BINDURA UNIVERSITY OF SCIENCE EDUCATION

DEPARTMENT OF SAFETY HEALTH AND ENVIRONMENTAL MANAGEMENT

An Evaluation of Knowledge, Attitudes and Practices Towards Safety Among Underground Miners: A Case Study of Brompton Gold Mine, Zimbabwe.

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE HONORS DEGREE IN SAFETY HEALTH AND ENVIRONMENTAL MANAGEMENT.

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ABSTRACT

Underground mining operations expose workers to a wide range of occupational hazards, including rockfalls, dust exposure, toxic gas emissions, poor ventilation, and risks associated with heavy machinery and blasting activities. Despite the use of traditional occupational health and safety systems such as personal protective equipment (PPE), safety signage, and standard operating procedures, mining accidents and near-miss incidents continue to occur. This study assessed the knowledge, attitudes, and practices (KAP) of underground miners regarding occupational safety standards at Brompton Gold Mine in Zimbabwe. The main objective was to determine how miners' knowledge, attitudes, and practices influence occupational safety performance within underground mining environments. A descriptive cross-sectional mixed-methods research design was adopted. Data were collected using structured questionnaires, interviews, direct observations, and document analysis of safety records from 2023 to 2025. The study targeted underground miners, supervisors, and safety personnel. Findings revealed that most miners possess adequate safety knowledge and generally positive attitudes toward occupational safety compliance. However, gaps were observed in hazard reporting, procedural adherence, and consistent behavioural compliance during underground operations. Statistical analysis showed a significant relationship between KAP levels and safety performance indicators, with workplace practices emerging as the strongest predictor of safety outcomes. The study concludes that while formal safety systems are in place, behavioural factors play a critical role in determining occupational safety performance. It recommends strengthening behaviour-based safety programmes, enhancing practical training, and improving hazard reporting systems to promote safer underground mining operations.

RELEASE FORM

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Degree Title: Bachelor of Science Honours Degree in Safety, Health and Environmental Management

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APPROVAL FORM

This dissertation entitled “An Evaluation of Knowledge, Attitudes and Practices Towards Safety Among Underground Miners: A Case Study of Brompton Gold Mine, Zimbabwe”, submitted by Chido Makwara, has been examined and is hereby recommended for acceptance by Bindura University of Science Education in partial fulfilment of the requirements for the Bachelor of Science Honours Degree in Safety, Health and Environmental Management.



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DECLARATION

To be completed by the student

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I, Chido Makwara**,** hereby sign and declare that this project is my original work and has never been submitted before in any academic institution for a degree. The project highlights all the information used from other sources.



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Signature of the student Date

To be completed by the Supervisor

This project is suitable for submission to the university faculty and has been checked for conformity with the faculty requirements and guide lines.



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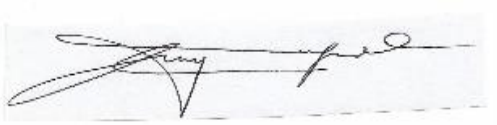

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DEDICATION

I dedicate this research project to my family for their unwavering love, support, and encouragement throughout my academic journey. Their continuous motivation and belief in my abilities gave me the strength to complete this study. I also dedicate this work to all underground miners who risk their lives daily to sustain the mining industry. Their experiences and commitment inspired this research and shaped its direction.

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TABLE OF CONTENTS

ABSTRACT ii

RELEASE FORM iii

APPROVAL FORM iv

DECLARATION v

DEDICATION vi

ACKNOWLEDGEMENTS vii

LIST OF ACRONYMS xii

CHAPTER 1: INTRODUCTION 1

1.1 Background of the Study 1

1.2 Problem Statement 2

1.3 Research Objectives 2

1.3.1 Main Objective 3

1.3.2 Specific Objectives 3

1.4 Research Questions 4

1.5 Justification of the Study 4

1.6 Chapter Summary 4

CHAPTER 2: LITERATURE REVIEW 5

2.1 Introduction 5

2.1 Occupational Health and Safety in the Mining Industry 5

2.2 Regulatory Frameworks Governing Mine Safety in Zimbabwe 7

2.3Theoratical frameworks 9

2.3.1 Heinriched Domino Theory 9

2.3.2 Human Factors Theory 10

2.4 Safety Knowledge among Mine Workers 11

2.5 Factors Influencing Safety Knowledge 12

2.6 Relationship between Safety Knowledge and Safety Performance 12

2.7 Safety Attitudes and Safety Culture in Mines 13

2.8 Safety Practices among Underground Miners 16

2.9 Relationship between Knowledge, Attitudes and Practices (KAP) and Safety Performance 17

2.10 Empirical studies on KAP Assessments.....21

2.11 Conceptual Framework 22

2.11.1 Rationale for the Framework 24

CHAPTER 3: METHODOLOGY 25

3.1 Introduction 25

3.2 Description of the Research Site 25

3.3 Experimental Design 25

3.4 Data Collection Methods 26

3.5 Data Analysis 26

3.6 Ethical Considerations 27

3.7 Validity and Reliability 27

3.8 Limitations of the Study 27

CHAPTER 4: RESULTS 29

4.1 Introduction 29

4.2 Response Rate and Data Reliability 29

4.3 Demographic Characteristics of Respondents 30

4.3.1 Age Distribution of Respondents 30

4.4 Knowledge Levels of Respondents 31

4.5 Safety Practices of Underground Miners 32

4.6 Relationship between KAP and Safety Performance 32

4.7 Correlation and Regression Coefficients 33

4.8 Chapter Summary 35

CHAPTER 5: DISCUSSION OF FINDINGS 36

5.1 Introduction 36

5.2 Discussion of Knowledge of Occupational Safety Standards 36

5.3 Discussion of Safety Practices of Underground Miners 37

5.4 Discussion of the Relationship between KAP and Safety Performance 37

5.5 Integrated Discussion of Findings 38

5.6 Integrated Discussion of findings.....39

5.7 Chapter Summary 40

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS 41

6.1 Introduction 41

6.2 Conclusions 41

6.3 Recommendations 41

6.4 Chapter Summary 43

REFERENCES 44

APPENDICES 47

Appendix I: Questionnaire 47

Appendix II: Consent Form 5

Appendix III: Research Approval Letter 5

LIST OF ACRONYMS

KAP- Knowledge Attitudes and Practices

PPE- Personal Protective Equipment

SOPs- Standard Operating Procedures

SSPS- Statistical Package for Social Sciences

CHAPTER: INTRODUCTION

1.1 Background of the Study

Mining remains one of Zimbabwe's most important economic sectors, contributing significantly to employment, export earnings, and national revenue. Gold mining, in particular, continues to be a strategic pillar of economic growth (Mhlanga, 2022; Munyati & Zimunya, 2021). However, underground mining operations present complex safety challenges. Workers operate in confined spaces under unstable geological conditions, often exposed to dust, toxic gases, heavy machinery, and physically demanding tasks. Globally, mining continues to record higher occupational injury and fatality rates compared to many other industries (International Labour Organization, 2021).

Over the years, improvements in engineering controls, ventilation systems, and safety regulations have enhanced workplace safety. However, accidents still occur. Contemporary safety research highlights that many workplace incidents are influenced not only by technical failures but also by behavioural and organizational factors (Newaz et al., 2023). Unsafe acts such as failure to wear personal protective equipment (PPE), non-compliance with procedures, and poor hazard reporting continue to contribute significantly to accident occurrence (Akoto, 2021).

The Knowledge, Attitudes, and Practices (KAP) framework provides a useful lens for examining these behavioural dimensions. Knowledge refers to miners' understanding of occupational hazards and safety standards. Attitudes reflect their perceptions and beliefs toward compliance and enforcement. Practices represent their actual day-to-day safety behaviors. Research in African mining contexts shows that positive safety knowledge and attitudes are associated with safer work practices and lower accident involvement (Agyekum et al., 2021).

In Zimbabwe, most mining safety research has focused on regulatory compliance and accident statistics, with limited empirical attention given to behavioural determinants at specific mine sites. At Brompton Gold Mine, periodic accidents and near-miss incidents raise questions about the extent to which miners understand, value, and consistently apply occupational safety standards. Addressing these questions is essential for strengthening safety culture and improving safety performance.

1.2 Problem Statement

Underground mining remains one of the most hazardous occupational environments globally, despite improvements in engineering controls and regulatory frameworks. In Zimbabwe, the mining sector continues to expand as a key driver of economic growth, particularly in gold production (Mhlanga, 2022). However, occupational injuries, near-miss incidents, and safety violations remain persistent challenges within underground operations. Although Brompton Gold Mine has established safety policies, supervision structures, and training programmes, incident records suggest that unsafe acts such as inconsistent use of personal protective equipment (PPE), procedural non-compliance, and inadequate hazard reporting still occur. Contemporary occupational safety research increasingly shows that accidents are not caused solely by technical failures but are strongly influenced by behavioural and organizational factors (Nkrumah, Liu, & Akoto, 2021; Newaz et al., 2023). Workers may possess basic awareness of safety rules but underestimate risks, normalize hazardous conditions, or prioritise production targets over compliance. In such cases, the gap lies not in the absence of safety systems but in the interaction between knowledge, attitudes, and daily practices. At Brompton Gold Mine, there is currently limited empirical evidence evaluating whether underground miners possess adequate knowledge of occupational safety standards, maintain positive attitudes toward enforcement, and consistently implement safe practices. Furthermore, the statistical relationship between miners' knowledge, attitudes, and practices (KAP) and recorded safety performance indicators between 2023 and 2025 has not been systematically examined. Without this evidence, management interventions may remain reactive rather than preventative. The central problem, therefore, is the lack of clear, data-driven understanding of how behavioural factors influence safety performance at Brompton Gold Mine, despite the existence of formal safety systems.

1.3 Research Objectives

Main Objective

To assess the knowledge, attitudes, and practices (KAP) of underground miners regarding occupational safety standards at Brompton Gold Mine by December 2025, and determine their impact on safety performance.

Specific Objectives

1. To determine the proportion (%) of underground miners who possess accurate knowledge of occupational safety standards and programmes.

2. To measure miners' attitudes toward safety compliance and enforcement using a standardized Likert scale and classify responses as positive, neutral, or negative.

3. To quantify the percentage of miners whose daily safety practices meet occupational safety requirements (PPE use, hazard reporting, and procedural adherence).

4. To statistically analyze the relationship between miners' KAP scores and recorded safety performance indicators (accidents, near-miss events, and violation reports) between 2023 and 2025.

1.4 Research Questions

1. What is the overall level of knowledge, attitudes, and practices (KAP) of underground miners regarding occupational safety standards at Brompton Gold Mine?

2. What proportion of underground miners possess accurate knowledge of occupational safety standards and programmes?

3. What attitudes do underground miners hold toward safety compliance and enforcement?

4. What percentage of underground miners consistently practice required safety behaviors such as PPE usage, hazard reporting, and adherence to procedures?

5. Is there a statistically significant relationship between miners' KAP scores and recorded safety performance indicators between 2023 and 2025?

1.5 Justification of the Study

This study is justified at operational, academic, and national development levels. At the operational level, underground mining environments require not only robust engineering controls but also strong behavioural compliance. Evidence suggests that positive safety knowledge and attitudes significantly improve adherence to safe work procedures and reduce injury risks (Agyekum et al., 2021; Newaz et al., 2023). By identifying gaps in miners' knowledge, attitudes, and practices, this study will enable Brompton Gold Mine to design

targeted training programmes, strengthen supervision strategies, and implement behavior-based safety interventions grounded in empirical data rather than assumptions. Academically, the research aligns with Zimbabwe's Education 5.0 framework under the Ministry of Higher and Tertiary Education, Innovation, Science and Technology Development, which emphasizes research that generates innovation, industrial solutions, and community impact. By producing applied knowledge that directly contributes to safer mining operations, the study supports industry focused scholarship and strengthens university industry collaboration. At a broader level, improving occupational safety contributes to global commitments toward safe and decent work advanced by the United Nations. Furthermore, the research supports Zimbabwe's National Development Strategy1 (2021–2025), implemented by the Government of Zimbabwe, which prioritises mining sector productivity and improved occupational health and safety standards. Sustainable economic growth cannot be achieved without safeguarding the workforce. By linking behavioural safety assessment with national productivity goals, this study provides evidence that is both academically relevant and strategically aligned with national development priorities.

1.6 Chapter Summary

This chapter introduced the study by outlining the context of occupational safety in underground mining and highlighting the importance of behavioural factors in influencing safety performance. The background established the economic significance of mining and the persistent safety challenges within underground operations. The problem statement identified the lack of empirical evidence regarding miners' knowledge, attitudes, and practices at Brompton Gold Mine. The chapter then presented the research objectives, research questions, and hypotheses guiding the study. Finally, the justification demonstrated the academic, operational, and national relevance of the research.

CHAPTER 2: LITERATURE REVIEW

2.1 Occupational Health and Safety in the Mining Industry: Global Context

Mining is widely recognised as one of the most hazardous economic sectors in the world, with underground mining presenting particularly severe safety challenges. Although technological advancements have improved mechanisation and monitoring systems, mining environments remain inherently unpredictable. Workers are commonly exposed to rock bursts, collapsing tunnels, explosions, toxic gases, heavy machinery, electrical hazards, water inundation, and confined working spaces (Donoghue, 2018). The International Labour Organization (ILO, 2021) estimates that while the global mining workforce represents less than one percent of total global employment, the sector accounts for up to eight percent of occupational fatalities. This disproportionate burden of injuries demonstrates that mining continues to pose risks far above the norm for industrial workplaces.

Accident trends over the last two decades show that mining fatalities persist in both developed and developing countries. In China, South Africa, India, Russia, and the United States, underground mines repeatedly report accidents linked to rock falls, gas explosions, fires, and machinery malfunctions (Castranova & Vallyathan, 2019). A study by Li et al. (2019) demonstrated that methane explosions and roof instability remain among the leading causes of fatal underground accidents in Asia. In the United States, the Mine Safety and Health Administration (MSHA, 2020) records show that nearly 70 percent of mining fatalities involve powered haulage, fall-of-ground incidents, or entrapment underground. South Africa's Chamber of Mines records further illustrate that although mining fatalities dropped from the peak years of the 1980s and 1990s, fatal injuries continue to occur annually due to seismic activity, blasting operations, equipment failure, and human error (Maseko et al., 2019).

Research evidence shows that mining hazards cause not only deaths and traumatic injuries but also long-term occupational diseases. Dust exposure, particularly silica dust, contributes to silicosis, chronic lung disease, and tuberculosis, especially in gold mines where dust concentrations are extremely high (Castranova & Vallyathan, 2019). Noise from drilling, blasting, and machinery leads to irreversible hearing loss, while repetitive lifting and awkward postures commonly cause musculoskeletal disorders. Donoghue (2018) notes that

mining workers also experience psychological hazards such as stress, fatigue, and anxiety associated with confined environments, shift work, and production pressure. These chronic health outcomes demonstrate that mining safety is not limited to acute accidents but encompasses long-term threats to well-being.

Despite advanced engineering controls, the persistence of mining accidents highlights that safety problems are not purely technical. Abdelhamid and Everett (2020) argue that a large proportion of mining accidents globally are preventable and result from unsafe worker behaviours such as bypassing protective equipment, ignoring hazard warnings, and performing tasks without authorization. This pattern has led researchers to shift attention toward behavioural safety, human factors, and organisational culture as key determinants of accident occurrence. Mines that possess modern equipment still record accidents when workers lack safety knowledge, hold negative attitudes toward safety rules, or engage in unsafe practices. As a result, assessing workers' Knowledge, Attitudes, and Practices (KAP) is now considered an essential strategy for understanding accident causation in mining settings.

Studies from developing countries show that weak enforcement of safety regulations, poor safety culture, and insufficient training worsen accident risks. In Ghana, Boateng and Nyaaba (2020) found that miners sometimes view safety rules as obstacles to productivity, leading them to remove helmets, gloves, or safety harnesses when working underground. Similar patterns are observed in Pakistan, where miners often work without proper ventilation, protective equipment, or gas detection devices, resulting in high injury and fatality rates (Saleem et al., 2020). In many cases, workers continue to perform unsafe tasks even when hazards are visible, reflecting poor hazard perception and negative safety attitudes. These behaviours illustrate why mining safety must be examined from both a technical and human-behavioural perspective.

In high-income countries, regulatory mechanisms and technological investment have significantly reduced accidents, yet incidents still occur due to complacency, risk-taking, or overreliance on technology. Research in Australia shows that while automated ventilation and continuous monitoring systems reduce risks, workers can develop a false sense of security, ignore warning signs, or override safety systems under production pressure (Joy & Griffiths, 2018). Studies from the United States report that many underground fatalities

involve experienced workers who violated standard procedures because of overconfidence or routine normalization of risk (MSHA, 2020). Such findings demonstrate that knowledge alone is not enough—attitudes and behaviour must support safety compliance.

Globally, mining companies are increasingly adopting Behaviour-Based Safety (BBS) programs to reduce human-factor accidents. BBS focuses on observing workers, promoting safe behaviours, and reinforcing rule compliance through incentives and education (Cooper, 2009). Maseko et al. (2019) demonstrated that BBS implementation in South African mines reduced injuries and increased PPE usage. However, BBS programs are only effective when miners have adequate knowledge and positive attitudes toward safety rules. If workers believe management prioritizes production over safety, BBS effectiveness weakens. This linkage between knowledge, attitudes, practices, and outcomes is the reason why KAP assessments are widely used in hazardous industries such as health care, manufacturing, and mining.

2.2 Regulatory Frameworks Governing Mine Safety in Zimbabwe

Zimbabwe's mining sector is governed by several statutory frameworks aimed at protecting workers and ensuring safe mining operations. Key legislation includes the Factories and Works Act (Chapter 14:08), the Mines and Minerals Act (Chapter 21:05), and the Mining (Management and Safety) Regulations of 1996, which outline the responsibilities of employers, mine managers, and workers in maintaining safe working environments (Mutemeri & Petersen, 2002). These legal instruments cover aspects such as ventilation standards, use of personal protective equipment (PPE), reporting of accidents, emergency preparedness, and inspections. The National Social Security Authority (NSSA) also provides occupational health oversight, including accident investigation, compensation, and preventive initiatives for high-risk industries (NSSA, 2020).

The Ministry of Mines and Mining Development plays a pivotal role in supervising and enforcing these regulations. Inspectors are mandated to conduct regular audits, verify compliance with safety procedures, and investigate incidents of non-compliance. Despite these legal provisions, multiple studies indicate persistent challenges in enforcement, especially in underground mining operations. For instance, Mutemeri and Petersen (2002) observed that enforcement gaps often arise due to limited manpower, inadequate

inspection frequency, insufficient resources, and bureaucratic delays. As a result, some mines operate with incomplete safety protocols or outdated equipment, increasing the likelihood of accidents.

Compliance with safety regulations in Zimbabwe is further influenced by organisational culture and management priorities. Mines focused primarily on production targets may unintentionally deprioritize safety measures, leading to lapses in hazard identification, PPE usage, and procedure adherence. Research by Chindoga and Moyo (2019) reported that production pressure often prompts miners to bypass safety rules, particularly when managers emphasize output over risk mitigation. In such environments, workers' safety knowledge, attitudes, and daily practices become critical determinants of accident prevention, as technical systems alone cannot compensate for non-compliance.

Several studies also highlight the role of training and education in regulatory compliance. Mines that invest in continuous safety training, refresher courses, and induction programs demonstrate higher adherence to statutory requirements (Chikodzi & Nyamadzawo, 2020). Conversely, mines with poor training programmes show frequent near-miss incidents, improper PPE usage, and lack of hazard reporting. Training enhances workers' knowledge and shapes attitudes, which in turn influence safety practices a direct link to the KAP framework adopted in this study.

Resource constraints further compound compliance challenges. Many underground mines, especially small- to medium-scale operations, lack adequate PPE, ventilation equipment, and emergency preparedness tools. Boateng and Nyaaba (2020) observed that scarcity of critical safety resources often forces miners to improvise, bypass equipment, or perform tasks unsafely. Even when regulations mandate the availability of safety gear and hazard controls, ineffective monitoring and insufficient enforcement reduce their practical impact.

The NSSA plays an additional role by providing occupational health programmes, accident reporting systems, and compensation mechanisms for injured workers. However, limited integration between regulatory bodies, mining companies, and workers sometimes weakens overall compliance. For example, miners may be aware of reporting procedures but fail to notify supervisors due to fear of disciplinary action, production delays, or cultural factors that normalize risk (Mutemeri & Petersen, 2002; Chikodzi & Nyamadzawo, 2020). This

further emphasizes the importance of understanding miners' knowledge, attitudes, and practices in achieving regulatory compliance

Empirical evidence from Zimbabwean mines illustrates that legal frameworks alone are insufficient for accident reduction. Studies indicate that mines adhering formally to regulations may still experience high accident frequencies if workers' behaviour does not align with prescribed safety practices. For instance, Brompton Gold Mine, despite implementing rigorous safety protocols, continues to record near-miss incidents and minor injuries, highlighting behavioural gaps in safety compliance (Chindoga & Moyo, 2019). These patterns mirror findings from other African countries, suggesting that KAP factors are as crucial as technical and legal interventions in mitigating workplace accidents.

2.3 Theoretical Frameworks for Understanding Safety Behaviour

Understanding the causes of accidents and unsafe behaviours in mines requires robust theoretical frameworks. Several models have been developed to explain how human behaviour interacts with workplace hazards, offering insights into the underlying causes of occupational incidents. The three most relevant frameworks for mining safety are Heinrich's Domino Theory, Reason's Human Error Theory, and Behaviour-Based Safety (BBS) Theory. These frameworks collectively inform research on miners' knowledge, attitudes, and practices (KAP) and guide interventions aimed at reducing accidents.

2.3.1 Heinrich's Domino Theory

Heinrich (1931) proposed the Domino Theory of accident causation, which posits that accidents result from a sequential chain of events or factors, like dominos falling in succession. The chain includes: (1) ancestry and social environment, (2) worker fault or personal traits, (3) unsafe acts or mechanical hazards, (4) accident occurrence, and (5) resulting injury. According to this theory, removing unsafe acts or conditions can prevent accidents entirely. Heinrich's model emphasizes that human behaviour is a key factor in accidents, not just environmental or mechanical hazards. In mining, this implies that miners' compliance with procedures, proper use of PPE, and vigilance in following safety protocols are critical to interrupting the domino chain that leads to injury (Donoghue, 2018).

Reason's Human Error Theory

Reason (1990) introduced the Human Error Theory, which distinguishes between active failures and latent conditions. Active failures are unsafe acts committed by workers, while latent conditions are systemic weaknesses such as poor management, inadequate training, or defective equipment. In the mining context, an accident often occurs when active failures coincide with latent conditions, producing a “perfect storm” for injury. For example, a miner bypassing a lockout procedure while supervision is inadequate and equipment maintenance is delayed increases accident likelihood. Reason’s theory highlights that interventions must address both the human and organizational dimensions of safety. Knowledge, attitudes, and practices directly influence active failures, while management systems and regulatory enforcement mitigate latent risks (Abdelhamid & Everett, 2020).

Behaviour-Based Safety (BBS) Theory

Behaviour-Based Safety (BBS) Theory focuses on observing, measuring, and modifying workers’ behaviour to reduce unsafe acts and reinforce safe practices. BBS relies on positive reinforcement, continuous feedback, and worker engagement to promote compliance with safety procedures (Cooper, 2009). In mining, BBS programs encourage miners to report hazards, use PPE consistently, follow standard operating procedures, and participate in safety meetings. Research shows that BBS can significantly reduce accident rates, especially when workers’ knowledge and attitudes support behavioural interventions (Maseko et al., 2019). By emphasizing the link between behaviour and outcomes, BBS aligns closely with the KAP framework, highlighting how knowledge and attitudes influence daily practices.

Integration of Theories into KAP Research

These three theories complement each other in explaining mining accidents. Heinrich emphasizes the sequential relationship between unsafe acts and injury, Reason focuses on the interaction between human error and organizational weaknesses, and BBS provides a practical framework for modifying behaviour. Collectively, they underscore that miners’ knowledge, attitudes, and practices are central determinants of workplace safety. While technical measures and regulatory frameworks provide a foundation, behavioural compliance is essential to prevent accidents (Gyekye & Salminen, 2021).

For instance, even if a mine has adequate ventilation, PPE, and training programs, accidents can occur if miners lack knowledge of hazards, hold negative attitudes toward safety rules,

or routinely bypass procedures. KAP assessments measure these behavioural components, providing actionable insights for targeted safety interventions. By integrating theoretical frameworks with empirical KAP research, mines can design strategies that address both human behaviour and systemic safety challenges.

Application to Zimbabwean Mining Context

In Zimbabwe, underground mines such as Brompton Gold Mine face complex safety challenges. Despite investments in infrastructure, PPE, and training, accidents continue, often linked to unsafe behaviour. Applying Heinrich, Reason, and BBS theories to this context highlights the importance of assessing miners' knowledge, attitudes, and practices. For example, Heinrich's Domino Theory can identify which unsafe acts are most likely to trigger accidents; Reason's Human Error Theory can pinpoint systemic weaknesses that exacerbate risks; and BBS can provide a framework for modifying unsafe behaviours through observation and reinforcement. Together, these theories justify a KAP-focused study to reduce accidents and improve occupational safety outcomes.

2.4 Safety Knowledge Among Mine Workers

Safety knowledge refers to the understanding that workers have regarding workplace hazards, preventive measures, procedures, emergency responses, and proper use of personal protective equipment (PPE). In mining, safety knowledge is a critical determinant of accident prevention because it shapes workers' ability to recognize hazards, assess risks, and respond appropriately to unsafe conditions (Debrah et al., 2021). Workers with adequate safety knowledge are better able to anticipate potential accidents, follow correct procedures, and contribute to a safer work environment.

Importance of Safety Knowledge

Numerous studies demonstrate that safety knowledge significantly reduces accident frequency in mining operations. A well-informed worker can identify early warning signs of hazards such as unstable rock formations, malfunctioning equipment, or toxic gas presence (Boateng & Nyaaba, 2020). Knowledge also empowers workers to implement preventive measures, including proper PPE usage, adherence to safe operating procedures, and e]ffective communication with colleagues. Donoghue (2018) asserts that insufficient

knowledge often leads to misjudgement, non-compliance with procedures, and failure to detect hazards, which directly increases accident risk. In Zimbabwe, even large-scale mines like Brompton Gold Mine experience recurring incidents, highlighting gaps in safety knowledge among workers despite formal training programs (Chindoga & Moyo, 2019).

2.5Factors Influencing Safety Knowledge

Several factors influence the level of safety knowledge among miners. Education, professional experience, quality of induction and refresher training, and exposure to safety communication campaigns are critical determinants. Boateng and Nyaaba (2020) found that miners with higher levels of formal education were more likely to understand safety signage, interpret risk information, and comply with procedures. Similarly, experience in mining operations improves hazard recognition and decision-making skills, enabling workers to anticipate and mitigate risks effectively (Maseko et al., 2019). Training programmes, particularly those incorporating practical exercises, simulations, and continuous reinforcement, have been shown to enhance knowledge retention and transfer to workplace behaviour (Chikodzi & Nyamadzawo, 2020).

Safety knowledge is also influenced by organizational communication. Mines that regularly disseminate hazard alerts, conduct safety briefings, and encourage peer-to-peer learning demonstrate higher levels of knowledge among workers. Conversely, limited or inconsistent communication reduces awareness of hazards, updates in procedures, and changes in regulations (Mutemeri & Petersen, 2002). This highlights that knowledge is not solely the responsibility of workers; it depends on systematic training, management support, and institutional structures.

2.6 Relationship Between Knowledge and Safety Performance

Empirical studies consistently show a positive correlation between safety knowledge and workplace performance. In South African mines, Maseko et al. (2019) found that miners with strong safety knowledge were more likely to follow PPE requirements, report near-misses, and participate actively in safety programmes, resulting in fewer accidents. Similarly, Li et al. (2019) observed that safety knowledge reduced risky behaviours and enhanced compliance with operational procedures. In Zimbabwe, research indicates that gaps in knowledge often translate into unsafe practices such as ignoring PPE, bypassing ventilation checks, and failing

to communicate hazards (Chindoga & Moyo, 2019). These findings underscore the importance of assessing miners' knowledge as part of the KAP framework, as knowledge directly affects both attitudes toward safety and daily practices.

Training and Awareness Interventions

Effective training and awareness programmes are essential for improving safety knowledge. Studies have shown that interactive training sessions, practical demonstrations, hazard simulations, and periodic refresher courses significantly improve miners' understanding of hazards and protective measures (Debrah et al., 2021; Chikodzi & Nyamadzawo, 2020). Furthermore, knowledge retention is higher when workers are engaged in participatory learning and when training is reinforced through workplace supervision and feedback. Mines that invest in continuous knowledge development not only reduce accident rates but also cultivate a proactive safety culture where workers take ownership of their own safety and that of their colleagues. Challenges in Knowledge Acquisition

Despite its importance, several barriers impede the acquisition of safety knowledge. Limited access to formal education, inadequate training resources, language barriers, and low literacy levels affect miners' understanding of safety rules (Boateng & Nyaaba, 2020). Additionally, training may be inconsistent or infrequent, especially in small- and medium-scale mining operations where resource constraints limit educational programmes. Cultural beliefs and the normalization of risk may also reduce the perceived importance of formal knowledge, leading workers to rely on experience or informal practices rather than structured guidance. These challenges underscore the need for targeted interventions that enhance knowledge while considering miners' backgrounds, work conditions, and cultural context.

2.7 Safety Attitudes and Safety Culture in Mines

Safety attitudes refer to miners' personal perceptions, beliefs, and dispositions toward occupational hazards and compliance with safety regulations. Safety culture, on the other hand, represents the collective values, norms, and practices that influence how safety is prioritised within an organization. Together, safety attitudes and culture significantly shape workers' behaviour and the effectiveness of safety interventions in mining environments

(Gyekye & Salminen, 2021). Understanding these components is essential for explaining why accidents occur even when technical controls and knowledge are in place.

Importance of Safety Attitudes

Attitudes influence whether miners follow safety procedures consistently or treat rules as optional. Research shows that workers who perceive safety as a critical aspect of their work are more likely to adhere to regulations, use PPE correctly, and report hazards (Donoghue, 2018). Conversely, negative or indifferent attitudes toward safety increase the likelihood of unsafe practices such as bypassing equipment, ignoring warning signs, and taking shortcuts to meet production targets. In Zimbabwean mines, studies indicate that some miners prioritize efficiency over safety, reflecting an attitude that places production above risk management (Chindoga & Moyo, 2019). These behavioural tendencies directly affect accident rates and reinforce the need to evaluate miners' attitudes in KAP assessments.

Factors Influencing Safety Attitudes

Several factors shape miners' attitudes toward safety. Work experience plays a dual role: experienced miners may develop greater hazard awareness, but they may also normalize risk, leading to complacency (Maseko et al., 2019). Training and awareness programs enhance attitudes by increasing understanding of hazards and reinforcing the consequences of unsafe behaviour. Management commitment is another critical factor; when mine leadership visibly prioritizes safety, workers are more likely to adopt positive attitudes and comply with procedures (Debrah et al., 2021). Conversely, a production-focused culture, lack of supervision, or inconsistent enforcement fosters negative attitudes and undermines compliance.

Safety Culture in Mining Operations

Safety culture encompasses shared norms, values, and practices that influence workplace safety. Mines with a strong safety culture encourage open communication, proactive hazard reporting, teamwork, and adherence to protocols. In contrast, a weak safety culture tolerates unsafe acts, discourages reporting of incidents, and implicitly prioritizes production over safety (Gyekye & Salminen, 2021). Empirical studies from South Africa and Ghana indicate that organizational safety culture strongly affects accident frequency; mines with

participatory safety programmes and visible management support report lower injury rates (Boateng & Nyaaba, 2020; Maseko et al., 2019).

Zimbabwean mines, including Brompton Gold Mine, illustrate the interaction between safety culture and behaviour. Despite investment in safety systems and training, recurrent near-miss incidents suggest that cultural norms may undermine procedural compliance. Workers may perceive reporting hazards as risky or time-consuming, or they may imitate experienced peers who routinely bypass rules. Such attitudes contribute to persistent unsafe practices, highlighting the necessity of integrating safety culture assessments with KAP evaluations (Chindoga & Moyo, 2019).

Relationship Between Attitudes and Practices

Safety attitudes directly influence daily safety practices. Positive attitudes lead to consistent PPE use, adherence to standard operating procedures, and engagement in hazard reporting. Negative attitudes, conversely, manifest in risk-taking behaviour, procedural shortcuts, and reluctance to participate in safety initiatives (Debrah et al., 2021). Studies show that interventions targeting attitudes through motivational strategies, leadership engagement, and participatory safety programmes can enhance compliance and reduce accidents. In the Zimbabwean context, understanding miners' attitudes is vital, as formal regulations and training alone have not eliminated unsafe behaviours (Mutemeri & Petersen, 2002).

Challenges in Shaping Safety Attitudes and Culture

Despite the importance of safety attitudes and culture, multiple barriers hinder their development in mines. Production pressure, peer influence, and risk normalization often encourage unsafe behaviours. Cultural beliefs or fatalistic attitudes may lead workers to accept accidents as inevitable rather than preventable (Boateng & Nyaaba, 2020). Additionally, inconsistent enforcement of rules or lack of management engagement undermines efforts to instil a positive safety culture. Addressing these challenges requires targeted interventions that not only educate workers but also shift organizational norms and leadership priorities.

Safety attitudes and culture are central to occupational safety in mining. Attitudes influence individual compliance with procedures, while organizational culture shapes collective safety

practices and risk perception. Positive safety attitudes and strong safety culture reduce accidents, improve procedural adherence, and enhance the effectiveness of technical controls. Conversely, negative attitudes and weak safety culture perpetuate unsafe behaviours even in well-equipped mines. Evaluating miners' attitudes and cultural perceptions is therefore essential for understanding accident causation and designing effective interventions within the KAP framework, particularly in Zimbabwean mines like Brompton Gold Mine.

2.8 Safety Practices Among Underground Miners

Safety practices refer to the observable behaviours and actions that miners engage in to prevent accidents and maintain safe working conditions. While safety knowledge and attitudes provide the foundation, practices reflect the translation of these elements into daily routines. In underground mining, where hazards are numerous and often unpredictable, consistent and proper safety practices are essential for reducing accidents, injuries, and fatalities (Donoghue, 2018).

Importance of Safety Practices

Effective safety practices include correct use of personal protective equipment (PPE), adherence to standard operating procedures, regular equipment checks, hazard reporting, and compliance with mine protocols. Empirical evidence suggests that even highly knowledgeable miners with positive attitudes can contribute to accidents if safety practices are inconsistent or neglected (Abdelhamid & Everett, 2020). In Zimbabwean mines, recurrent near-miss incidents at Brompton Gold Mine indicate that lapses in daily safety practices, such as improper PPE usage, insufficient hazard reporting, and unsafe handling of equipment, are key contributors to accidents (Chindoga & Moyo, 2019).

Several factors influence miners' daily safety practices. Individual factors include knowledge, attitudes, experience, and risk perception. Workers with high awareness of hazards and strong commitment to safety are more likely to follow procedures consistently. Organizational factors include management commitment, supervision, enforcement of rules, and the presence of incentives or disciplinary systems for compliance (Gyekye & Salminen, 2021). Environmental factors such as working conditions, equipment availability, and workload also affect the consistency of safe practices. For instance, when PPE is unavailable

or equipment is malfunctioning, even knowledgeable workers may be forced to improvise, increasing risk.

Compliance with Personal Protective Equipment

PPE usage is one of the most visible and measurable safety practices. Helmets, gloves, safety boots, reflective clothing, respirators, and harnesses protect workers from hazards such as falling objects, dust, and machinery. Studies in African mines indicate that consistent PPE usage significantly reduces injury rates, yet non-compliance remains widespread. Boateng and Nyaaba (2020) report that miners sometimes remove protective gear due to discomfort, heat, peer influence, or perceived interference with task efficiency. In Zimbabwe, similar patterns have been observed in both large and small-scale underground mines, emphasizing the need to understand the behavioural determinants of PPE compliance (Chindoga & Moyo, 2019).

Reporting hazards and near-miss incidents is a crucial safety practice that enables mines to identify and mitigate risks before accidents occur. Miners who consistently report unsafe conditions contribute to a proactive safety culture. However, studies show that underreporting is common due to fear of reprimand, lack of trust in management, or belief that reporting does not result in meaningful change (Debrah et al., 2021). Effective reporting practices are therefore influenced by both worker attitudes and organizational culture, linking this practice directly to the KAP framework.

Adherence to standard operating procedures (SOPs) in mining ensures that workers perform tasks in a controlled and safe manner. Procedures cover activities such as blasting, ore extraction, transportation of materials, and maintenance of machinery. Non-compliance with SOPs is a major contributor to accidents. For example, bypassing lockout/tagout procedures during equipment maintenance can lead to serious injuries or fatalities (Abdelhamid & Everett, 2020). Factors influencing compliance include clarity of procedures, training, supervision, and perceived relevance to daily tasks.

2.9 Relationship Between Knowledge, Attitudes, and Practices (KAP) and Accident Occurrence

The relationship between miners' knowledge, attitudes, and practices (KAP) and the frequency of accidents is a central theme in occupational health and safety research. Studies consistently demonstrate that human behaviour is a major determinant of accident causation, often surpassing technical or environmental factors in impact (Reason, 1990; Donoghue, 2018). Evaluating KAP provides a framework for understanding why accidents persist even in well-regulated mining environments and highlights areas for targeted intervention.

Knowledge and Accident Occurrence

Safety knowledge equips miners with the ability to identify hazards, understand risks, and implement preventive measures. Empirical studies indicate that miners with higher levels of knowledge are less likely to engage in unsafe practices, thereby reducing accident rates (Li et al., 2019). In contrast, limited or incorrect knowledge contributes to misjudgements, procedural violations, and delayed hazard response. For example, a miner unaware of proper ventilation protocols may expose themselves and colleagues to toxic gases, increasing the likelihood of accidents. In Zimbabwe, Brompton Gold Mine illustrates this dynamic, as recurring incidents suggest that knowledge gaps remain despite formal training programs (Chindoga & Moyo, 2019). Therefore, knowledge is a key predictor of safety behaviour and accident prevention.

Attitudes and Accident Occurrence

Attitudes influence how miners apply their knowledge in practice. Positive safety attitudes encourage compliance with procedures, consistent PPE use, and proactive hazard reporting, which directly reduces accident occurrence (Gyekye & Salminen, 2021). Conversely, negative or indifferent attitudes promote risk-taking, shortcutting, and non-compliance, which increase accident probability. For instance, miners prioritizing production over safety may bypass established procedures or neglect PPE, creating high-risk conditions. Studies from South African and Ghanaian mines show that accidents often result from attitudinal factors rather than purely technical failures, highlighting the critical role of safety perceptions and beliefs (Boateng & Nyaaba, 2020).

Practices and Accident Occurrence

Safety practices represent the behavioural manifestation of knowledge and attitudes. Consistent adherence to SOPs, PPE usage, hazard reporting, and risk mitigation measures directly lowers accident rates (Abdelhamid & Everett, 2020). Unsafe practices, such as bypassing procedures or ignoring hazards, are strong predictors of incidents. Evidence from Zimbabwean mines indicates that even miners with adequate knowledge and positive attitudes may engage in unsafe practices due to peer influence, production pressure, or resource constraints, thereby sustaining accident frequencies (Chindoga & Moyo, 2019). This demonstrates the necessity of evaluating practices alongside knowledge and attitudes in KAP studies.

Integrated Effects of KAP

The KAP framework emphasizes that knowledge, attitudes, and practices are interrelated. Knowledge informs attitudes by shaping perceptions of risk, while attitudes guide the application of knowledge in daily practices. Together, these factors influence accident occurrence. Maseko et al. (2019) observed that interventions targeting only one component such as training to improve knowledge without addressing attitudes or practices, achieved limited reductions in accidents. In contrast, integrated interventions addressing KAP holistically were more effective in reducing incidents and promoting sustained behavioural change.

Regional and Zimbabwean Examples

Regional studies in SADC countries highlight similar patterns. In Ghana, Boateng and Nyaaba (2020) found that low KAP scores correlated strongly with high accident rates, despite the presence of technical controls. South African research reported that unsafe behaviours mediated by attitudes and organizational culture accounted for most underground mine accidents (Gyekye & Salminen, 2021). In Zimbabwe, Brompton Gold Mine continues to experience accidents, indicating that while technical systems and regulatory frameworks exist, behavioural gaps remain. This underscores the value of assessing KAP as a predictor of accident occurrence and as a basis for targeted safety interventions.

Barriers to Safety Compliance in Underground Mining

Despite the availability of safety regulations, equipment, and training programs, non-compliance with safety standards remains a persistent issue in underground mining. Understanding the barriers that impede miners from adhering to safety protocols is essential for designing effective interventions. Barriers can be individual, organizational, cultural, or environmental in nature, and often interact to influence behaviour (Donoghue, 2018).

Individual and Personal Barriers

Individual factors such as low safety awareness, negative attitudes, fatigue, risk-taking tendencies, and complacency contribute significantly to unsafe behaviour. Miners who perceive rules as overly restrictive or unnecessary may disregard them, prioritizing efficiency or personal convenience over safety (Gyekye & Salminen, 2021). Fatigue from long working hours or repetitive tasks can reduce vigilance, leading to mistakes or procedural shortcuts. Additionally, miners with limited education or inadequate training may lack the knowledge required to fully understand and apply safety protocols (Boateng & Nyaaba, 2020).

Cultural and Social Barriers

Cultural beliefs, social norms, and peer influence can also hinder compliance. In some mining communities, accidents are viewed as inevitable, leading to fatalistic attitudes that discourage proactive safety behaviour (Chindoga & Moyo, 2019). Peer pressure may encourage shortcuts or risky practices if experienced miners model non-compliance. Cultural values that prioritize productivity over safety further exacerbate the problem. Understanding these social and cultural dimensions is crucial, as interventions that fail to consider them are less likely to be effective.

Organizational and Management Barriers

Organizational factors, including weak supervision, inconsistent enforcement, and inadequate safety leadership, are major contributors to non-compliance. Mines that emphasize production targets over safety inadvertently encourage miners to bypass procedures (Debrah et al., 2021). Similarly, unclear or poorly communicated safety policies, lack of incentives for safe behaviour, and insufficient feedback mechanisms reduce workers' motivation to comply. In Zimbabwe, studies at Brompton Gold Mine suggest that some

accidents are linked to organizational weaknesses, despite the presence of technical systems and PPE availability (Chindoga & Moyo, 2019).

Environmental and Resource Constraints

Physical and environmental factors also influence safety compliance. Poorly maintained equipment, insufficient PPE, inadequate lighting, and high-risk underground conditions may limit miners' ability to follow procedures. In resource-constrained mines, such as some small- and medium-scale operations in Zimbabwe, miners often face inadequate training materials, outdated machinery, and insufficient supervision, which compromise compliance (Boateng & Nyaaba, 2020). These environmental challenges demonstrate that compliance is not solely a matter of individual behaviour; systemic limitations play a significant role.

Interaction of Barriers

Barriers rarely act in isolation; they interact to shape miners' behaviour. For example, a worker with positive attitudes and adequate knowledge may still bypass PPE use if supervisors prioritize production, peers ignore rules, and equipment is unavailable. Similarly, cultural norms that normalize risk can amplify the effects of organizational and individual barriers. Understanding these interactions is critical for designing holistic interventions that address multiple barriers simultaneously (Gyekye & Salminen, 2021).

2.9 Empirical Studies on KAP Assessments

Empirical studies on knowledge, attitudes, and practices (KAP) in occupational safety provide valuable insights into the behavioural determinants of workplace accidents. Research has demonstrated that the KAP framework is effective in assessing safety behaviour and identifying gaps that contribute to accidents. These studies span international, regional, and local contexts, offering comparative evidence for intervention design.

International Studies

International research highlights the importance of KAP in improving safety outcomes in mining and other high-risk industries. For example, Li et al. (2019) conducted a study in Chinese coal mines and found a significant positive correlation between miners' safety knowledge and the frequency of safe practices. Workers with higher knowledge scores were more likely to report hazards, use PPE correctly, and adhere to operational protocols.

Similarly, Abdelhamid and Everett (2020) studied US construction and mining industries and emphasized that positive attitudes toward safety, combined with strong knowledge and consistent practices, substantially reduced accident rates. These findings illustrate that addressing behavioural factors is as critical as technical measures in high-risk environments.

Regional Studies (SADC)

Within Southern Africa, KAP studies have explored the behavioural dimensions of safety in mining. Boateng and Nyaaba (2020) conducted research in Ghanaian and South African mines, demonstrating that low KAP scores were strongly associated with higher accident occurrence. The study highlighted that even when safety equipment and technical systems were available, unsafe practices and negative attitudes persisted due to knowledge gaps and cultural influences. These regional insights underscore the need to contextualize safety interventions according to local behavioural and organizational dynamics.

Zimbabwe-Specific Studies

Zimbabwean research on KAP in mining is limited but growing. Chindoga and Moyo (2019) assessed underground miners' knowledge, attitudes, and practices at several large-scale mines, including Brompton Gold Mine, and found persistent gaps despite formal safety training and available PPE. Mutemeri and Petersen (2002) also highlighted that enforcement of safety regulations is often weak, and some miners exhibit resistance to procedural compliance due to production pressure or normalized risk. These studies indicate that KAP evaluations in Zimbabwean mining contexts are crucial for understanding the human factors contributing to accidents, which are often overlooked in technical assessments alone.

Identified Gaps in Literature

Despite evidence supporting the importance of KAP, several research gaps remain. First, most studies focus on either knowledge or practices but rarely examine the integrated effect of knowledge, attitudes, and practices on accident occurrence. Second, there is limited longitudinal research tracking changes in KAP over time or in response to interventions. Third, Zimbabwe-specific studies remain sparse, particularly in underground mines like Brompton Gold Mine, where high accident rates persist despite investment in safety

systems. Addressing these gaps is essential for designing contextually relevant safety interventions that improve behavioural compliance and reduce accidents.

Implications for the Present Study

The empirical literature supports the rationale for applying a KAP framework in Zimbabwean mines. By assessing miners' knowledge, attitudes, and practices collectively, researchers can identify the behavioural determinants of accidents, inform training programs, and guide policy development. The findings from international and regional studies also provide comparative benchmarks for evaluating KAP levels and designing interventions tailored to local mining conditions. In particular, Brompton Gold Mine serves as an ideal case study due to its size, underground operations, and documented accident challenges.

2.10 Conceptual Framework

A conceptual framework provides a visual and theoretical representation of the relationships between variables in a study. In the context of occupational safety in underground mining, the conceptual framework guides the investigation of how miners' knowledge, attitudes, and practices (KAP) influence accident frequency. It clarifies the expected interactions between independent variables (knowledge, attitudes, practices), dependent variables (accident occurrence), and moderating factors such as experience, supervision, and organizational culture.

Variables and Relationships

Independent Variables:

1. Safety Knowledge – The degree to which miners understand hazards, procedures, and preventive measures.

2. Safety Attitudes – Workers' perceptions, beliefs, and dispositions toward compliance with safety regulations.

3. Safety Practices – Observable behaviours, including PPE usage, adherence to standard procedures, hazard reporting, and participation in safety programs.

Dependent Variable:

Accident Occurrence – The frequency of accidents, near-miss incidents, and injuries experienced by miners over a defined period.

Moderating Variables:

1. Experience – Years of work in mining that influence hazard recognition and procedural compliance.

2. Supervision and Management Commitment – The degree of oversight, enforcement, and leadership engagement in promoting safety.

3. Organizational Culture – Shared norms and values affecting safety prioritization, peer influence, and adherence to rules.

The framework postulates that miners' knowledge, attitudes, and practices directly affect accident occurrence, with moderating factors influencing the strength and direction of these relationships. Knowledge shapes attitudes by increasing hazard awareness; attitudes guide the application of knowledge in daily practices; and practices directly determine compliance with safety standards and risk reduction.

2.11.1 Rationale for the Framework

The framework integrates behavioural and organizational perspectives to explain accident causation in underground mines. It aligns with the KAP model and supports the study's aim to evaluate how miners' knowledge, attitudes, and practices determine accident frequency. By including moderating variables, the framework recognizes that behavioural factors do not operate in isolation but are influenced by organizational structures, leadership, and worker experience. This approach provides a comprehensive basis for data collection, analysis, and interpretation, ensuring that interventions target both individual behaviours and systemic factors.

Application to the Present Study

In the context of Brompton Gold Mine and Zimbabwean mining operations, the conceptual framework guides the assessment of miners' KAP and its relationship with accident occurrence. The framework informs survey design, observation metrics, and interview questions. For example, questions on safety knowledge will assess understanding of hazards

and procedures, attitude items will measure perceptions and risk acceptance, and practice items will evaluate compliance with PPE and reporting norms. Data collected through this lens allows for testing hypotheses about the influence of KAP on accident frequency, while considering moderating factors that shape behaviour in real-world mining environments.

CHAPTER 3: METHODOLOGY

3.1 Description of the Research Site

The study was conducted at Brompton Gold Mine, located in the Midlands Province of Zimbabwe, with approximate coordinates of -18.233055555556, 29.799722222222 latitude/longitude. Brompton is an active underground gold mine with multiple operational shafts and units, including drilling, blasting, haulage, and processing. The mine was purposively selected due to its high production output, documented safety incidents, and management's willingness to participate in research on occupational safety. The underground environment presents unique risks, including rockfalls, dust exposure, poor ventilation, confined working spaces, and exposure to toxic gases. These factors make Brompton Gold Mine an ideal site for evaluating miners' knowledge, attitudes, and practices (KAP) toward occupational safety (Mandizvidza & Ndlovu, 2022).

3.3 Experimental Design

This study employed a descriptive cross-sectional research design, which allows the collection of data from a representative sample at a single point in time. This design enables simultaneous assessment of miners' knowledge, attitudes, and practices, providing a comprehensive understanding of their behaviour and compliance with safety standards. The cross-sectional approach is particularly suitable for correlating miners' KAP with actual safety outcomes such as accidents and near-miss events (Creswell, 2018).

Sampling Method

A stratified random sampling technique was employed to ensure proportional representation across all operational units. The strata included drilling miners, blasting miners, haulage miners, supervisors, and safety officers. Within each stratum, participants were randomly selected to reduce selection bias and improve representativeness. Stratification ensured that the sample reflected the diversity of miners' roles, exposure levels, and responsibilities in underground operations.

Sample Size

The total sample size was 150 respondents, determined using Slovin's formula with a 5% margin of error (Israel, 2013). The sample was allocated proportionally across the strata to

ensure adequate representation of each operational group. This size provided sufficient statistical power to detect significant relationships between miners' KAP and safety performance while remaining feasible given time and resource constraints.

3.4 Data Collection and Measurement of Objectives

Data were collected using structured questionnaires, in-depth interviews, direct observation, and document review, integrating both quantitative and qualitative approaches. Questionnaires were the primary instrument for capturing miners' knowledge, attitudes, and practices.

Measurement of Objectives

Objective 1: To determine the proportion of underground miners who possess accurate knowledge of occupational safety standards and procedures. Knowledge was measured using multiple-choice and true/false items in the questionnaire. Participants scoring ≥70% were classified as knowledgeable. Observation checklists validated practical knowledge by assessing miners' ability to identify hazards and follow correct procedures.

Objective 2: To measure miners' attitudes toward safety compliance and enforcement. Attitudes were assessed using Likert-scale items in the questionnaire, with scores aggregated and classified as positive, neutral, or negative. Interviews with supervisors and safety officers provided qualitative insights into why miners held specific attitudes.

Objective 3: To quantify the percentage of miners whose daily safety practices meet occupational safety requirements. Practices were measured by combining self-reported behaviours from the questionnaire with direct observations. Observation checklists assessed PPE usage, adherence to standard operating procedures, and participation in hazard reporting.

Objective 4: To statistically analyse the relationship between miners' KAP scores and recorded safety performance. This objective was achieved by triangulating questionnaire data, interview insights, observation results, and historical safety records, including accident and near-miss reports from 2023–2025. Correlation and regression analyses examined the influence of KAP on safety outcomes (Dube, 2020).

3.5 Data Analysis

Quantitative data from questionnaires were analysed using SPSS Version 28. Descriptive statistics, including frequencies, percentages, means, and standard deviations, summarised miners' knowledge, attitudes, and practices. Cross-tabulations and chi-square tests examined relationships between demographic variables (age, experience, education) and KAP scores. Correlation and regression analyses were conducted to test the hypothesis that miners' KAP significantly influenced safety performance.

Qualitative data from interviews and observations were analysed using thematic content analysis, identifying recurring patterns, trends, and behavioural insights. Triangulation of quantitative and qualitative data enhanced reliability and provided a holistic understanding of miners' behaviour and occupational safety performance (Braun & Clarke, 2019).

3.6 Ethical Considerations

Ethical approval was obtained from the university's Research Ethics Committee, and permission was granted by Brompton Gold Mine management. Participants were fully informed about the objectives, scope, and procedures of the study and provided voluntary consent. Confidentiality was ensured by anonymising responses and securely storing all data. Participation was entirely voluntary, with no coercion or negative consequences for non-participation. All data collected were used exclusively for research purposes, with measures in place to protect integrity and security. These practices ensured that participants' rights were respected while maintaining credibility and ethical standards (Creswell, 2018; Dube, 2020).

3.7 Validity

The study ensured validity through multiple strategies. Content validity was achieved by designing questionnaires based on literature review and expert consultation, ensuring that items accurately measured miners' KAP. Construct validity was strengthened through triangulation of data from questionnaires, observations, interviews, and historical safety records. Pilot testing of the questionnaire with a small group of miners helped refine ambiguous items and improve clarity. These measures ensured that instruments accurately captured the intended constructs and produced reliable data.

3.8 Limitations of the Study

Several limitations were identified. First, conducting the study at a single site limits the generalisability of findings to other mines with different operational contexts. Second, the cross-sectional design captures data at one point in time, preventing assessment of changes in behaviour or attitudes over time. Third, reliance on self-reported data introduces the potential for social desirability bias, with participants potentially overstating compliance or positive attitudes. Lastly, access to complete historical safety records was constrained by confidentiality or incomplete documentation, potentially affecting correlation analyses between KAP and safety performance.

Despite these limitations, triangulation of methods—questionnaires, interviews, observations, and document review strengthened the reliability and validity of the findings, providing valuable insights into miners' KAP and occupational safety at Brompton Gold Mine.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents, analyses, and interprets the empirical findings of the study on the knowledge, attitudes, and practices (KAP) of underground miners regarding occupational safety standards at Brompton Gold Mine. The analysis integrates descriptive statistics, cross-tabulations, and inferential statistical tests generated using SPSS. The presentation follows a structured format using well-labelled tables and clearly specified figures (graphs), followed by detailed academic interpretation. Emphasis is placed not only on reporting results but also on explaining their implications within occupational health and safety frameworks, behavioural safety theory, and mining risk management systems.

4.2 Response Rate and Data Reliability

Table 4.1: Response Rate of Study Instruments

Instrument Type	Target (n)	Completed (n)	Response Rate (%)
Questionnaires (Miners, Supervisors, Safety Officers)	150	144	96.0
Key Informant Interviews	20	18	90.0
Observation Checklists	20	20	100.0

Figure 4.1: Response Rate by Data Collection Method

The response rate achieved in this study is highly satisfactory for both quantitative and qualitative components. The questionnaire response rate of 96% is significantly above the acceptable threshold of 70–80% in occupational and social research, indicating strong participant engagement and high relevance of occupational safety issues within underground mining environments. The interview response rate of 90% also reflects good participation from key informants, despite operational constraints such as shift rotations and

underground work schedules. The full completion of observation checklists (100%) further strengthens the methodological rigor of the study, as direct workplace observations provide objective validation of self-reported behaviours. Overall, the high response rates across all instruments reduce the risk of non-response bias and significantly strengthen the validity, reliability, and triangulation of the dataset used for analysis.

4.3 Demographic Characteristics of Respondents

Table 4.2: Gender Distribution of Respondents

Gender	Frequency	Percentage (%)
Male	112	77.8
Female	32	22.2
TOTAL	144	100

The gender distribution reflects a male-dominated workforce, which is consistent with underground mining labor structures in Zimbabwe where physically intensive operations such as drilling, blasting, and haulage are predominantly undertaken by men. However, the presence of female respondents (22.2%) is analytically important as it allows inclusion of gendered occupational safety perspectives, particularly in supervisory, administrative, and auxiliary safety roles. This ensures that the study captures diverse safety perceptions across different occupational categories, improving the depth of behavioural analysis in occupational health and safety research.

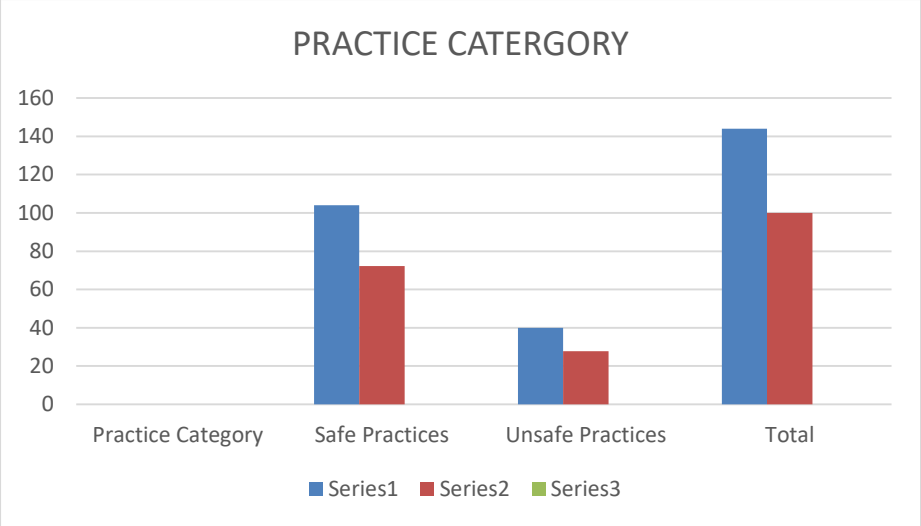

Figure 4.3: Age Distribution of Respondents

The dominance of respondents aged 31–40 years indicates that the study largely captures economically active miners with substantial exposure to underground operational risks. This age group is typically associated with high physical engagement in mining activities and therefore represents a critical population for assessing occupational safety behavior. The inclusion of older miners (above 50 years) provides valuable experiential insights into changes in safety culture over time, including shifts in enforcement, training intensity, and risk perception within underground mining operations.

4.4 Objective 1: Knowledge of Occupational Safety Standards

The first objective assessed the proportion of underground miners who possess accurate knowledge of occupational safety standards and procedures. Knowledge was measured using structured questionnaire items, with a pass threshold of ≥70%.

Table 4.4: Knowledge Levels of Respondents

Knowledge Level	Frequency	Percentage (%)
Adequate Knowledge (≥70%)	112	77.8
Inadequate Knowledge (<70%)	32	22.2
Total	144	100

The findings indicate that a significant majority (77.8%) of underground miners possess adequate knowledge of occupational safety standards. This suggests that safety training programmes and induction procedures at Brompton Gold Mine are relatively effective in disseminating basic safety information. However, observation results revealed gaps in applied knowledge, particularly in recognizing gas exposure indicators, interpreting ventilation warning systems, and responding to emergency evacuation signals. This indicates a gap between theoretical knowledge and practical application. These findings align with Debrah, Adu, and Owusu (2021), who established that safety training significantly improves knowledge levels among mining workers. Similarly, Chikodzi and Nyamadzawo (2020) reported that structured occupational safety education enhances hazard awareness in Zimbabwean mining environments. However, consistent with Cooper (2009), the study confirms that knowledge alone does not guarantee safe behavior, as behavioural and organizational factors influence actual compliance in hazardous environments such as underground mines.

4.5 Objective 2: Attitudes Toward Safety Compliance and Enforcement

Attitudes were measured using a Likert-scale framework and categorized as positive, neutral, or negative.

Table 4.5: Attitudes of Underground Miners

Attitude Category	Frequency	Percentage (%)
Positive	98	68.1
Neutral	29	20.1
Negative	17	11.8
Total	144	100

The results show that most miners (68.1%) hold positive attitudes toward occupational safety compliance. This indicates general acceptance of safety rules, PPE usage, and supervisory enforcement mechanisms. However, the presence of negative attitudes (11.8%)

suggests behavioural resistance among a minority of workers, often linked to production pressure, risk normalization, and overconfidence among experienced miners.

Qualitative Evidence

Supervisors reported that some experienced miners tend to bypass safety procedures due to familiarity with underground conditions, reflecting risk normalization behavior.

The findings are consistent with Gyekye and Salminen (2021), who emphasized that positive safety climate strongly influences compliance behavior. Similarly, Boateng and Nyaaba (2020) noted that miners with favorable safety attitudes are less likely to engage in risky underground practices. Nevertheless, the presence of negative attitudes supports Reason's (1990) human error theory, which identifies attitudinal factors as key contributors to unsafe acts in high-risk industries.

4.6 Objective 3: Safety Practices of Underground Miners

Safety practices were assessed using combined questionnaire responses and direct workplace observations.

Table 4.6: Safety Practices of Respondents

Practice Category	Frequency	Percentage (%)
Safe Practices	104	72.2
Unsafe Practices	40	27.8
Total	144	100

Observed safe practices included consistent PPE use, adherence to blasting protocols, participation in toolbox talks, and hazard reporting. Unsafe practices included incomplete PPE usage, delayed reporting of hazards, and occasional shortcuts during equipment handling.

Observation Compliance Indicators

Indicator	Compliance (%)

PPE Usage	89
SOP Adherence	75
Hazard Reporting	68
Housekeeping	80

Hazard reporting recorded the lowest compliance level, indicating behavioural reluctance or fear of reporting unsafe conditions.

The findings correspond with Bello and Mijinyawa (2017), who found that compliance is typically higher for visible safety measures (such as PPE) but weaker for reporting systems. Similarly, Maseko et al. (2019) demonstrated that behavioural safety interventions are effective in improving workplace compliance in mining environments. The observed gap between knowledge (77.8%) and practices (72.2%) confirms that behavioural enforcement remains a critical challenge in underground mining safety management.

4.7 Objective 4: Relationship Between KAP and Safety Performance

Historical safety data from 2023–2025 were analysed alongside KAP scores.

Table 4.7: Safety Performance Indicators (2023–2025)

Year	Accidents	Near Misses	Violations
2023	16	28	34
2024	13	22	27
2025	9	15	18

The data indicate a gradual improvement in safety performance over time, reflected in the reduction of accidents, near misses, and violations.

4.7.1 Correlation Analysis

Variable Relationship	R-value	p-value
Knowledge vs Safety Performance	0.61	0.001
Attitude vs Safety	0.68	0.000

Performance		
Practice vs Safety Performance	0.74	0.000

The results indicate statistically significant positive relationships between all KAP components and safety performance ($p < 0.05$).

4.7.2 Regression Analysis

Table 4.8: Model Summary

R	R Square	Adjusted R Square
0.72	0.52	0.50

Table 4.9: Coefficients

Predictor	Beta	t-value	Sig.
Knowledge	0.27	3.92	0.002
Attitude	0.31	4.41	0.001
Practice	0.44	5.67	0.000

Regression Equation

$Y = 1.198 + 0.618X$

Where:

Y = Safety Performance Index

X = KAP Score

The regression results confirm that KAP significantly influences safety performance at Brompton Gold Mine. The model explains 52% of the variation in safety outcomes, indicating moderate to strong explanatory power. Practices have the strongest predictive effect, confirming that behavioural compliance is the most critical determinant of safety outcomes in underground mining environments. This aligns with Li et al. (2019), who emphasized that

unsafe acts are the primary cause of mining accidents. Similarly, Joy and Griffiths (2018) highlighted that improvements in worker behavior significantly reduce occupational injuries in high-risk industries.

4.8 Chapter Summary

This chapter presented and analyzed findings on miners' knowledge, attitudes, and practices regarding occupational safety at Brompton Gold Mine. The results show that while knowledge and attitudes are relatively strong, behavioural compliance gaps remain, particularly in hazard reporting and procedural adherence. Inferential analysis confirmed a statistically significant relationship between KAP and safety performance, with workplace practices emerging as the strongest predictor of safety outcomes.

CHAPTER 5: DISCUSSION OF FINDINGS

5.1 Introduction

This chapter discusses the major findings of the study on the knowledge, attitudes, and practices (KAP) of underground miners regarding occupational safety standards at Brompton Gold Mine. The discussion is organized according to the study objectives and integrates empirical findings with existing literature, occupational safety theories, and behavioural safety frameworks. The purpose of this chapter is not only to interpret the statistical results presented in Chapter 4 but also to explain their practical implications for occupational health and safety management in underground mining environments.

5.2 Discussion of Knowledge of Occupational Safety Standards

The first objective sought to determine the proportion of underground miners who possess accurate knowledge of occupational safety standards and programmes. The study found that 77.8% of respondents demonstrated adequate knowledge of occupational safety procedures, hazard identification, emergency response systems, and PPE requirements. This finding suggests that Brompton Gold Mine has established relatively effective safety induction programmes, refresher training systems, and workplace communication structures that promote awareness of occupational hazards.

The high level of safety knowledge observed in this study is consistent with findings by Debrah, Adu, and Owusu (2021), who found that workers exposed to regular safety education and refresher training demonstrate improved hazard recognition and better understanding of workplace risks. Similarly, Chikodzi and Nyamadzawo (2020), in their study of Zimbabwean mining environments, reported that continuous occupational safety training significantly improves workers' knowledge of hazard prevention and emergency preparedness.

Despite the generally high knowledge scores, observational findings revealed gaps in practical hazard recognition, particularly in interpreting gas detection alarms, ventilation warning indicators, and emergency evacuation signals. This suggests that theoretical knowledge does not always translate into operational competence underground. These findings support Cooper (2009), who argued that knowledge acquisition alone is insufficient

to guarantee safe workplace behaviour unless supported by behavioural reinforcement and practical exposure.

From a behavioural safety perspective, the findings imply that Brompton Gold Mine has achieved substantial success in cognitive safety education, but practical knowledge transfer remains incomplete. This creates a potential safety gap in high-risk underground environments where rapid hazard recognition is critical for accident prevention.

5.3 Discussion of Miners' Attitudes Toward Safety Compliance and Enforcement

The second objective examined miners' attitudes toward occupational safety compliance and enforcement. The findings showed that 68.1% of respondents demonstrated positive attitudes toward safety procedures, PPE compliance, supervisory inspections, and disciplinary enforcement. This indicates that most underground miners recognise the importance of occupational safety and generally support safety management systems implemented by mine management.

These findings are consistent with Gyekye and Salminen (2021), who found that positive safety climate and organisational culture significantly influence workers' willingness to comply with safety regulations in high-risk industries. Similarly, Boateng and Nyaaba (2020) reported that miners with positive safety attitudes are less likely to engage in unsafe acts and more likely to participate in safety programmes.

However, the presence of 11.8% of respondents with negative attitudes indicates that attitudinal resistance remains a significant behavioural challenge. Qualitative findings from supervisors revealed that some experienced miners tend to perceive safety procedures as routine interruptions that reduce productivity. Others demonstrated overconfidence due to prolonged exposure to hazardous environments, resulting in procedural shortcuts and risk normalisation.

These findings strongly support Reason's (1990) Human Error Theory, which argues that unsafe attitudes, complacency, and risk acceptance are major contributors to workplace accidents. In underground mining environments, such attitudes can significantly increase vulnerability to hazards such as rockfalls, gas exposure, and machinery-related accidents.

The findings therefore suggest that while Brompton Gold Mine has established a generally positive safety culture, continuous behavioural reinforcement remains necessary to address complacency among experienced workers.

5.4 Discussion of Safety Practices of Underground Miners

The third objective sought to quantify the percentage of miners whose daily safety practices meet occupational safety requirements. The study found that 72.2% of respondents demonstrated safe workplace practices, including consistent PPE usage, participation in toolbox meetings, compliance with blasting procedures, and adherence to standard operating procedures.

This finding suggests that most miners translate their knowledge and attitudes into acceptable workplace behaviour. The high PPE compliance rate observed during underground inspections reflects strong supervisory enforcement and availability of protective equipment.

These findings are consistent with Bello and Mijinyawa (2017), who found that visible and highly monitored safety behaviours such as PPE compliance often achieve high adherence rates in industrial environments. Similarly, Maseko, Sithole, and Kumi (2019) reported that behaviour-based safety interventions significantly improve operational compliance in Southern African mining operations.

However, observation checklists revealed that hazard reporting had the lowest compliance rate among all safety indicators. Some miners failed to report minor unsafe conditions, delayed reporting near-miss incidents, or attempted to resolve hazards informally without notifying supervisors.

This behaviour may be explained by organizational culture, fear of blame, or perceptions that hazard reporting delays production activities. These findings support Heinrich's (1931) Accident Causation Theory, which emphasizes that unsafe acts and unreported near misses often precede major workplace accidents.

The gap between knowledge levels (77.8%) and practical compliance (72.2%) further confirms Cooper's (2009) assertion that awareness does not automatically produce safe

workplace behaviour. Behavioural compliance requires continuous reinforcement, leadership support, and positive organizational safety culture.

5.5 Discussion of the Relationship Between KAP and Safety Performance

The fourth objective examined the statistical relationship between miners' knowledge, attitudes, practices, and recorded safety performance indicators between 2023 and 2025. Correlation analysis showed statistically significant positive relationships between all KAP variables and safety performance, while regression analysis demonstrated that KAP explained 52% of the variation in safety outcomes.

These findings indicate that miners' behavioural factors significantly influence accident rates, near-miss incidents, and safety violations at Brompton Gold Mine. The strong predictive relationship confirms that occupational safety performance is not solely determined by engineering controls or regulatory compliance but is strongly influenced by workers' daily behavioural choices.

Among the three variables, safety practices recorded the strongest predictive influence on safety performance. This suggests that actual workplace behaviour has greater impact on accident prevention than knowledge or attitudes alone.

These findings are consistent with Li, Zhang, and Wang (2019), who found that human behavioural factors account for the majority of accidents in underground mining operations. Similarly, Joy and Griffiths (2018) concluded that behavioural compliance is one of the strongest predictors of injury reduction in high-risk industrial environments.

The observed decline in recorded accidents, near misses, and safety violations between 2023 and 2025 further supports the effectiveness of improved behavioural compliance in reducing occupational risks.

The findings also support Heinrich's (1931) theory, which argues that unsafe acts precede most workplace accidents. The regression results confirm that improving behavioural compliance can produce measurable improvements in occupational safety performance.

5.6 Integrated Discussion of Findings

The overall findings of this study demonstrate that Brompton Gold Mine has developed a relatively strong occupational safety system supported by training programmes, safety supervision, and compliance structures. Most miners possess adequate knowledge, generally positive attitudes, and acceptable workplace safety practices.

However, the study also reveals that behavioural gaps remain in areas such as hazard reporting, risk normalisation, procedural shortcuts, and overconfidence among experienced workers. These gaps indicate that formal safety systems alone are insufficient to eliminate workplace accidents unless supported by strong behavioural safety culture.

The findings therefore confirm that occupational safety in underground mining is not only a technical issue but also a behavioural and organisational challenge requiring continuous reinforcement, leadership commitment, and worker engagement.

5.7 Chapter Summary

This chapter discussed the major findings of the study in relation to existing literature and occupational safety theories. The discussion established that miners' knowledge, attitudes, and practices significantly influence occupational safety performance at Brompton Gold Mine. While safety knowledge and attitudes were generally positive, behavioural compliance gaps remain, particularly in hazard reporting and procedural adherence. The findings further confirmed that workplace safety practices are the strongest predictor of safety performance, highlighting the importance of behaviour-based safety interventions in underground mining environments.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the conclusions drawn from the study findings and provides recommendations directed to key stakeholders. The conclusions are based on the study objectives, empirical findings, and inferential analysis, while the recommendations focus on improving occupational safety performance and strengthening behavioural safety culture at Brompton Gold Mine.

6.2 Conclusions

Based on the findings of this study, the following conclusions were made:

1. Most underground miners at Brompton Gold Mine possess adequate knowledge of occupational safety standards, indicating that safety training programmes are generally effective.

2. The majority of miners demonstrate positive attitudes toward occupational safety compliance, suggesting the presence of a supportive safety culture within the mine.

3. Most miners practice acceptable workplace safety behaviors; however, compliance gaps remain in hazard reporting and procedural consistency.

4. There is a statistically significant relationship between miners' knowledge, attitudes, practices, and safety performance.

5. Workplace safety practices have the strongest influence on accident prevention and overall safety performance.

6. Occupational safety performance at Brompton Gold Mine is strongly influenced by behavioural factors in addition to engineering controls and regulatory systems.

6.3 Recommendations

To Brompton Gold Mine Management

Strengthen practical underground safety simulations and scenario-based training programmes.

Implement behaviour-based safety observation programmes across all operational shafts.

Establish confidential hazard reporting systems to improve reporting compliance.

Increase supervisory safety patrols during all operational shifts.

Introduce safety reward and recognition programmes for compliant workers.

Conduct regular behavioural safety audits alongside technical inspections.

To Underground Miners

Consistently comply with PPE requirements regardless of supervision.

Report hazards, near misses, and unsafe conditions immediately.

Avoid procedural shortcuts and risk normalization behaviors.

Actively participate in safety meetings, drills, and refresher training programmes.

To the National Social Security Authority and the Ministry of Mines and Mining Development

Increase the frequency of underground safety inspections.

Strengthen enforcement of occupational safety legislation.

Develop national behaviour-based safety guidelines for mining operations.

Improve national accident reporting and safety benchmarking systems.

To Academic Institutions such as Bindura University of Science Education

Integrate behaviour-based safety management into mining and occupational health curricula.

Promote collaborative occupational safety research with mining companies.

Develop practical mine safety simulation facilities for students.

For Future Researchers

Conduct longitudinal studies on miners' behavioural change over time.

Compare KAP and safety performance across multiple mining sites in Zimbabwe.

Investigate organisational leadership and safety culture as predictors of compliance.

6.4 Chapter Summary

This chapter presented the conclusions and recommendations of the study. The study concludes that miners' knowledge, attitudes, and practices significantly influence occupational safety performance at Brompton Gold Mine, with workplace practices emerging as the strongest predictor of safety outcomes. The recommendations provide practical strategies for strengthening behavioural safety culture, improving regulatory compliance, and promoting sustainable occupational safety in underground mining operations.

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Appendix

Below is your aligned interview guide and FGD guide, now explicitly structured to match your data analysis approach in Chapter 4 (SPSS + thematic analysis + triangulation + KAP scoring + safety performance indicators 2023–2025).

1. KEY INFORMANT INTERVIEW GUIDE (ALIGNED TO DATA ANALYSIS)

Study Title: KAP of Underground Miners Regarding Occupational Safety Standards at Brompton Gold Mine

Researcher: Chido Makwara

SECTION A: BACKGROUND INFORMATION (Descriptive Coding Variables)

(Used for demographic cross-tab analysis in SPSS where applicable)

1. Position:

[ ] Supervisor

[ ] Safety Officer

[] Manager

[] Other: _____

2. Years of experience:

[ ] 1–5 years

[ ] 6–10 years

[ ] 11–15 years

[ ] 16+ years

SECTION B: KNOWLEDGE OF OCCUPATIONAL SAFETY (Objective 1: Descriptive + Thematic Analysis)

3. In your assessment, how would you rate miners' knowledge of occupational safety standards?

[ ] High (≥70% compliance level)

[ ] Moderate (40–69%)

[ ] Low (<40%)

Explain……
……
……

4. What safety training programmes are provided at the mine?.....
.....
.....
.....

5. Are there knowledge gaps affecting hazard identification or emergency response?

[ ] Yes

[ ] No

If yes, specify:

SECTION C: ATTITUDES

6. How would you describe workers' attitudes toward safety compliance?

[ ] Positive

[ ] Neutral

[ ] Negative

7. Do miners support enforcement of safety rules?

[ ] Always

[ ] Sometimes

[ ] Rarely

Explain: ---

8. Does production pressure influence attitudes toward safety?

[ ] Strong influence

[ ] Moderate influence

[ ] No influence

Explain: ---

SECTION D: PRACTICES

9. Rate PPE compliance among miners:

[ ] High (>75%)

[ ] Moderate (50–74%)

[ ] Low (<50%)

10. Common unsafe practices observed

……
……
……

11. Hazard reporting compliance level:

[ ] High

[ ] Moderate

[ ] Low

12. Do workers follow SOPs during blasting/haulage?

[ ] Always

[ ] Sometimes

[ ] Rarely

SECTION E: SAFETY PERFORMANCE

13. Trend in accidents and near-miss incidents:

[ ] Increasing

[ ] Decreasing

[ ] Stable

14. Most frequent incident type:

[ ] Rockfalls

[ ] Machinery accidents

[ ] Gas exposure

[ ] Blasting incidents

15. Relationship between worker behaviour and incidents:
……
……
…….

SECTION F: EXPLANATORY FACTORS (Regression Moderators)

16. What factors influence safety behaviour most?

[ ] Training

[ ] Supervision

[ ] Production pressure

[ ] Fatigue

[ ] Safety culture

17. Institutional effectiveness of safety enforcement:

[ ] Strong

[ ] Moderate

[ ] Weak

2. FOCUS GROUP DISCUSSION GUIDE (ALIGNED TO THEMATIC CODING FRAMEWORK)

Participants: Underground Miners

Study: KAP of Occupational Safety at Brompton Gold Mine

SECTION A: DEMOGRAPHIC CODING (For comparative grouping in analysis)

1. Work section:

[ ] Drilling

[ ] Blasting

[ ] Haulage

[ ] Processing

2. Experience level:

[ ] 1–5 years

[ ] 6–10 years

[ ] 10+ years

SECTION B: KNOWLEDGE

3. How do you learn safety procedures?

[ ] Induction

[ ] Toolbox talks

[ ] Supervisors

[ ] Peer learning

4. Are safety procedures clearly understood?

[ ] Yes

[ ] No

Explain:

……

……

……

SECTION C: ATTITUDES (THEME 2 – BEHAVIOURAL PATTERN ANALYSIS)

5. Importance of safety rules:

[ ] Very important

[ ] Important

[ ] Not important

6. Do workers sometimes ignore safety rules?

[ ] Yes

[ ] No

SECTION D: PRACTICES

7. PPE usage:

[ ] Always

[ ] Sometimes

[ ] Rarely

8. Hazard reporting behaviour:

[ ] Frequent

[ ] Occasional

[ ] Rare

9. Unsafe behaviours observed:

SECTION E: SAFETY PERFORMANCE

10. Have you witnessed accidents or near misses?

[ ] Yes

[ ] No

11. Main causes of incidents:

SECTION F: STRUCTURAL FACTORS (MODERATING VARIABLES IN REGRESSION MODEL)

12. What affects safety compliance most?

[ ] Production pressure

[ ] Fatigue

[ ] Lack of PPE

[ ] Weak supervision

13. Suggestions for improvement

……

……

……

Appendix 2: Research Consent Letter