. I also agree to any audio recording that may be necessary during my participation.

Participant's name :……..

Participant's signature :……..

Date :……..

Should you have any questions regarding this study or wish to report any problems you have experienced that is related to the study, please contact the study coordinator:

Study Coordinator's name: Mr Mavhunga Khuthalo

Cellphone no. : 076 777 8384
Email address : Khuthalo@gmail.com
Address : Department Public Health, University of Venda
Private bag X5050, Thohoyandou, 0950

APPENDIX D: PARTICIPATION INFORMATION SHEET

Title of the study

Knowledge, Attitudes and practices of coal mineworker pertaining to occupational health and safety at the Leeuwpan Mine in Mpumalanga Province

Who I Am?

I am a student studying at the University of Venda for a Master's Degree. This information sheet will provide you with answers to some of the questions you may have concerning the above-mentioned study. Prior to agreeing to participate, please make sure that you have understood this document and if it is necessary, please feel free to pose any clarity seeking questions.

How do you participate?

If you agree to participate you will be asked to **HONESTLY** fill out a questionnaire about what you think, know and do in your job.

Why are we doing this study?

In this study, we are trying to find out what coal mine workers know and think about their safety in the mine and to see if they are doing all the things that will keep them and their co-workers safe in the mine.

How is this study going benefit society?

The results of this study will be published and you and other participants will get a report of the feedback of the results. This is helpful because it can help you improve the way you view safety and may motivate you to take more responsible actions. This will help researchers, companies and training institution understand the problem mineworkers face more clearly.

What are my personal benefits for participating in the study?

There are no personal benefits to participating in the study. No form of incentive will be given for participation.

Will my information be safe in your hands?

All the information that you give in your questionnaire cannot be used against you because the questionnaire you will fill out will not even have your name on it and your employer will not have access to the questionnaires.

What if you want to stop participating?

You are free to stop participating at any time in the study and you will not be asked any question because it is your choice to participate.

Are we approved to do this study?

We have obtained permission to conduct this study form the University of Venda and they have verified that our study does not harm participants. We have also received approval to do this study from the manager of the mine.

Do you have any further questions?

More information can be obtained from Mr Mavhunga Khuthalo.

Cellphone no. : 076 777 8384
Email address : Khuthalo@gmail.com

THANK YOU

APPENDIX D: REQUEST TO CONDUCT RESEARCH

University of Venda
Private Bag X5050
Thohoyandou, 0955
07 October 2016

The Mine Manager
Exxaro Mine Leeuwpan
P.O. Box 2353
Delmas
2210

Dear Sir

RE: PERMISSION TO CONDUCT A RESEARCH PROJECT REGARDING THE KNOWLEDGE, ATTITUDES AND PRACTICES OF COAL MINE WORKERS PERTAINING TO OCCUPATIONAL HEALTH AND SAFETY AT THE LEEUWPAN MINE IN MPUMALANGA PROVINCE.

I, Khuthalo Leander Mavhunga, a Master's student from the Department of Public Health, University of Venda, hereby request for permission to conduct a study at your mine. The title of the study is: *Knowledge, attitudes and practices of coal mine workers pertaining to occupational health and safety at the Leeuwpan mine in Mpumalanga province.*

The study will involve the following:
Identifying 234 participants (sample), providing them with information about the aim of the study, distribution of questionnaires to participants which they are expected to fill in. The information from this study will be kept confidential and will only be used for research purposes. Participants will have the right to withdraw from the study without prejudice.

Thank you in advance for duly considering my request.

Yours Truly
Mavhunga Khuthalo Leander

UNIVERSITY OF VENDA

OFFICE OF THE DEPUTY VICE-CHANCELLOR: ACADEMIC

TO : MR/MS K MAVHUNGA

SCHOOL OF HEALTH SCIENCES

FROM: PROF J.E. CRAFFORD

DEPUTY VICE-CHANCELLOR: ACADEMIC

DATE : 30 AUGUST 2017

DECISIONS TAKEN BY UHDC OF 24TH AUGUST 2017

Application for approval of Master's research proposal in Health Sciences: **K. Mavhunga (11605341)**

Topic: "Knowledge, Attitudes and Perceptions of Coal Mineworkers pertaining to occupational Health and Safety at a Mine in Limpopo Province, South Africa."

Supervisor	UNIVEN	Dr. N.J Ramakuela
Co-supervisor	UNIVEN	Prof. H.A Akinsola

UHDC approved Master's proposal

Prof J.E. CRAFFORD
DEPUTY VICE-CHANCELLOR: ACADEMIC

NAME OF RESEARCHER/INVESTIGATOR:

Mr K Mavhunga

Student No:
11605341

PROJECT TITLE: **Knowledge, attitudes and practices of coal mineworkers pertaining to occupational health and safety at a selected mine in Limpopo Province.**

PROJECT NO: SHS/17/PH/19/2109

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr NJ Ramakuela	University of Venda	Supervisor
Prof HA Akinsola	University of Venda	Co- Supervisor
Mr K Mavhunga	University of Venda	Investigator – Student

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE

Date Considered: September 2017
Decision by Ethical Clearance Committee Granted
Signature of Chairperson of the Committee: .....
Name of the Chairperson of the Committee: Prof. G.E. Ekosse

UNIVERSITY OF VENDA
DIRECTOR
RESEARCH AND INNOVATION
2017 -09- 21
Private Bag X5050
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University of Venda
Creating Future Leaders

Editorial letter

This serves to confirm that I, Mr. ET Sikitime, attached to University of Venda, English Department have proofread a thesis titled:

Knowledge, Attitude and Practice of Coal Mineworkers Pertaining to Occupational Health and Safety at The Leeuwpan Mine in Mpumalanga Province, South Africa

By

Mavhunga Khuthalo

Student number: 11605341

Editorial work focused mainly on technical precision and common errors relating to syntax, diction, word order and formulation of ideas. Corrections and suggestions were made for the student to effect before submission.

Signature **Date 10/05/2018**

Ext: 015 962 8288
Email: Emmanuel.sikitime@univen.ac.za
BA (ed), BA (Hons) English, Univen, BA Communication Science UNISA, MA (SLS) Stellenbosch University