ENHANCING MINE WORKERS LEARNING FROM ONLINE SITE SAFETY INDUCTION PROGRAMS: PRINCIPLES FOR DEVELOPERS


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ABSTRACT

Mining is one of the world’s most dangerous jobs accounting for an estimated 12,000 deaths each year. In Australia 7 deaths were recorded in 2009-10 by the Australian mining industry. This is eleven less than the 18 recorded by the industry in 2008-2009. The Australian mining industry recorded the fourth highest fatality rate of 3.9 fatalities per 100,000 employees in 2010-11. According to State/Territory Occupational Health and Safety Legislation, safety training for mine workers is compulsory and they cannot carry out any task at a mine site unless they have completed induction training. In Queensland, the regulation provides a general outline of the information to be covered in training, though does not specify duration or mode of delivery.

Online training programs in the mining industry are becoming more popular with the most common uses being induction and regulatory training as the internet provides a highly cost-effective way to deliver information pertaining to regulatory requirements. Compliance to the regulatory requirements is a key driver for developers of online training however the quality of instruction for online training programs varies greatly among organisations. Many companies focus on the technological aspects of their online learning programs and not the adult learning theories which underpin effective design and are most suited to the mine employees who are adults. Without effective instructional design, courses delivered online may negatively impact learners’ understanding and performance.

This thesis focuses on mine workers’ perspectives of an online site safety induction program. The research approach used an interpretivist theoretical framework with both quantitative and qualitative methods used to collect and analyse data. Quantitative data regarding participants’ perspectives of how satisfied and effective they found the online site safety induction program were collected using a survey. Semi-structured interviews were used to collect qualitative information to not only elaborate and clarify the survey data but also to provide the necessary depth and detail of participants’ perspectives, thoughts and beliefs regarding the online induction program.

In this study, 83 useable surveys from 7 mine sites located in the Bowen region of Queensland were collected, and 19 in-depth individual interviews were conducted with mine workers who had completed a specific online site safety induction program. The data was analyzed to discover participants’ perceptions of the online site safety induction program. Analysis of the information indicates that overall, mine workers
thought the online safety program was easy and efficient but not very effective in regards to learning safety. More experienced workers viewed it as a ‘tick and flick’ exercise, focusing on information they perceived as important, whilst skipping content they regarded as irrelevant or a repetition of what they had already learned. Hence, if the content is not arranged in a holistic and themed manner, site induction training performance criteria can be repetitive.

The findings of the study produced a set of guiding principles and practical recommendations for the design of online site safety induction programs in the mining industry. The outcomes of this research provides valuable information regarding what factors contribute to the effectiveness of the online safety induction program, and highlights barriers which impede workers’ learning. This allows companies to determine whether the online induction training they are providing their employees is equipping them with the competency, including knowledge, skills and attitudes, to not only work more safely, but also to keep up with the pace of change in today’s highly competitive marketplace.
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LIST OF ABBREVIATIONS AND KEY TERMS

Abbreviations:

ANTA - Australian National Training Authority
CBET - Competency Based Education and Training
CBT – Competency Based Training
CLT – Cognitive Load Theory
DEST - The Department of Education Science and Training
ISD - Instructional Systems Design
MD – Managing Director
NTB - National Training Board
ODL – Open and Distance Learning
OH&S or OHS – Occupational Health & Safety also known as Work Health & Safety (WHS) and Workplace Health & Safety (WH&S).
PPE – Personal Protective Equipment
RCC - Recognition of Current Competence
RPL - Recognition of Prior Learning
RTO – Registered Training Organisation
SCT – Social Cognitive Theory
SMS – Safety Management System
SOPs – Standard Operating Procedures
TAFE – Tertiary and Further Education

Key Terms

Competencies - the knowledge, skills and attitudes necessary to perform at the required standard in the workplace.

Generic Induction - A nationally recognised program which is designed to introduce mine workers to the Acts and Regulations, safety processes and accepted practices that are employed in underground and surface coal mining sites in Queensland. It is a mandatory requirement for entry into many Queensland mine sites.

Online learning – can be used interchangeably with web-based training and e-learning and refers to a learning environment where instructional content is delivered electronically via the internet, intranets or multimedia platforms such as CD-ROM or DVD.
STATEMENT OF ORIGINAL AUTHORSHIP

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: _____________________________

Date: _____________________________
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1. INTRODUCTION

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Mine workers are exposed to a range of hazards and inadequate or insufficient training has often been cited as the cause for many fatalities (Filigenzi, Orr, & Ruff, 2000). The resources directed towards training within the mining industry are significant however compliance with legislation is a key driver rather than learning outcomes. Safety induction training is crucial in equipping employees with the knowledge and skills to identify and safely manage potential hazards in the workplace. It is therefore essential that mining organisations align training to the skills employees need in an ever changing and increasingly technological work environment. The introduction of online learning as an instructional medium provides mining companies with the opportunity to not only cater to the learning styles and expectations of the young adult generation but also to tailor training to individual needs to maximise learning (Mining Industry Skills Centre, 2007). This study seeks to examine the perspectives of mine workers who have completed an online site safety induction program to discover how satisfied and effective they found learning via a computer-based system, with the end aim of developing design principles that could be adopted when developing online site safety programs for the mining industry.

The following sections of this introductory chapter briefly outlines the background to the study and its rationale, the research purpose and questions guiding this inquiry, as well as the research setting and design. Next, the chapter highlights the significance of the study. Finally, it concludes with an outline of the remaining chapters of the thesis.
1.1 An Overview of the Research Context and Rationale for the Study

This section introduces the context of the study. A full description of the context is found in Chapter Two. Mining is an important industry in the Australian economy due to its sizeable economic contribution, even though the number of people directly employed in the industry is small compared to most other industries (1.8 per cent of the total workforce). Mining has experienced the strongest job growth of all industries in recent years underpinned by the demand for commodities from Australia’s trading partners. Mining employment increased by 127,700 representing an average annual growth rate of 10.2% over the past 10 years. This has resulted in an influx of new workers in all age groups, particularly in the coal and iron ore sectors (SkillsInfo, 2011). In Queensland, (the setting of this study), the mining industry has traditionally preferred to recruit workers with mining experience, however this pool of talent is diminishing and the industry “can no longer rely solely on purchasing skills to match its future workforce requirements” (Kinetic Group, 2012, p. 23). This will mean that new and relatively inexperienced workers will make up a growing proportion of the mining workforce. According to Smith and Mustard (2007) the first few months of a new job is a time of high risk for work-related injury. Even older, more experienced workers have a similar risk of being injured during their first months of employment as do younger, and often less experienced workers. Providing health and safety training helps introduce new workers to the potential hazards and safety procedures in their new workplace, thus reducing their risk of injury. In the Australian mining industry, safety induction training is mandatory. However as the literature reveals, not all workers understand and/or can effectively apply their knowledge in the workplace (Laurence, 2005; Wilkins, 2011).

High risk industries such as agriculture, construction and mining are characterized by many different but constantly changing hazards, and require workers who possess a range of critical skills and are able to adapt to the changing situations (Mitropoulos & Cupido, 2009). Further, increased intensive competition, industrial change and globalisation have compelled companies to search for new ways to increase their competitive advantage (Wang, 2011) and improve safety. Most companies are reliant on individuals who can work safely and identify potential hazards to avoid injury and even death. The cost to a company of down time due to injuries is significant, not only
in monetary terms, but also in reputation (Mitchell, 2001). It is therefore in the interests of companies, if they wish to grow efficiently in today's global economy, to ensure that employees’ skills and knowledge are current and that what they learn is applied in the workplace.

Prior to commencing work on a mine site in Australia, an employee new to the site, a contractor or a visitor is required to participate in a site safety induction. The aim of safety inductions is to communicate to workers the knowledge and skills to effectively gain the competencies required to identify risks, and then manage those risks to avoid accidents and incidents. A site safety induction provides workers with the skills to identify the unique hazards of the mine site and to be aware of the dangers associated with a constantly changing environment prior to entering the work area. Site safety training processes should be tailored to the individual’s position/role and incorporate relevant elements of the site’s safety and health management system, which comprises principal hazard management plans, standard operating procedures (SOPs) and site standards/procedures. The regulation does not dictate the methods used to conduct training and assessment but encourages the development and delivery of flexible training which suits individual and industry requirements (Department of Employment Economic Development and Innovation, 2010).

The Department of Employment, Economic Development and Innovation (2010) encapsulated the key objectives relating to training in coal mines, and includes the following:

- Personnel have the appropriate knowledge and skills to perform their tasks efficiently and safely;
- Appropriate inductions are conducted for employees, contractors and visitors at appropriate levels and intervals;
- Refresher training is conducted at appropriate intervals;
- Verification of competencies via assessment and record keeping;
- Regular review (at least 12 monthly) of training plans to make certain current needs are adequately covered;
- Incorporating requirements from site Standards and the site’s safety and health management system (for example, Principal Hazard Management Plans, Standard Operating Procedures, Mine Operating Procedures) into training regimes;
- Recognition of current competencies (RCC) and recognition of prior learning (RPL) when establishing competence of individuals; and
- Seeking opportunities to continually improve site training systems by regularly auditing and reviewing effectiveness (Department of Employment Economic Development and Innovation, 2010, p. 1).
Most safety induction training in the mining industry is competency based. Competencies focus on key knowledge and skills and the process involved in a job, and are always expressed as an outcome, describing what a person can do. Competency is achieved by attaining the appropriate training, and transferring that knowledge through genuine job performance in the workplace to the standard expected of the role, and the company (Benson, 2004).

Methods of health and safety training range from passive, knowledge-based techniques such as a trainer lecturing to inductees to moderately engaging such as computer-based training through to highly interactive and learner-centred activities such as simulations and performance-based techniques (Burke et al., 2006). A benchmarking e-learning survey of 800 employers conducted by the Australian Flexible Learning Framework (2010) revealed the most common use of online learning was in training related to industry or workplace specific knowledge and skills, including Occupational Health and Safety (OH&S) and induction training. Although instructor-led training is the primary mode of training delivery in the mining industry (Mining Industry Skills Centre, 2007), the huge costs associated with training a geographically disperse, and often remote, workforce has resulted in mining companies adopting online learning to mitigate these problems (Latimer, 2012).

As the move towards online learning in the mining industry grows, it becomes important to examine the effectiveness of safety training programs including how learners perceive their experience and what processes are used for the development of instructional materials for online delivery. To create an effective online learning environment requires appropriate design of the content materials as well as an understanding of learners’ needs. This study aims to examine mine workers’ experiences of an online site safety induction program. In conducting such an investigation, the study enables the consideration of the factors which contribute to, or limit, the effectiveness of online learning programs.

### 1.2 Research Purpose and Questions

The purpose of this study was to examine with a sample of mine workers the learning and instructional design effectiveness of an online site safety induction program in the Australian mining industry, with the aim of developing design principles to help guide
the development of online site safety programs. Specifically, the study examines the perspectives of mine workers who have completed an online site safety induction program to discover:

RQ1 - What are the perspectives of mine workers on the effectiveness of online site safety inductions in the Australian mining industry?

RQ2 - What instructional design strategies assist adult learners in the mining industry to engage with online OH&S induction training?

These two major research questions were broken down into subsidiary questions that helped serve as a framework for the collection, analysis, and interpretation of data pertinent to the phenomenon under investigation. The key research questions, with related sub-questions are presented in Table 1.1.

<table>
<thead>
<tr>
<th>Major Research Questions</th>
<th>Subsidiary Questions</th>
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<tr>
<td>1. What are the perspectives of mine workers on the effectiveness of online site safety inductions in the Australian mining industry?</td>
<td>i) What are the perceived levels of satisfaction towards online learning among mine workers and managers?</td>
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<td>ii) What factors do learners perceive may hinder their learning via computer-based systems?</td>
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<td></td>
<td>iii) What are the perceived levels of effectiveness of knowledge acquired online training programs among mine workers and managers?</td>
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<tr>
<td>2. What instructional design strategies assist adult learners in the mining industry to engage with online OH&amp;S induction training?</td>
<td>iv) What instructional design strategies used in the online induction program do learners feel aided their learning?</td>
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</table>

The aim of safety induction training in the mining industry is to ensure workers understand and can effectively apply the necessary knowledge and skills to identify risks, and then manage those risks to avoid accidents and incidents. The outcomes of this study include, but are not limited to, the following:

1. An evaluation of the efficiency and effectiveness of an existing online site safety induction program from the perspective of the participants.

2. A determination of what factors contributed to the effectiveness of the online site safety induction program and their importance in the design and/or delivery of training.
3. Identification of barriers to learning via the online site safety induction program and recommend changes or improvements to its design and/or delivery.

4. A set of guiding principles that will inform future policy and practices in the area of study, namely online learning for mine workers in one specific context.

5. A framework of factors which will contribute to the effectiveness of the design and evaluation of online safety programs in the mining industry.

1.3 An Overview of the Research Setting and Design

This study follows an interpretivist theoretical framework as the goal of the investigation was to ascertain the perspectives of mine workers on the effectiveness of an online site safety induction program. A case study approach was employed as the objective was to examine a contemporary phenomenon, in depth, in its real-life context that reflected the perspectives of the participants involved.

1.3.1 Research Setting

The context for this study was miners who worked in the open-cut coal mines in Central Queensland’s Bowen Basin region and who had completed an online site safety induction program. Figure 1.1 shows the location and extent of the mining operations in this region of Queensland. Queensland has a rich resource of high-quality coal, with more than 34 billion tonnes having been identified by drilling operations.
The Bowen Basin, which contains virtually all of the state’s hard coking coal, is the most important source of export coal in Queensland (Department of Natural Resources and Mines, 2012).

The research setting was a Training Company based in Mackay, which provides online training for various mining organisations in Central and Northern Queensland. The miners who participated in this study worked at one or more of seven mine sites which had consented to assist in the study. Mine workers must complete a site induction before they can work at a new mine site (a site they have not worked at before), regardless of previous work experience. Mining companies scheduled site safety training for their employees with the Training Company which provided the training facilities, including; computers, online training program, administrative services, and
certification on completion. Each worker was seated at a booth with a computer and head-phones. The office had 16 computers and usually operated in three shifts (7.30am, 11.00am and 2.00pm), although this was flexible. According to the Managing Director of the Training Company, on average, most workers completed the online induction program within 3 to 4 hours. Some workers were expected to complete multiple inductions, such as 4 or 5 sites on the same day as their job roles required them to visit a number of mine sites. The content of the program is owned by the respective mining companies and any changes or amendments to the material must be approved by them. Before an individual can complete the online site safety induction program they must have completed a Generic Induction (see glossary) and passed a Coal Board medical.

1.3.2 Research Design

This study examined mine workers’ experiences of learning in their natural environment, the mine site. Within the interpretive perspective, the research strategy chosen was the empirical case study approach (Yin, 2009), using a combination of quantitative and qualitative methods to provide insights into the research problem. The case study approach is particularly appropriate for this study because the contextual conditions (mine workers employed at open-cut coal mines in the Bowen Basin region of Queensland) are pertinent to the phenomenon under investigation (mine workers experiences of an online site safety induction program). In addition, the multiple methods offered by the case study approach are invaluable in a study of this nature, which seeks both breadth and depth in explaining and understanding a complex phenomenon involving multiple perspectives, variables and levels of analysis. This study employs an explanatory (Yin, 2009) approach in which the data collected is examined to identify trends and patterns.

In brief, data collection and analyses in this study were carried out in two phases. In the first quantitative phase, 83 useable surveys were completed by mine workers and managers regarding their perspectives towards an online site safety induction program. The target population was all mine workers who had completed the same online site safety induction program within the last twelve months. The purpose of distributing the survey first, was to identify phenomenon that required more in-depth and complex exploration during the interviews (DePoy & Gitlin, 1998). As there were no suitable instruments relating to adult workers learning about safety in the mining industry via a
web-based system, a survey was developed for this study. The numeric data emerging from the survey were analysed using appropriate descriptive statistical techniques and a chi-square test to identify interesting associations with participants’ perspectives of the online program.

This was followed by a qualitative phase, in which 19 in-depth interviews were carried out with a selected sample of mine workers to expand on the general themes identified in the survey data analysis. Textual data collected from the interviews were analysed using an inductive process developed by Miles and Huberman (1994) to obtain rich insights into workers’ perspectives of the online site safety program they had completed. The combination of quantitative and qualitative research methods, referred to as triangulation, allows for different research methods to be utilised in this study as a check on reliability and validity (Flick, 2007; Maxwell, 2005). However, Patton (2002) argues that triangulation does not necessarily produce a uniform picture as different kinds of data may yield somewhat different types of inquiry are sensitive to different real-world nuances. Thus, understanding inconsistencies in findings across different kinds of data can be illuminative and important. Finding such inconsistencies ought not be viewed as weakening the credibility of results, but rather as offering opportunities for deeper insight into the relationship between inquiry approach and the phenomenon under study (Patton, 2002, p. 556).

Thus identifying and understanding why inconsistencies arise in a study is important as it may provide further insight into the complexities of the phenomenon under investigation. The results and findings from the quantitative and qualitative phases were integrated at the data interpretation stage to provide a more complete picture of miners’ perspectives of the online induction program.

**1.4 Significance of the Study**

There is a need to gain a better understanding of what constitutes effective online safety training in the mining industry. According to Burke, Holman and Birdi (2006), not only do the learning theories which underlie safety training initiatives differ, but also potentially relevant learning theories are not necessarily incorporated into the design of safety training programs. Further, they argue that “no unified discussion of the implications of learning theory and research for safety and health training research and practice has been presented in a disciplinary literature” (p. 1). This gap in the literature is particularly significant given the amount of essential knowledge and skills required to
operate safely in dangerous and changing work environments, such as the mining industry. Moreover, the vast majority of training research has been conducted with well-educated, white collar workers (Anger et al., 2006), and the bulk of research examining the effectiveness of online learning programs occurs in education environments with primary to tertiary age students (Derouin, Fritzsche, & Salas, 2005).

This study is significant in that it investigates mainly blue collar workers’ perspectives of the efficiency and effectiveness of an online safety training program. Further, the workforce in the mining industry is characterised by low levels of literacy and individuals who are used to being passive learners in a classroom setting (Newton, Hase, & Ellis, 2002). Workers’ perceptions were particularly important in identifying issues or barriers which impacted on understanding and subsequent application of knowledge to the workplace. By identifying areas which needed improvement or modification, the mining companies will be able to create the optimum learning environment for their employees. Implications and recommendations emerging from the findings of this study include the importance of understanding and applying relevant learning theories and design principles when developing online training programs. Further this study identified the need to tailor training to workers’ prior knowledge and experience and that legislative compliance should not necessarily be the main focus of training but rather successful learning outcomes. The findings of the study have also given a clear indication as to what aspects of the online site induction training program workers valued and why. It has offered a set of guiding principles and practical recommendations to help in the development and delivery of future online site safety programs to ensure workers are equipped with the knowledge, to not only to identify safety issues and thus work more safely, but also to keep up with the pace of change in today’s highly competitive marketplace.

1.5 Thesis Outline

The study contains eight chapters in total. The following chapters are summarised briefly in this section.

Chapter Two: This chapter provides an overview of the mining industry including the importance of Occupational Health and Safety (OH&S) regulations and the impact of safety climate and culture. It reviews the safety training approaches adopted in high
risk industries and the consequences when safety initiatives fail. This chapter also examines the evaluation processes used for measuring training effectiveness and the place of safety inductions in the mining industry. Literature in the field of online learning, particularly in the mining industry, is presented and discussed. Research and knowledge gaps in the relevant areas of study are identified and an argument is presented for the significance of this study.

Chapter Three: This chapter reviews the literature relevant to the issues involved in how adults learn in different contexts. It reviews the early learning theories, such as behaviourism, cognitivism and constructivism and their influence on current learning practices. The chapter also explores the contribution of adult learning theories, particularly humanist and transformational learning theories, and how they impact on adult learning. It discusses workplace learning theories, and the need to understand and utilise training approaches effectively. Finally, this chapter examines how learning theories have influenced instructional design theories and models.

Chapter Four: This chapter provides information on the research strategy and design of the study, and contains a detailed explanation of the methods of data collection, the instrumentation and data analysis techniques. The validity and reliability of the study are also discussed.

Chapter Five: This chapter reports on the findings of the quantitative phase of the study. It provides a description of mine workers' perceptions of an online site safety induction program under the following themes: demographic information; perceived satisfaction with the online induction program; perceived barriers to learning via the online induction program; perceived effectiveness of the online induction program to facilitate learning; perceived effectiveness of the instructional design strategies used in the online induction program.

Chapter Six: This chapter contains the findings of the qualitative phase of the study. It augments the descriptive findings in the preceding quantitative phase and provides in-depth and rich explanations of mine workers perspectives of an online site safety induction program.

Chapter Seven: This chapter provides an integrated analysis of both the qualitative and quantitative research results. It situates the findings in the context of literature
regarding theories of learning and instructional design, and discusses implications for practice.

Chapter Eight: This chapter summarises the purpose and importance of the research and the main research outcomes in terms of their overall significance in relation to the research questions. This chapter suggests recommendations for practice and provides a site of guiding principles that will inform future policies and practices in the area of study. Further, this chapter outlines the contribution to knowledge, limitations of the study and suggests areas for further research.
2. **Context: The Mining Industry**

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2.1 **The Mining Industry**

The Australian Mining Industry incorporates the exploration and mining of minerals (including coal) and the associated minerals processing industry (Minerals Council of Australia, 2006-2007). Overall, mining has contributed over $500 billion directly to Australia’s wealth during the past 20 years and accounts for approximately 8% of Australia’s gross domestic product (Australian Bureau of Statistics (ABS), 2008). In 2010-11 reported export earnings from energy and mineral commodities reached $185 billion and was forecast to rise 8% in 2011-12 to $199 billion (Bureau of Resources and Energy Economics (BREE), March 2012). Australia is one of the world’s largest exporters of black coal, iron ore, lead and zinc, and one of the leading producers of bauxite, alumina, gold, uranium and silver. Nationally the industry employs over three hundred and twenty thousand people, either directly or indirectly with many mining sites situated in remote and sparsely populated areas of regional Australia (Australian Bureau of Statistics (ABS), 2008).

As miners work in confined, physically demanding and dangerous environments which are constantly changing (Gyekye, 2006), the mining industry is typically regarded as hazardous (Galvin, 2006; Gunningham, 2006b; Somerville & Abrahamsson, 2003). Although the rate of reported injuries in Australia and other industrialised countries has decreased significantly over the past fifteen years (Joy, 2004; Ninness, 2005), mining fatalities are still occurring regularly (MacNeill, 2008). In America 71 miners were killed in 2010 (Mine Safety & Health Administration, 2010) despite the existence of
new technology and stronger regulations (Tien, 2008). According to Tien (2008) an increased demand for mineral products and a shortage of skilled workers and mining professionals had impacted on safe work practices in the field (Tien, 2008). In developing countries such as South Africa and China the number of fatalities is extremely high. The official reported number of mining deaths in China stands at 6,000 personnel per year, however unofficially it is believed the toll could be as high as 12,000 to 15,000 per year (Ninness, 2005). South African mining data indicates the industry suffered 220 fatalities in 2007, twenty more than in 2006 (Minerals Council of Australia, 2006-2007).

In Australia 7 deaths were recorded in 2009-10 by the Australian mining industry. This is eleven less than the 18 recorded by the industry in 2008-2009 (Figure 2.1). On average 12 deaths have occurred per year during the past decade (Minerals Council of Australia, 2010). The mining industry recorded the fourth highest fatality rate of 3.9 fatalities per 100,000 employees in 2010-11. The most common causes of fatality in the mining industry were vehicle accidents, falling from height and being hit by falling objects (Safe Work Australia, 2012).

![Fatality and Lost Time Injury Frequency Rates](image)

*Figure 2.1 Fatalities and lost time injury frequency rates in the Australian mining industry (Minerals Council of Australia, 2010)*

The mining industry employs more workers aged 25 to 54 years than the all industries average, with over half the workers falling within the 25 to 44 year age group; in 2010 the median age of workers was 40 years. Further, 40% of mine workers have a non-school qualification such as a certificate III or IV, reflecting the importance of trades’ occupations to the industry, and almost one third (30%) have no formal qualifications.
Interestingly, the industry has the second lowest share of female employment at 13.2% of the workforce compared to the average of 45.6% for all industries (SkillsInfo, 2011). Today’s mining industry is dynamic and constantly changing, and miners work in highly sophisticated and complex environments. As a result managers, miners, contractors and other mining personnel are expected to possess a range of critical skills, and understand and safely apply many complex operating and safety procedures (Kowalski-Trakofler et al., 2004; Mine Safety Technology and Training Commission, 2006). Safety in mining is of paramount concern, not only to the mine workers themselves, but also to the mining companies. They not only face fines and prosecution for serious accidents and deaths but also public perception as the community is less tolerant of risk in high hazard industries (Mitchell, 2001; Verra, Tate, & Dryden, 2006). Mining companies are aware of the business case for excellent Occupational Health and Safety (OH&S) performance as mining injuries not only disrupt production but can also entail high workers’ compensation costs and threaten the company’s licence to operate (Gunningham, 2006a). Verra and colleagues (2006) claim, fatality and lost time injuries statistics do not tell the whole story as they do not reveal all those who have suffered injuries and permanent disabilities as a result of mining accidents. Further they cannot describe the anguish and suffering when a loved one dies in a workplace accident nor the impact on colleagues and the community. It is important to remember

Fatalities, particularly multiple fatalities, have had a major impact upon public perception of the mining industry. Mines have been forced to close. Parliamentary action has provoked significant changes to mining practices and applicable occupational health and safety legislation…The recent world-wide coverage of the Beaconsfield incident highlights the degree of public scrutiny, and accountability, the community can demand when a disaster occurs (Verra, Tate & Dryden, 2006, p. 2).

### 2.2 Occupational Health and Safety Regulations

For many years, the states of Australia have maintained separate regulatory practices to oversee the health and wellbeing of workers in the mining industry. In some states, such as Queensland, there are specialist OH&S statutes covering the mining industry (Gunningham, 2005). Historically each Australian state adopted most of the provisions of the 19th century British health and safety legislation. This traditional model relied upon a very prescriptive approach which tells the employer precisely what measures to take to eliminate or minimise safety risks in the workplace and requires little interpretation on their part (Breslin, 2004; Gunningham, 2005). The advantage of this
approach was that employers knew exactly what to do. However, there were many limitations including:

- minimum standards were prescribed, with little involvement in OHS by workers and unions,
- the legislation was complex, inflexible and difficult to keep up to date,
- many hazards were not covered by any legislation,
- there was too much legislation,
- the legislation varied from state to state (Breslin, 2004, p. 565).

By the late 1960s the weaknesses in this traditional model created an environment in which there was a mass of detailed law covering many different industries and occupations with no effective means of enforcement. This allowed for a paradigm shift in which the 1972 British Robens Report advocating a performance-based approach was adopted (Breslin, 2004; Gunningham, 2005). In contrast to the prescriptive method which required employers to comply with specific rules, the performance-based approach established responsibilities in broad terms. The employer was to provide a safe workplace for their employees, so far as practicable, and address new hazards as they emerge. This self-regulating system involved workers and management working together to achieve, and improve upon, the OH&S standards prescribed by the State. Thus the current legislation stipulates the desired outcome but does not inform the employer how it can be achieved (Breslin, 2004).

Beginning with South Australia in 1972 each State has enacted new OH&S statutes containing broad general duties with more detailed standards in regulations and codes of practice. Provisions in regulations were mandatory, whereas codes contained general guidance material. Most regulations required the employer to identify hazards and assess and control identified risks. Increasingly, OH&S regulations require employers to document measures they have taken to comply with standards (National Research Centre of OH&S Regulation, 2008). If companies do not comply, the Australian OH&S statutes give mining inspectors the power to investigate and issue improvement and prohibition notices, and ultimately to prosecute employers found to be in breach of the legislation. All of the OH&S statutes stated that the principal penalty for OH&S offences was a fine. The maximum fine varied from state to state with the highest being in New South Wales and Victoria. With regards to prosecution, most were conducted against corporate employers rather than their office holders, even though there was provision in the statutes to prosecute managers and directors of corporations (National
Worker participation in the identification, assessment and control of workplace hazards was important to reduce injury and disease in the workplace. Workers have the most direct interest in OH&S outcomes as they suffer the consequences when things go wrong. Moreover, workers generally know more about the hazards and risks associated with their environment than anyone else as they have to live with them on a daily basis (Gunningham, 2006a). All of the Australian OH&S statutes make provision for worker representation in OH&S matters, however their effectiveness in reducing accident and injury rates and eliminating deaths was largely dependent upon the powers they had in this role (Gunningham, 2005). In some states, the powers were quite broad and included the ability to issue a provisional improvement notice and the right to order that unsafe work cease. In the Queensland Coal Mining Safety and Health Act 1999, site safety and health representatives have the right to inspect documents relating to an OH&S management system and to examine whether the procedures in the system were actually in place at the mine site. If they did not exist or they were inadequate the representative must inform the Site Manager; if the manager does not take sufficient action the representative must inform an inspector. Representatives have the right to stop mining operations where there was an immediate threat to the health and safety of workers (Gunningham, 2006a). Prior to January 1 2012, Queensland also required employers to engage OH&S experts. Companies appointed a workplace health and safety officer when there were 30 or more workers employed at a workplace (National Research Centre of OH&S Regulation, 2008). According to Gunningham (2006a) effective worker participation was essential if OH&S performance was going to improve.

In summary, the most notable deficiency of the Australian OH&S legislation was the lack of uniformity. Workers in different states or territories who faced similar risks were offered different levels of legal protection. Further, companies operating in more than one jurisdiction were faced with inconsistent standards and enforcement approaches which made compliance complex and expensive (Johnstone, 2008; National Research Centre of OH&S Regulation, 2008). In the report by coroner Rod Chandler (2009) into the death of Larry Knight after the Beaconsfield incident, he stated that that Tasmania’s legislation at the time was “incapable of providing the mining industry with
a proper occupational, health and safety framework within which to operate” (p. 87) and that it was in need of immediate review and reform. Chandler (2009) recommended a separate body of regulations be adopted which specifically addresses the OH&S requirements of the mining industry.

According to Workplace Health and Safety Queensland (2011) the National OH&S review has been completed and the harmonisation of OH&S laws in Australia was reached in 2011, and nationally, uniform laws should replace existing work health and safety legislation in all states, territories and the Commonwealth from 1 January 2012 (Workplace Health & Safety Queensland, 2011). However, Victoria, Tasmania, Western Australia and South Australia have delayed implementation of harmonised OH&S laws, hence standardisation has not been achieved across Australia as yet (Donaldson, 2012). Further, for Queensland the laws The Act does not apply to include:

• metalliferous mining (Mining and Quarrying Safety and Health Act 1999) and,
• coal mining (Coal Mining Safety and Health Act 1999) (Workplace Health & Safety Queensland, 2011).

2.3 Safety Culture and Climate

In Queensland, (the location of the mining sites for this research), the mining industry is subject to a separate OH&S regulatory system which includes the Mining and Quarrying Safety and Health Act 1999 (MQSHA) and the Coal Mining Safety and Health Act 1999 (CMSHA 1999), together with their accompanying regulations: These are the Mining and Quarrying Safety and Health Regulation 2001 (MQSHR 2001) and the Coal Mining Safety and Health Regulation 2001 (CMSHR 2001). The mining legislation is administered by the mines inspectorate which is part of the Department of Natural Resources, Mines and Water (NRMW). In these statutes the focus has been on a risk management approach including OH&S management systems. This involved a process whereby hazards were assessed and ranked from low risk to high risk, and controls implemented to eliminate or minimize the hazard. A possible deficiency in this approach was that risks which were considered low ranking may not be resolved immediately (Gunningham, 2006a). The legislation also required mining companies to institute OH&S management systems and hazard management plans in specified situations which maintain and review the assessment and control of risks identified in
the workplace.

Its [the legislation’s] focus is on the organisational structure, responsibilities, practices, procedures, processes and resources for implementing and maintaining safety management (Gunningham, 2006a, p. 239).

OH&S management systems are important tools but they alone cannot improve safety outcomes. It is not only the established safety culture of the company and particularly of the mine site which has a big impact on safety performance (Harvey, Bolam, Gregory, & Erdos, 2001) but also the safety climate, which has an important influence in the promotion of worker commitment and involvement in safety (Clarke, 2006). The mining industry is considered to have a risk taking culture due to its dangerous nature and the high incidence of accidents and injuries (Gunningham, 2006a; Paul & Maiti, 2007; Somerville & Abrahamsson, 2003; Stephan, 2001; Trethewy, Gardner, Cross, & Marosszeky, 2001; Valais, 2007). A poor safety culture was often a contributing factor when a major catastrophe occurred (Wilson-Donnelly, Priest, Salas, & Burke, 2005).

Before we can define safety culture and climate it is necessary to establish the difference between organisational culture and climate: Guldenmund (2000) discovered that the distinction between the two concepts was quite vague. He indentified that climate originally proceeded culture and that the term culture replaced that of climate in the 1980s. According to Guldenmund (2000) organisational climate once referred to a global, integrating concept underlying most organisational events and processes: now it was viewed as a way of expressing organisational culture (Guldenmund, 2000). Although there were many definitions available for the concepts of culture and climate, there was general agreement as to how to define them (Wilson-Donnelly, et al., 2005). Climate was based on employees’ perceptions of the practices, procedures and rewards in the company (Griffin & Neal, 2000). Denison (1996) encapsulated this definition of climate as;

\[ \text{a situation and its link to thoughts, feelings and behaviours of organizational members. Thus, it is temporal, subjective, and often subject to direct manipulation by people with power and influence (Denison, 1996, p. 644).} \]

Whereas culture was a learned set of values (what is important) and beliefs (how things work) which may in an organisation take the form of practices interpreted through rules and norms of behaviour (the way we do things around here) (Harvey, et al., 2001; Uttal, 1983). Further, Denison (1996) stated that culture was “rooted in history, collectively held, and sufficiently complex to resist many attempts at direct manipulation” (p. 644).
Safety culture was considered a vital component of organisational culture. It was how the organisation expressed its values, attitudes and beliefs regarding safety, and was evident in the company’s safety management practices (Harvey, et al., 2001). Conversely, safety climate had been defined as perceptions of the role of safety within a company and whether or not safety was promoted and emphasized (Prussia, Brown, & Willis, 2003): It was concerned with intangible issues, and was unstable and subject to change (Wilson-Donnelly, et al., 2005). Wilson-Donnelly and colleagues (2005) argued that safety climate was derived from safety culture, and consists of the perceptions of company workers regarding safety, whereas safety culture was made up of practices and attitudes. Both safety climate and culture impact on the level of safety performance of a company and what behaviours will be observed in the workplace (Wilson-Donnelly, et al., 2005).

Consequently, it was likely that workers in a company which had a positive safety culture would feel responsible for safety and pursue it on a daily basis. Safety was a priority and could not be devalued due to competing demands. Unsafe practices and behaviours were identified and measures taken to minimize or eliminate them by appropriate employees (Stephan, 2001). A positive safety climate improves employee attitudes, which leads to a motivation to perform safe behaviours. Further, management commitment to safety was linked to the success of safety initiatives. For example fewer injuries and accidents have been recorded in companies where workers’ perception of management commitment and leadership with safety issues has been high (O’Toole, 2002; Trethewy, et al., 2001; Wilson-Donnelly, et al., 2005; Zohar, 1980). Another aspect of management commitment to safety which had a significant impact on safety climate was the perceived status of safety representatives. If employees were actively involved in safety practices and their knowledge and judgement valued, a greater level of trust and better communication was achieved between workers and management (Zohar, 1980). Other factors which influenced employee perceptions and their subsequent behaviours included; how open and frequent communication was between management and workers (Paul & Maiti, 2007); the level of housekeeping, (Harvey, et al., 2001; Zohar, 1980); adequacy of procedures including investigations of accidents and injuries (Wilson-Donnelly, et al., 2005); the effectiveness of OH&S policies and management systems (Trethewy, et al., 2001); the amount of positive reinforcement for safe work practices and performance (Stephan, 2001; Zohar, 1980) and finally how well
safety training was emphasised and whether it was considered an integral part of new employee’s training and necessary to refresh or update current workers and supervisors (Harvey, et al., 2001; Zohar, 1980).

In the mining industry, the culture has been described as male dominated, close-knit, competitive and risk taking (Billett & Somerville, 2004; Somerville, 2005). Until the mindset that mining was inherently dangerous and a certain number of injuries or deaths were inevitable, improved engineering or legislative solutions would fail in creating better safety standards and performance in the mining industry (Jennings, 2001; Williams & Purdy, 2005). In organisations which had high risk taking cultures and where safety was not paramount, organisational misconduct or worse, major disasters could occur (Hopkins, 1999), even if adequate safety management systems were in place (Valais, 2007). As Reason (1998) stated, “a poor safety culture will encourage an atmosphere of non-compliance to safe operating practices” (p. 297). When the unspoken perception by workers was that production and commercial goals were more important than those relating to safety, violations were more likely to occur (Reason, 1998).

2.4 The Implications of a Poor Safety Culture

In March 2005 an explosion killed 15 people and injured another 170 at the BP refinery Texas City, USA. According to Valais (2007), the report by the US Chemical Safety and Hazard Investigation Board (CSB) also known as the Baker report, was scathing of BP’s safety culture. Even though top management espoused the goals of zero harm, there was little operational guidance for the workforce and management at the plant from corporate management. So with little guidance, safety was subject to the competing demands of production which were linked to performance bonuses and innovation. Budget cuts also contributed to deterioration of safety and resulted in plant and equipment not being maintained appropriately. Other signs of an unhealthy safety culture included ad hoc application of supervision and discipline leading to management not being held accountable for incidents, and employees not complying with acceptable safety practices and procedures. Poor reporting of risks or hazards by employees culminated in frequent incidents and near-misses and an acceptance of high injury rates (Valais, 2007). Ultimately the sub-optimal values, attitudes and beliefs about safety were expressed by workers and management at the refinery and influenced the direction
that the company took in respect of safety culture (Glendon & Stanton, 2000).

In the case of the 1994 Moura coal mine explosion in Australia which claimed 11 lives it has been argued that an entrenched set of beliefs preventing warning signs from being recognised were a significant contributing factor to the disaster (Hopkins, 1999). The explosion was caused by spontaneous combustion when an increase of methane gas was ignited. The increased level of methane was expected but the presence of heating coal was not (Chapman & Ferfolja, 2001). For approximately six weeks before the explosion, signs of an increase in methane were detected by mine officials and even recorded by supervisors. Unfortunately the warnings were not heeded by management as the reports were not effectively monitored. According to Hopkins (1999) the most notable deficiencies observed by the official inquiry were the numerous indications from instrumentation that a spontaneous combustion was occurring but the widespread miscommunication in the mine resulted in overlooking or minimising this important information. Consequently, the reliance on personal experience and oral tradition (that it took at least six months for spontaneous combustion to occur after mining had begun) proved to be more influential than written reports and technological equipment, resulting in the company not responding appropriately to clear warning signs (Hopkins, 1999). This culture of dismissing or minimising important information and not communicating effectively between all levels within the mine impacted negatively on the ability of management to bring together all the vital pieces of evidence that would have helped predict an explosion (Chapman & Ferfolja, 2001). More recently, a news report in the New Zealand Herald relating to the Pike River Mine explosion in New Zealand which killed 29 people in November 2010, highlighted some interesting revelations amongst the evidence given at the Royal Commission of Inquiry; including ineffective management, production pressures and serious methane issues (Lundy & Backhouse, 2012). However the cause of the explosion and subsequent deaths of workers cannot be determined ahead of the commission’s final report, due in September 2012.

2.5 Behavioural Safety Training

The effectiveness of safety training can have a significant impact on safety performance (Cooper & Cotton, 2000; Jennings, 2001; O'Toole, 2002; Zohar, 1980) and ultimately builds and improves safety culture. Conversely the absence of effective safety training
can lead to major disasters resulting in the loss of life (Cooper & Cotton, 2000). Paul and Maiti (2007) state it is not the inherently dangerous nature of mining that is the problem, but rather risky behaviours (Paul & Maiti, 2007). There are two main methods used to improve safety in the mining industry: engineering and behavioural interventions. The most effective control is to eliminate the hazard. If this is not feasible then engineering controls such as placing a barrier on machinery to reduce risk is the next step. The lower levels of control are administrative (including training) and wearing personal protective equipment (PPE) (Hopkins, 2006). As described by Wirth and Sigurdsson (2008) “there is no better solution for reducing worker injuries than eliminating safety hazards and risks through direct engineering or administrative controls” (p. 589). Behavioural interventions concentrate on “the attitudes and behaviours of the mineworkers in coping with the inherent physical, technical and situational risks” (Maiti, Chatterjee, & Bangdiwala, 2004, p. 29) and “provides a means of motivating workers to perform in a consistently safe manner” (Paul & Maiti, 2007, p. 450). Consequently, behavioural safety approaches are popular in the mining industry and appear to be an important component of training programs.

Employees with high-risk taking dispositions may impact negatively on the effectiveness of safety interventions and training (Harvey, et al., 2001). According to the UK Health and Safety Executive (HSE), between 80% to 90% of all workplace accidents and incidents can be attributed to unsafe behaviours (UK Health and Safety Executive, 2002). So it is not surprising that behavioural based safety intervention which focus on people and their behaviours at work and provide observation, feedback, coaching and mentoring are more likely to reduce accident/injury rates and improve workplace safety (Cox, Jones, & Rycraft, 2004; Krause, Seymour, & Sloat, 1999; Paul & Maiti, 2007). Typical behavioural based safety training programs include information regarding safe and at-risk behaviours, regular observation and recording of targeted behaviours, feedback to employees regarding safe versus at-risk behaviours and incentives to encourage the observation and feedback process (Paul & Maiti, 2007). This approach to behavioural change appears to use both Skinner’s (1953) theory of operant conditioning, and Bandura’s (1976) social cognitive theory (SCT). Skinner (1953) believed that to ensure learning, the desired behaviour needs to be reinforced. Thus externally delivered consequences, either positive (rewards) or negative (punishments) which follow behaviour influence its future occurrence (Kamp, 2001).
Bandura (1976) promoted the idea that learning can be achieved by observing others. So it is not the actual consequences of the behaviour but rather anticipated consequences that control human behaviour (Kamp, 2001). Therefore feedback, whether one-on-one, group or site based, and modelling via observations, coaching and mentoring can reinforce safe behaviours (Cox, et al., 2004).

The research literature also indicates that attitudes as well as behaviour need to be targeted in safety training programs (Choudhry & Fang, 2008; Cox, et al., 2004; Harvey, et al., 2001; Kamp, 2001; Loosemore & Andonakis, 2007). Loosemore and Andonakis (2007) state that more emphasis is needed on changing attitudes and developing skills rather than focusing on information transfer. Successful behavioural training programs focus on changing internal processes such as perceptions, attitudes and values rather than relying on the manipulation of external motivators (Kamp, 2001). Kamp (2001) argues that the traditional model of behaviourism, which emphasises positive and negative reinforcement, does not explain why workers choose safe behaviours over at-risk behaviours when they are not being observed. Hence, external reinforcement does little to change the attitudes that motivate behaviours. He believes that current behavioural safety programs work by producing cognitive changes, and that understanding cognitive psychology will improve behavioural safety theory and methods (Kamp, 2001). Further, DePasquale and Geller (1999) state that effective behaviour-based safety programs are designed to elicit the desired cognitive and/or behaviour changes among participants. However, employee perception regarding the relevance and quality of the training they receive will also have a dramatic impact on quality and frequency of worker involvement in the training (Colquitt, LePine, & Noe, 2000; DePasquale & Geller, 1999). Unfortunately, many training approaches and processes are proprietary or not well documented in the safety literature. Therefore it is difficult for safety professionals to identify best intervention practices. Information about industry’s experience with behavioural safety training is limited at best. A better understanding of these experiences will help identify not only best or promising practices, but also obstacles and barriers to successful implementation (Wirth & Sigurdsson, 2008).

2.6 Evaluating Safety Training Effectiveness

Web-based training continues to grow in popularity as it offers the potential to deliver
‘just-in-time’ training at any time to almost any location. However, the advantages of cost savings and convenience will be mitigated if the training does not produce the desired outcomes (Long, DuBois, & Faley, 2007). A review of the literature indicates the critical importance of assessing the effectiveness of training interventions, however, very few organisations undertake even rudimentary evaluations (Anderson, Cunningham-Snell, & Haigh, 1996; Cohen & Colligan, 1998; Cooper & Cotton, 2000; Cullen, 2008; Harvey, et al., 2001).

If companies do evaluate their training programs, the most common approach is to use Kirkpatrick’s (1979) four-level evaluation model, which progresses from the easiest to very resource intensive. The following is a brief summary of Kirkpatrick’s (1979) model:

**Level 1: Reactions to or perceptions of training – a measure of satisfaction.** Evaluation at this level measures how a participant feels about their experience and how well they liked or disliked the training program. However, it is important to understand that even if a participant liked the program, it does not mean learning has occurred (Kirkpatrick, 1979). Conversely, in a web-based training program participant reaction may play a more significant role in training effectiveness as high participant control and the absence of instructor-led interaction creates a learning environment where the participants’ reactions to training may have a more significant impact on their learning outcomes (Long, et al., 2007).

**Level 2: Improvement in knowledge or skills as a result of training – a measure of learning.** According to Kirkpatrick (1979), a definition of learning is “What principles, facts and techniques were understood and absorbed by the conferees?” (p. 82). At this level, a more rigorous process than a reaction survey is needed to measure how much the skills, knowledge or attitudes of participants in a training program have changed. Ideally, a pre-test and post-test are given to participants to determine how much was learned as a result of the training (Strother, 2002). This type of assessment is often conducted at the end of a safety training program and is usually in the form of a test or quiz. This would be appropriate if the aim was to measure the retention of information, however, if the skill or task was to identify hazards in the workplace a more effective measurement of learning would be required (for example scenarios, role plays, simulations) to demonstrate learning has taken place (Machles, 2003). This point has
important implications for mandated safety training which, for the most part, use true-false and multiple-choice test to assess learning (Burke, Holman, et al., 2006).

**Level 3: Transfer of new skills or knowledge – a measure of behaviour change.** The goal of most safety training programs is to change behaviour and have this transfer to the workplace, however measuring this change is more difficult. Machles (2003) suggests using supervisors to observe and assess workers’ performance on the job after training. Also if the knowledge or skill is not used for sometime after the training he advises drills or reviews to evaluate transfer of training. He also recommends that the evaluator has the proper qualifications to evaluate the effectiveness of training (Machles, 2003). Further, Galloway argues that computer-based testing provides an excellent means of gauging a participant’s learning and understanding. When participants have completed an assessment the examiner can see whether they have performed the desired steps, trace the order of the steps and view the finished product or results (Galloway, 2005).

**Level 4: Overall impact on the company – a measure of results.** This level attempts to evaluate whether the results of training directly affect a company's bottom line. Kirkpatrick (1979) admitted that this was an extremely difficult task, if not impossible due to the many variables and complicating factors in an organisation. One example Kirkpatrick (1979) gave was to evaluate the effectiveness of safety training programs in terms of lost-time accidents. He mentioned a study where safety records were compared nine months prior and the same period after the safety training intervention. The frequency rate for lost-time accidents and reported incidents was measured; the results showed a drop in the frequency rate and number of reported incidents. As there were no physical changes implemented in the time period, the improvement was credited directly to the training initiative (Kirkpatrick, 1979). As previously mentioned, many scientific studies support the claim that injury reductions can be achieved through safety training. However, the challenge is identifying the interventions which work in a particular context as training content and approaches vary considerably and few studies have evaluated and compared the various approaches systematically. As Wirth and Sigurdsson (2008) state it is not always possible to use injuries or fatalities as a measure of training effectiveness as many work-related safety and health outcomes develop long after the accident or exposure to the hazard has occurred. Further, a recent study by
Bahn and Barratt-Pugh (2012a) concluded “Research in this area is frustrated by the complexity of the relationship between training and subsequent workplace incidents as there are many interwoven mediating factors that influence any causal relations” (p. 215).

Despite the fact that Kirkpatrick’s (1979) evaluation model is over 30 years old its simplicity has caused it to be the most widely used method of evaluating training programs, including e-learning (Galloway, 2005). Phillips (1996) recommended an additional fifth level to calculate a return on investment, as Kirkpatrick’s (1979) model cannot be used to determine the cost-benefit ratio of training (ROI) and it cannot be used diagnostically, such as when a training program does not deliver the expected results. This requires collecting level 4 data, converting the results to monetary values and then comparing those results with the cost of the training program (Phillips, 1996). Holton III (1996) contends that Kirkpatrick’s (1979) model is really a taxonomy of outcomes and a true evaluation model would “specify outcomes correctly, account for the effects of intervening variables that affect outcomes, and indicate causal relationships” (1996, p. 5). He proposes a new model which considers intervening variables such as motivation, trainability, job attitudes, personal characteristics and transfer of training conditions (Holton III, 1996).

### 2.7 Safety Inductions

Safety training for mine workers is compulsory in Australia with the objective of maintaining the health and safety of all workers. The intention is not only to meet statutory obligations but to ensure that mining activities are performed in a safe manner. According to Cullen (2008) federal law in the U.S. not only mandates health and safety training for all miners but also specifies the duration and type of training. For example, new underground miners must undergo 40 hours of training and 24 hours for new surface miners, and annual refresher training for every miner which is to be at least 8 hours each year (Cullen, 2008). The mining industry in Western Australia has a generic safety induction training program that was developed by the Mining and Resource Contractors Safety Training Association (MARCSTA) which has to be completed every two years to maintain accreditation (Douglas & Oosthuizen, 2010). Research by Douglas and Oosthuizen (2010) to determine the efficacy of the eight-hour MARCSTA generic safety induction course for workers in the metalliferous mining sector revealed
that some participants believed the training material was being duplicated in site specific inductions. Further, 53% of workers who had attended multiple inductions (four or five times) over the past decade believed the information was repetitive and they were not learning anything new. They also questioned whether an online mode of delivery would be suitable for workers in the mining industry and suggested further investigation to determine its feasibility (Douglas & Oosthuizen, 2010). This sentiment was echoed by Wilkins (2011) who warned that the absence of an instructor for the Occupational Safety and Health Administration (OHSA) 10-Hour Construction Safety Training Course in the United States would allow a lack of understanding on behalf of participants to go unnoticed, and the potential for taking shortcuts in learning such as cheating on assessments would be considerable. Research in the construction industry, regarding workers’ perceptions of health and safety training programs has indicated that participants who had worked longer in the industry were less influenced by the training (Bahn & Barratt-Pugh, 2012b; Wilkins, 2011) and subsequently achieved poorer scores on knowledge assessments. Hence experience does not guarantee sufficient understanding of health and safety regulations (Wilkins, 2011). According to Wilkins (2011) workers were more likely to observe good safety practices if they received training based on an andragogical learning model (section 3.3) as the information would “appear more relevant from the trainees’ point of view by drawing examples from and parallels with their working experience” (p. 1023).

In Queensland, the Coal Mine Safety and Health Regulation 2001 requires companies to conduct training and assessment of its workers including induction training. New coal mine workers cannot carry out any task at the mine unless they have completed induction training (such as the Generic Induction) and refresher training is required for workers at least once every 5 years. The regulation provides a general outline of the information to be covered in training, though does not specify duration or mode of delivery. The worker cannot carry out any task in the mine unless they have been assessed as ‘competent’ to do so (Coal Mining Safety and Health Regulation, 2001). The purpose of safety induction training is to provide employees with a broad understanding of Occupational Health and Safety (OH&S) principles and responsibilities and promote safety awareness. Safety induction training can cover issues such as employer and employee obligations; safety management systems; safety rules and regulations; hazard identification, assessment and control; incident reporting;
communication systems; safety signs; protective equipment requirements; housekeeping and risk management processes. Specific site OH&S training is designed to familiarize new workers with hazards associated with that particular site (Loosemore & Andonakis, 2007) as well as general safety information including site processes and procedures. Although site safety inductions are mandatory in high risk industries such as mining and construction there is little evidence that research has been conducted on the content and effectiveness of site safety induction training programs. As Peters and colleagues (2010) state, many miners attend training on a regular basis in order to comply with legislation, however unless “effective training materials and methods are used, miners are unlikely to learn what they need to know” to prevent accidents and injuries (p. 507).

Workers who attend safety inductions vary in age, experience, education and literacy levels. Newton and colleagues (2002) reported low reading literacy levels in the mining industry and this needed to be considered when designing learning programs. In an online environment the level of text and visuals used would impact greatly on learning outcomes (Newton, et al., 2002). A number of research articles also commented on an ageing workforce in the mining industry (Kowalski & Vaught, 2002; Mining Industry Skills Centre, 2007; National Centre for Vocational Education Research (NCVER), 2005). This can present challenges to the design and delivery of training. Wallen and Mulloy (2006) conducted a study which compared the effectiveness of a computer-based training program on respiratory safety for older and younger workers. They discovered that older workers can have more difficulty learning via computer-based instruction due to age-related decreases in cognitive function used for information processing and storage. Consequently, learning is less likely to occur when there is a decrease in working memory function. This means that information may not be retained and processed effectively resulting in lower levels of comprehension of complex information. Experience and practice can moderate the effects of reduced cognitive function however in new or unusual learning environments their performance may decline compared to younger learners. The research also revealed that older workers benefited from instruction which incorporated pictures and audio narration rather than just text or text and pictures (Wallen & Mulloy, 2006). Further, older workers can be more susceptible to distraction whilst reading (DeStefano & LeFevre, 2007) as they find it more difficult to ignore irrelevant information (DeStefano & LeFevre, 2007; Schulz & Robnagel, 2010). Therefore less information displayed on the screen (Rivera-Nivar &
Pomales-Garcia, 2010) and more structured, hierarchical hypertexts may help concentration (DeStefano & LeFevre, 2007; Lin, 2004).

Health and safety is the most common type of training undertaken by employees in the mining industry (National Centre for Vocational Education Research (NCVER), 2005). Laurence (2005) studied safety rules and regulations on mine sites and conducted an attitudinal survey at 33 mines throughout Queensland, New South Wales and international mine sites involving approximately 500 mine workers. He noted that many accidents in the mining industry were caused by workers not following rules and regulations. Research by Wilkins (2011) in the construction industry indicated a lack of understanding of policies and procedures may be due to workers’ unwillingness or inability to see the applicability of theoretical information provided during training in a practical workplace situation, hence some workers not grasping the relevance of some material (Wilkins, 2011). Similarly, Laurence (2005) found that:

The workforce did not demonstrate any meaningful awareness of the concepts of duty of care, risk assessment, safety management systems, or any of the promulgated legislation, which embodies these concepts (Laurence, 2005, p. 44).

Laurence (2005) argued that more safety rules and regulations will not result in a safer workplace as miners believe there are too many prescriptive regulations, safe work procedures and safety management plans. Mine workers also think they have a good knowledge and understanding of existing rules and regulations, thus making them less amenable to learning this information. Laurence (2005) suggests that improved training including an induction process which evaluates the inductee’s understanding of the material covered and a process for regular re-assessment of employees’ knowledge of induction material such as rules and regulations is required (Laurence, 2005).

In the mining industry existing training and assessment can often be focused on achieving the minimum standard identified by the competency thus meeting legislative requirements rather than improving learning outcomes. Hence “mandatory programs can offer an illusion of complete and continued compliance that is seductive and easily consumed” (Bahn & Barratt-Pugh, 2012b, p. 338). Course content, duration and mode of delivery can vary from site to site and is mainly delivered face-to-face (Mining Industry Skills Centre, 2007).

Face-to-face training provides the most intimate and immediate form of feedback as it
allows learners to process and interpret two forms of communication; verbal and non-verbal. Signals such as gestures, eye contact and handshakes from peers and instructors provide an effective ‘short hand’ form of communication. It offers teams opportunities to informally get to know each other in subtle ways that may not be possible via computer based delivery systems (Collins & Berge, 1996). In face-to-face learning situations a high level of interaction can be achieved. Learners can participate in brainstorming activities, project work, roles plays and group discussions which helps them to develop critical thinking skills (Newman, Johnson, Webb, & Cochrane, 1997). Face-to-face learning has its disadvantages, as it tends to be instructor-centric, in which instructors mainly control course material, discussion and progress. Many learners do not take the opportunity to question or ask for clarification if they do not understand the instructor. Moreover too much learning material can be exposed in a classroom situation, leading to poor retention of information (Zhang, 2005; Zhang & Nunamaker, 2003).

2.8 **Benefits of Online Learning**

According to the Mining Industry Skills Centre’s (2007) report the quality and consistency of program content varies considerably between mining sites and organisations and few processes are in place to evaluate the training programs (Mining Industry Skills Centre, 2007). Further, effective and innovative training incorporating technology is needed to prepare employees for a more sophisticated and complex work environment. The report identifies a number of characteristics which should be present in mining companies’ training systems and are summarised below:

- Learning outcomes being the primary focus and legislative compliance second
- Efficient record keeping maximizing the use of technology
- Learners’ needs driving the selecting of delivery methodologies
- Training is contextualised in the workplace
- The ‘why’ aspect is incorporated into training
- Innovative training, incorporating technology, is used to prepare employees for potentially dangerous rare events
- Refresher training is meaningful and adds value to employee development and business outcomes
- The impacts of training initiatives are measured (Mining Industry Skills Centre, 2007, pp. 2-3).

These recommendations clearly point to the use of technology to deliver more efficient and effective training. The words online learning, e-learning and web-based training are used interchangeably, and all refer to a learning environment where instructional
content is delivered electronically via the internet, intranets or multimedia platforms such as CD-ROM or DVD when and where people require it (Smart & Cappel, 2006; Zhang & Nunamaker, 2003). A report by the Australian Flexible Learning Framework (2006) declared that the most common uses for e-learning were induction and regulatory training such as occupational health and safety. Compliance is a key driver for developers of online training as the internet provides a highly cost-effective way to deliver information pertaining to regulatory requirements (Tyrell, 2005). This has particular relevance to mine workers as they know they cannot work on a mine site without completing a site safety induction first, so attendance is important. However, mandatory training does not automatically mean that compliance has been achieved (Bahn & Barratt-Pugh, 2012b). Especially as many online training programs borrow models from the classroom that “passively transmit information or data” (Janicki & Liegle, 2001, p.59). Hence, there is a need to develop safety training which is more innovative in delivery using virtual reality, simulations and multimedia to ensure better knowledge transfer and attitudinal change (Loos & Diether, 2001; Loosemore & Andonakis, 2007).

The internet is not just an electronic tutor providing content in a range of appealing formats such as text, animation, graphics, sound and video (Kidney & Puckett, 2003). It is a communication medium which can carry real-time (synchronous) or delayed (asynchronous) time interaction between numerous people around the world (Zhang & Nunamaker, 2003). Interaction is considered an essential aspect of online learning (Bernard et al., 2009; Garrison & Cleveland-Innes, 2005; Park & Wentling, 2007) and a combination of different types of interaction: learner-learner, learner-teacher, and learner-content are valuable in promoting learning (Garrison & Cleveland-Innes, 2005). Online learning can encourage interaction amongst learners, by providing a means for teams to communicate about course content and collaborate on group projects, not only with those in the classroom, but people in the rest of the organisation (Reeve, Gallacher, & Mayes, 1998; Visser & Berg, 1999). A number of studies have suggested a relationship between perceived learning and teaching presence. Interaction with teachers in the form of facilitation and feedback appears to have a positive effect on satisfaction and perceived successful learning outcomes (Brown, Murphy, & Wade, 2006; Garrison & Cleveland-Innes, 2005; Hutchins & Hutchinson, 2008; Swan, 2001). Further frequent and engaging interaction with course content, such as working on
authentic problems, watching videos, interacting with multimedia and reading interesting and useful information is an important aspect of online course design as it increases participant satisfaction and subsequent learning (Bernard, et al., 2009; Swan, 2001). If workers have a positive emotional experience whilst participating in an online program, such as satisfaction with the learning process and outcomes of the program, they are more likely to learn (Brown, 2005; Orvis, Fisher, & Wasserman, 2009; Sitzmann, Brown, Casper, & Ely, 2008). Satisfaction with the learning process can include a number of factors including learner support, control, interaction, technology and course design (Burke & Huchins, 2007; Granger & Levine, 2010; Gunawardena, Linder-VanBerschot, LaPointe, & Rao, 2010; Puzziferro, 2008). Learner characteristics also impact achievement and satisfaction with learning. Learners who have confidence in their ability to use computers and were motivated to actively participate in the learning experience were more likely to be successful in transferring their learning, especially if they received support from their colleagues in the workplace (Gunawardena, et al., 2010). As Orvis and colleagues (2009) discovered:

in the e-learning context, satisfied trainees learn more, and prior research has demonstrated that satisfied trainees have a greater motivation and self-efficacy for applying the training content on the job (Orvis, et al., 2009, p. 969).

To meet the needs of a global economy, workers must have access to information and training regardless of location (Loos & Diether, 2001). The asynchronous nature of web communication can provide opportunities for ongoing contact with peers, instructors and experts without the need to be physically present at the same time. This reduces the disruption to workplace activities and more importantly provides support for the learner when it is most needed (Reeve, et al., 1998). Employees can access course materials 24 hours a day, 365 days a year so they can learn during non-work hours or while travelling. They can share information and ideas with peers from worldwide locations and store these communications so that they can be retrieved, reflected upon and responded to at a time convenient to the learner. This flexibility not only benefits the learner but also the organisation. As there is a reduced need to release key employees for days away on courses the organisation saves money whilst skilling the work force (Driscoll, 1998; Zhang & Nunamaker, 2003). The desire to produce workers who can solve problems in sophisticated and complex environments (Kowalski-Trakofler, et al., 2004; Mine Safety Technology and Training Commission, 2006) has created a need in many organisations to continually update employees’ knowledge and skills. Immediate
and constant access to consistent and current training programs ensures that quality is maintained thus reducing the probability of communicating unsafe or inconsistent work practices (Newton, et al., 2002). Effective training programs which are customised to employees’ individual needs and preferences are necessary if they are going to successfully respond to new opportunities and new technology in today's competitive environment (Meister, 1998).

The safety literature indicates that active and engaging safety training results in greater knowledge acquisition and safety performance in the workplace (Burke, Holman, et al., 2006; Burke, Sarpy, et al., 2006; Colligan & Cohen, 2004). This is important as the use of virtual reality and multimedia in safety training programs is becoming more popular in the mining industry (Kowalski-Trakofler, et al., 2004; Tichon & Burgess-Limerick, 2011). Multimedia involves computer based technology that presents instructional material in a variety of forms including verbal (such as narration or text) and visual (such as animation, pictures or graphics) (Mayer, 1999). Successful multimedia programs engage the learner and maximise retention of information as they use a variety of senses and active learning processes (Kiili, 2005; Zhang & Nunamaker, 2003). Unfortunately, the quality of instruction for multimedia training programs delivered online varies greatly among organisations. Providing information by translating notes and lecture materials into an electronic format does not achieve learning (Janicki & Liegle, 2001). Text dressed up with fancy graphics and dramatic features and downloaded to a computer will not necessarily promote understanding and performance improvement (Lee, Chamers, & Ely, 2005). A module placed online followed by three multiple-choice questions, is not an interactive learning experience and does not constitute effective course design (Oliver, 1999). For organisations, ineffective online safety training programs can be very expensive, not only due to the waste in time and resources spent on developing and implementing them (Williams, 2002) but also in penalties and loss of reputation if injuries or fatalities occur (Mitchell, 2001). From a learning perspective, ineffective training can lead to problems with transfer of training and subsequent dissatisfaction with online learning by workers. Many companies focus on the technological aspects of their online learning programs and not the adult learning theories which underpin effective instructional design (Wang, 2011; Williams, 2002). Without effective instructional design, courses delivered online may impact learners’ understanding and performance negatively (Williams, 2002).
According to Loos and Diether (2001) effective safety training involves learning in authentic environments which encourages learners to refine their understanding and build knowledge via continuous feedback. Simulations and/or virtual worlds can be constructed to resemble actual work settings (Loos & Diether, 2001) ensuring content that is considered by participants to be accurate and relevant both personally and professionally and delivered in a variety of ways such as stories and examples, helps maintain learner motivation (Hutchins & Hutchinson, 2008). Such methods engage learners and supports deep approaches to learning as the learning activities are relevant and/or authentic and resemble the contexts where the knowledge and skills they are acquiring will eventually be applied (Herrington, Reeves, & Oliver, 2006). The use of multimedia and simulations also provides a safe environment in which learners can make mistakes without endangering lives and obtain feedback on their performance before they go into the field. The capability to evaluate learners’ knowledge in private through formative and summative assessments such as quizzes, and from mistakes made in exercises is another important feature of online learning programs. It provides opportunities for the learner to revise information which was not understood without ‘loosing face’ with peers and allows managers to assess learners’ progress within courses more accurately without undue pressure (Newton, et al., 2002).

Learner control is another important aspect of online learning as it puts the learner at the centre of training (Bell & Kozlowski, 2008; Kozlowski & Bell, 2006) and allows individuals to tailor their learning experiences to their prior knowledge and existing understanding of the content area (Granger & Levine, 2010; Orvis, et al., 2009). Web-based learning typically gives learners control over various aspects of the training environment such as the pacing and selection of training content. Pace control not only allows learners to “skip material that they are familiar with and spend additional time on material that is more difficult” (Granger & Levine, 2010, p. 181) but also permits learners to choose the order in which the material is covered in the program (Granger & Levine, 2010; Orvis, et al., 2009). Content control gives learners power over the specific information presented in the training program (Granger & Levine, 2010) so they may focus on the self-assessment exercises and skim the instructional information only reading the parts of the material applicable to questions they answered incorrectly (Dobrovolny, 2006). As learners enter training with varying levels of knowledge and experience, learner control allows more experienced learners to skip or speed through
information and move to more complex content, whereas novice learners may need more time to assimilate the preliminary material in the training program (Granger & Levine, 2010). Transfer of learning to the workplace is the goal of safety training and the effective use of technological media and instructional strategies can facilitate this purpose (Loos & Diether, 2001).

2.9 Potential Barriers to Online Learning

Introducing an online learning program into the workplace needs to be done with consideration to the possible barriers which may arise to prevent employees’ learning and ultimately the transfer of this learning to their jobs. One very important element which must be investigated is employees’ familiarity and orientation to learning via this medium. The younger generation of students tend to be not only more positive (Manuel, 2002) but also more proficient in the use of digital technologies such as computers, mobile phones, blackboard and email (Kennedy, Judd, Churchward, & Gray, 2008; Salajan, Schonwetter, & Cleghorn, 2010). According to Oblinger and Oblinger (2005) younger learners are more visually literate (possibly through game playing), learn through discovery rather than passive forms of instruction and are quick to disengage if bored. However there is still a wide variation of experience among the younger cohort with technological tools, especially in learning situations (Kennedy, et al., 2008). If learners have a negative attitude or anxiety towards technology or are not proficient in the use of computer systems, this will have an impact on their ability to learn via computers (Long, et al., 2007; Song, Singleton, Hill, & Koh, 2004) and transfer that learning to the workplace (Park & Wentling, 2007). Research by Long and colleagues (2007) has shown that if learners suffered from computer anxiety their ability to learn was negatively impacted as their motivation, such as active participation, attention and effort during a course decreased.

The technology, including the software and hardware, needs to be reliable and provide the appropriate functionality (Johnson, Gueutal, & Falbe, 2009). For example, inadequate bandwidth can be a barrier as the multimedia content may be subjected to extensive delays and thus interrupt the learning process (Annansingh & Bright, 2010). Clear and usable screen layouts need to be considered; as poorly structured and unattractive multimedia applications or web-pages are confusing and not likely to engage learners (Cook & Dupras, 2004; Hutchins & Hutchinson, 2008). The interface
should be transparent to the learner, as a complicated interface distracts attention as it forces the learner to think about the logistics of the interface rather than on the learning. Similarly navigational cues should be clearly marked, consistent and obvious to the learner (Lee, et al., 2005). This is especially important for novices who are unfamiliar with the content, as they tend to experience more disorientation as they cannot rely on prior knowledge to help them determine the structure of the program. Hence, to support novices’ development of the structural representation of the information being learned, additional navigational support and appropriate content structure in the form of visual clues and hierarchical maps to provide an overall picture of the program is needed (Chen, Fan, & Marcredie, 2006). Similarly, participants’ level of motivation can be affected by their ability to decipher the structure and relevance of the information presented. A perception of large amounts of unnecessary or irrelevant material can lead to learners’ having a feeling of information overload (Kushnir, 2009). Further the younger generation of learners appear more comfortable in an image-rich rather than a text heavy environment and are more likely to scan information rather than read (Manuel, 2002; Oblinger & Oblinger, 2005). Hence, concise text that facilitates reading such as limited length of sentences and paragraphs, clear headings and short phrases and bulleted outlines are important. Unnecessary colour, graphics or animation should also be avoided to reduce learner distraction (Cook & Dupras, 2004; Hutchins & Hutchinson, 2008). Ultimately the user-friendliness or usability of an online program impacts learners as;

A properly designed interface is able to capture and maintain the learners’ attention, motivate them toward interaction with the system and help to achieve their learning goals without confusion and fatigue (Hutchins & Hutchinson, 2008, p. 370).

Therefore online training programs should incorporate ways of making the program more user-friendly especially for those with a fear of computers (Hutchins & Hutchinson, 2008; Long, et al., 2007). According to Wagner and associates (2010), increasing age may lead to increased computer anxiety. Thus with the aging workforce and the considerable variation in levels of computer literacy in the mining industry, more support maybe required for those who are not as confident with the technology. Likewise, Newton and colleagues (2002) suggest developing simple and relevant online learning programs that are easy to navigate and have minimal potential for user frustration. This is required to encourage confidence in accessing and learning via this
Safety training in the mining industry is usually face-to-face, formally delivered and often presented in highly technical or regulatory language (Cullen, 2008). For a significant proportion of mine workers, traditional classroom training does not appeal as it is equated to old school memories of boredom and irrelevant exercises (Camm & Cullen, 2002). According to Somerville few miners reported learning safety in a classroom but through observing and listening to more experienced miners and through their own practical experiences (Somerville, 2005). However mine workers may be conditioned to instructor led programs and not have the orientation to cope with the freedom to set their own agendas for learning provided by computer based systems (Newton, et al., 2002; Reeve, et al., 1998). In an online learning environment participants are primarily responsible for motivating themselves and navigating themselves through the learning, whereas in traditional classroom situations the instructor usually takes care of this aspect (Long, et al., 2007). Newton and associates (2002) revealed there were concerns that workers in the mining industry may not be motivated to learn online in an unsupervised capacity, as they were used to being passive learners in traditional classroom settings (Newton, et al., 2002). As online learning programs require learners to be self-directed and active in their learning approach, some learners may be lazy, careless or do not know how to self-motivate while others may lose motivation if they cannot immediately understand the learning materials and cannot simply ask a trainer for an explanation (Long, et al., 2007; Schell, 2001). Often learners do not achieve the level of performance required in the workplace as they do not accurately assess their current knowledge levels, make poor learning decisions and do not commit enough effort to learning (Sitzmann, Bell, Kraiger, & Kanar, 2009).

Previous research has indicated that an individual’s intellectual capacity or cognitive ability is a strong predictor of learning success (Colquitt, et al., 2000), especially as higher-ability learners tend to be “more capable of managing their own learning and using self-regulation to increase their knowledge and performance” (Sitzmann, et al., 2009, p. 713). Lower ability learners absorb and retain less information. Further, learners with lower cognitive ability are less capable of diagnosing and learning from errors compared to learners with higher cognitive ability (Sitzmann, et al., 2009). Thus
lower-ability learners would benefit from structured lessons as less demands are made on cognitive resources which higher levels of control would impose (Bell & Kozlowski, 2008). An empirical study by Granger & Levine (2010) investigated the impact of learner control and the learning and transfer of knowledge that varied in complexity. As some learners may not have the metacognitive and motivational skills necessary for maximal use of web-based learning, individuals who spent less time on complex training material may not learn the necessary information. Granger & Levine (2010) argued that according to cognitive load theory (see chapter 3.5.2) more complex material placed higher demands on learners’ cognitive resources so the “tendency of many trainees to make poor decisions during learner-controlled training may put them in a position that ultimately leads to reduced learning” (p. 187). Further, they discovered that higher levels of learner control offered in online learning negatively impacted the degree of cognitive learning and transfer of training when the training content was complex; “Specifically, a high degree of learner control can be especially detrimental to cognitive and skill-based learning outcomes when the training content is high in complexity” (Granger & Levine, 2010, p. 189). They concluded that it was inappropriate to carelessly allow high levels of learner control, especially when training content was complex in nature and learners have poor metacognitive and/or cognitive skills, as learning and transfer of training can suffer (Granger & Levine, 2010).

Feelings of isolation and/or lack of a sense of community were also barriers to online learning reported in the literature (Muilenburg & Berge, 2005; Song, et al., 2004). The absence of body language and social cues in an online environment may cause learners to feel inhibited and thus negatively impact their level of interaction resulting in misunderstandings and misinterpretations of the learning material (Vonderwell, 2003). However these challenges can be mitigated if the company provides access to a mentor or trainer and a structure or framework to the learning process to assist employees in managing their own learning (Newton, et al., 2002).

Access to equipment and appropriate and timely support may be another barrier to learning. In the mining industry some groups, such as underground workers, found their physical work conditions created problems for accessing computers and the internet (Newton, et al., 2002). If employees are unable to use the computer based systems regularly and at a time and place convenient to them, then the desire and
interest to learn will decrease. Further, according to Daniel (2002) locally delivered support was crucial to the success of all open and distance learning (ODL) initiatives. If an appropriate level of learner support services was not provided the more potential for failure, especially for large online learning programs (Latchem, 2007). Carter (2007) proposed a model of online learner support including; regular contact, prompt responses to learners’ enquiries regarding the content by appropriate staff, prompt resolution of technological problems, standardised promotional strategies and specialised learner support services (p. 202). In the mining industry, clear direction and information about the requirements of online learning along with ongoing guidance and learning support by experienced trainers will help ensure acceptance, understanding and application of the material. Moreover, if technological breakdowns occur frequently and there is no back up or support readily available this can cause major frustrations and a decrease in motivation (Song, et al., 2004). Also some groups, such as workers with literacy and/or limited computer knowledge, may need specialised support. All the above issues need to be considered by companies and addressed if and when they arise to ensure that learning via computer based systems are an effective and cost efficient means to train employees (Newton, et al., 2002).

2.10 **Summary**

In summary, the mining industry has been characterised as dangerous and constantly changing, thus requiring workers to have a range of knowledge and skills to successfully deal with routine and non-routine situations. To acquire the necessary knowledge, workers need to attend appropriate safety training courses. It has been suggested that to improve the efficiency and effectiveness of online safety programs, the technology should not only be reliable, simple and user-friendly but also the training material needs to be relevant and engaging by incorporating activities which promote interaction and authenticity such as real-life scenarios and genuine problem solving exercises. Further, learners should have an appropriate level of control over their learning as it allows them to tailor their prior knowledge and experience to the content area. However, the discussion also highlighted that some learners are not familiar with an online learning approach and that their motivation, computer skills and cognitive ability can all impact on their willingness and/or ability to learn in this environment.

There is a dearth of information relating to the evaluation methods used by companies
to assess the effectiveness of their safety induction programs (Bahn & Barratt-Pugh, 2012b; Douglas & Oosthuizen, 2010; Wilkins, 2011). An extensive review of the literature did not discover any evidence of empirical studies examining course content and delivery mode of site safety induction programs in the mining industry, particularly in Australia. Furthermore, there is a gap in the literature highlighting the need to discover workplace learners’ perceptions and reactions towards competency-based online learning (Cheng, Wang, Yang, Kinshuk, & Peng, 2011) and whether online learning can enhance safety training effectiveness (Burke, Sarpy, et al., 2006; Douglas & Oosthuizen, 2010; Wilkins, 2011; Wirth & Sigurdsson, 2008).

The study presented in this thesis aims to help address these gaps by evaluating participants’ perspectives of the effectiveness of an online site safety induction program in the mining industry. Thus in the context of this study it is clear that eliciting the perspective of miners about their experiences of an online site safety induction program will make a significant contribution to research. The following Literature Review Chapter reviews and discusses the different learning and instructional design theories relevant to the aim of the study.
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3.1 Introduction

The background of this study is in the Australian mining industry, and the majority of workers are adults, therefore the literature explored focuses on how adults learn in different contexts and conditions. Whilst a variety of literature was considered in relation to the topic, online site safety induction learning in the mining industry, adult learning theories, workplace learning and instructional design strategies have provided the predominant focus for this study. Within these bodies of literature, information pertaining to competency based learning and Occupational Health and Safety (OH&S) competencies utilised in the mining industry has provided different perspectives of learning in a blue collar industry. This chapter begins by examining the early learning theories and their influence on current learning practices. It then reviews adult learning theories and discusses the Humanist Learning and Transformational Learning theories and how they impact on adult learning. It considers the concept and elements involved in workplace learning as companies face changing from more traditional training approaches. The literature surrounding adult learning theories and workplace learning
is extensive and covers a range of learning models, each emphasising different aspects of the individual or workplace context (Hager, 2004; Illeris, 2003; Solomon, 1999). As Boud and Garrick (1999) point out there has been “a shift away from viewing educational institutions as the principal places of ‘valid’ learning towards recognition of the power and importance of workplaces as sites of learning” (p. 3). Finally it discusses the need to have access to current and effective learning programs which are designed for effective teaching and learning in an online environment.

3.2 Theories of Learning

Under the conditions of globalisation, the context of work and learning has changed. Advanced information and telecommunications technologies have helped facilitate the rise of multinational organisations which now control a large proportion of the world’s economy and exert substantial influence on global legislation (Casey, 1999). As Casey (1999) has observed “every aspect of work, from its practical everyday organisation, its form and function in production and economy, to its meaning and value in individual and collective life, are affected by these changes” (p. 15). In this era of global markets, companies are recognising that if they are to be competitive they need to train personnel for higher order cognitive skills such as problem solving, critical decision making, and troubleshooting (Ford, Kozlowski, Kraiger, Salas, & Teachout, 1997; Pillay, 1997). They also need to develop new skill sets so that employees can understand and use complex technologies and tools (Akdere & Conceicao, 2006; Newton, et al., 2002; Stevenson, 2002). In the mining industry, employees are being required more and more to use their own judgement to solve problems and accurately assess hazards and risks. Consequently, they need to be able to construct their own understanding and apply that knowledge in high pressured, complex and unique situations (Clark, 1999; Mine Safety Technology and Training Commission, 2006).

In order for miners to be equipped with the knowledge and ability to operate in the 21st century, current training must account for the changing philosophy of learning theory, the influences of the information age with the rapid introduction of technology into training, and the socio-cultural nature of the mining environment (Kowalski-Trakofler, et al., 2004). Modern organisations cannot ignore the significance of ongoing learning for staff or they run the risk of losing their competitiveness in the local and global markets (Solomon, 1999). Current literature emphasises the need for continual learning
and acknowledges the importance of learning as an integral part of the work process (Billett, 2006; Boud & Garrick, 1999; Kowalski-Trakofler, et al., 2004; Solomon, 1999; Stevenson, 2002) within all organisations. Continuous learning is especially relevant in the mining industry because the environment is high risk and constantly changing (Gyekye, 2006; Somerville, 2005). Traditionally, teaching safety in the mining industry has been classroom based and usually involved an instructor lecturing to passive learners (Camm & Cullen, 2002; Kowalski-Trakofler, et al., 2004). However, if learning is to be effective it must be based around sound learning theories and take into account both the learners’ individual circumstances and the community or organisation in which they operate (Billett, 2001; Illeris, 2003; Tynjala & Hakkinen, 2005). This section will first examine the three broad learning theories of behaviourism, cognitivism and constructivism as they are most often utilised in training and education, and have influenced the evolution of instructional design strategies.

3.2.1 Behaviourism

Behaviourists believe that all human behaviour is ruled by habit, and that learning results in a change in the learner’s behaviour. The focus of behaviourists is on the outputs of the learning process. They advocate the modification of learner behaviour, to some predetermined goal, while controlling external conditions. The theory of behaviourism avoids references to thought processes occurring in the mind. This is because it was initially based on observations of animal behaviour not human, and animal thought is not generally measurable via any practical, scientific, observation methods. So, essentially, behaviourism as a learning theory concentrates on observing and measuring responses to stimuli (Blanchard & Thacker, 1999; Merriam, Caffarella, & Baumgartner, 2007; Wallace, 1992).

Skinner (1953) is well accepted as one of the most prominent of the contemporary behaviourists. He believed in the stimulus-response pattern of conditioned behaviour. His theory of operant conditioning states that the learner ‘operates’ on the environment and receives a reward for certain behaviour (operations). Eventually the bond between the operation and the reward is established. To ensure learning, the desired behaviour needs to be reinforced. For optimal learning of a new behaviour, this reinforcement should occur immediately after the response (Burton, Moore, & Magliaro, 1996; Skinner, 1953). Reinforcement can either be positive or negative. Presentation of a
pleasant stimulus, or a reward, is an example of positive reinforcement. The removal of something unpleasant or a negative reinforcement can also strengthen the desired behaviour. Thus, if a behaviour brings about a consequence that the learner finds pleasant, then that behaviour is likely to be repeated in the future. Conversely, a punishment is a consequence that weakens a behaviour or makes it less likely to be repeated. It can involve the presentation of an unpleasant stimulus or the removal of a pleasant one, and is sometimes referred to as positive and negative punishment (Burton, Moore, & Magliaro, 1996).

Behaviourists believe learning is best achieved through a controlled environment. Therefore it is the instructor's job to elicit the correct behavioural responses by controlling the stimuli, and consequentially the learner experiences (Blanchard & Thacker, 1999). Behaviourism is the theory that underlies most training programs in the workplace (Akdere & Conceicao, 2006; Merriam, et al., 2007). The emphasis is on providing training which enhances performance on-the-job and focuses on designing training to meet specified behavioural objectives (Merriam, et al., 2007). Behaviourist attributes are also found in most technology-based instruction and include positive reinforcement, feedback, errorless learning and the use of reinforcement through reward (Cooper, 1993; Driscoll & Carliner, 2005; Schwier, 1995). Cooper (1993) suggests that behaviourally based instruction seems most useful for structured and well-defined content where learner responses are clearly assessed as either right or wrong. This reflects the strong orientation to a controlled learning environment to achieve most effective learning outcomes (Cooper, 1993).

### 3.2.2 Cognitivism

Cognitivism began a shift from behaviouristic practices to a concern with the internal mental processes of the mind and how they could be utilised in promoting effective learning. “The exclusion of the mind from the learning process by behavioural laws was a primary theoretical cause of the paradigm shift in learning psychology” (Jonassen, 1991b, p. 6). Cognitivists believe that learning occurs when learners are able to add new concepts and ideas to their internal knowledge structure or schema, by recognising a relationship between something they already know and what they are learning. New concepts, that can often be difficult to learn on their own, are therefore easier to store in memory and recall when needed if they are anchored to existing
knowledge or what cognitivists call schema, which are patterns of associations already formed. Thus controlled inputs to learning are important as they can be manipulated by instructors and learners to promote learning (Moallem, 2001).

With the advent of computers, the view of humans as information processors became prominent. Like computer hardware, the mind was seen as an information-processing system which goes through a series of processing stages where the output of one process becomes the input of the next cognitive process. Learning was seen as the acquisition of discrete pieces of information to form a mental representation (Mayer, 1996; Schunk, 2004). Mayer (1996) distinguishes between two interpretations of information processing, namely, the literal view and the constructivist view. According to the literal interpretation of the information processing model, the mind performs a discrete series of mental operations upon input information and stores the output as new information (Mayer, 1996). This approach is very linear and takes the underlying philosophical view that knowledge and truth exist independently of the individual and are, therefore, objective. Objectivism recognises individual differences between learners but the goal is to achieve correct understanding. In this paradigm that values objectivity, the goal of instruction is the communication or transfer of knowledge to learners in the most efficient, effective manner possible (Bednar, Cunningham, Duffy, & Perry, 1995; Driscoll & Carliner, 2005).

Cognitive theory (see section 3.4.1) provides an account of the construction of individuals’ representation of knowledge in memory, however it does not account for how interaction with persons and situations may impact on learning. Bandura’s (1976) social cognitive theory (SCT) suggested that people learn not only through personal experiences but also by observing others. In fact he believed learning could also be vicarious: “Virtually all learning phenomena resulting from direct experiences can occur on a vicarious basis through observation of other people’s behaviour and its consequences for the observer” (Bandura, 1976, p. 392). Thus the central tenet of SCT is that much human learning occurs in a social environment (Hergenhahn & Olson, 2005; Schunk, 2004), and that by observing the behaviour of others, particularly those who are admired or viewed as mentors, people acquire the necessary knowledge, skills, and attributes (Cullen & Fein, 2005; Schunk, 2004). Modelling is thus a key component in social cognitive theory. However if the desired behavioural, cognitive and affective
changes are going to occur, it is necessary to provide role models who are respected and credible, have the relevant knowledge and experience and are a part of the culture of the learners (Cullen & Fein, 2005). This theory also contributes to a focus on active self-management of the learner, and acknowledged the importance of factors such as self-efficacy (an individual’s judgement of their ability to perform a given task to a designated standard) and motivation in influencing learning and behaviour (Burke, Holman, et al., 2006). In a training situation, once committed to a course, learners motivate and guide themselves by generating goals, developing plans to reach their goals, assessing their motivation and aptitude for the course and identifying obstacles that may prevent completion of the course (Bandura & Locke, 2003; Sitzmann, et al., 2009). In the online environment, one important aspect of self-efficacy is related to the learner’s confidence in using technology to engage in learning (Gunawardena, et al., 2010). The greater the sense of self-efficacy, the greater will be the effort, persistence and resilience of the individual when completing online courses leading to higher levels of satisfaction and learning (Park & Wentling, 2007; Sun, Tsai, Finger, Chen, & Yeh, 2008).

3.2.3 Constructivism

Like cognitivism, constructivism acknowledges that learners use internal, mental models to help them interpret and incorporate experiences and then construct knowledge. Unlike cognitivism, which advocates that knowledge is distinct and abstract (Hung, 2001) and that the environment is the only important source of knowledge about reality (Prawat & Floden, 1994), constructivism is based on the belief that knowledge and truth are constructed by the learner and do not exist outside of the mind of the learner (Duffy & Jonassen, 1991).

This does not mean that an external reality does not exist, but learners interpret interactions with the world in ways that are meaningful to themselves, and construct a reality that is personal and based on their own interpretation (Bludau, Maddox, & Pounds, 1998; Jonassen, 1991b; Schunk, 2004):

The important epistemological assumption of constructivism is that meaning is a function of how the individual creates meaning from his or her experiences. We all conceive of the external reality somewhat differently, based on our unique set of experiences with the world and our beliefs about them (Jonassen, 1991b, p. 10).

According to constructivist epistemology the learner is at the centre of the equation.
Learners develop new knowledge through a process of active construction rather than passively absorbing the teacher’s interpretation of the knowledge domain (Jonassen & Reeves, 1996). Learners are required to take input from the training material or the instructor and actively incorporate the new knowledge with what they already know (their existing schemata) and create new knowledge and make it their own (Bludau, et al., 1998).

This perspective of constructivism stresses the central role of the learner, thus learning is considered a process of active individual construction of knowledge (Biggs, 1991a; Hung, 2001; Stage, Muller, Kinzie, & Simmons, 1998). Similarly, cognitive constructivism emphasizes knowledge acquisition as an adaptive process that requires active construction from the learner however it is typically associated with information processing and maintains the external nature of knowledge and the belief that an independent reality exists and is knowable to the individual. Thus, knowledge construction has little bearing on the subjective nature of knowledge within the mind but is considered primarily a technical process of creating mental structures (Doolittle, & Camp, 1999). Conversely, radical constructivism maintains the internal nature of knowledge and that while an external reality may exist, it is unknowable to the individual. Reality is unknowable as our senses mediate our experiences with the external world and our senses are not adept at rendering an accurate representation of these external forms. Hence, while knowledge is constructed from experience, that which is constructed is not an accurate representation of the external world or reality (Doolittle, & Camp, 1999; Raskin, 2002).

Further, social constructivism emphasizes the importance of interacting with people and situations to develop knowledge and understanding (Huang, 2002; Stage, et al., 1998). The work of Lev Vygotsky has had a major impact on modern constructivist thinking (Schunk, 2004). Vygotsky (1978) promoted the idea that knowledge construction is created through participation in socially situated contexts. The important aspect is in the social interaction, especially dialogue, with other learners. His interest in the cultural aspects of learning led him to his theory of the zone of proximal development, which is defined as:

the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (Vygotsky, 1978, p. 86).
By working together with more expert others on problems and tasks, novices can deepen their understanding by integrating their own knowledge and experiences as they interact with the more skilled members of their societies’ social institutions (Schunk, 2004).

This type of guided learning in a social context is consistent with the concept of ‘cognitive apprenticeship’ (Brown, Collins, & Duguid, 1989) and is a very common practice in the mining industry. Apprenticeships focus closely on the specific methods for carrying out tasks in a domain. Apprentices learn these methods through a combination of support and coaching from a master who is modelling the desired knowledge and skills. As the apprentices’ skills develop, the master progressively reduces the support or fades as the coach. In this sequence of activities, the apprentice repeatedly observes the master executing or modelling the target processes, which usually involves some different but interrelated skills. The apprentice then attempts to carry out the process with guidance and help from the master. A key aspect of coaching is the provision of scaffolding, which is the support, in the form of reminders and help that the apprentice requires to effectively master the whole task (Billett, 1994; Collins, Brown, & Newman, 1989).

Without appropriate support, learners can waste time and become frustrated when trying to solve problems using their own methods which may be limited in application. Appropriate scaffolding makes problem-solving activities more efficient because learners stay focused and thus develop the skills necessary to complete the tasks successfully (Wilson, 1995). This process not only helps learners gain expertise in their chosen vocation but also helps to socialize them into the culture of the profession and/or work practices they are involved in (Stage, et al., 1998). Further, the combination of observation, scaffolding and increasingly independent practice helps apprentices both in developing metacognitive skills such as self-monitoring and in integrating the knowledge needed to advance toward expertise (Collins, et al., 1989). Thus, cognitive apprenticeship is aimed at teaching the processes that experts use to handle complex tasks by emphasizing conceptual and factual knowledge in solving problems and carrying out tasks in authentic contexts (Brown, et al., 1989; Collins, et al., 1989).

Interest in situated learning has been growing since the 1990s and scholars such as Brown, Collins and Duguid (1989) argue for placing all instruction within ‘authentic’
contexts that mirror real-life problem-solving situations. They emphasize that understanding is related to experience. Learning does not occur when students are taught decontextualized knowledge and skills (Winn, 1993a). Thus the experience in which knowledge is embedded is critical to the individual’s understanding of and ability to use that knowledge (Duffy & Jonassen, 1991). Further, Herrington and colleagues (2006), contend that successful online courses are designed using real life scenarios. An authentic learning environment will involve the learner in problem solving activities which reflect the required level of complexity so they are able to apply that knowledge effectively in the real world (Herrington, et al., 2006). Lave and Wenger (1991), likewise, argue that learning occurs through active involvement in a community of practice. A community of practice is defined as “a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice” (Lave & Wenger, 1991, p. 98). People in workplaces operate in communities of practice and thus the construction of knowledge is not only through individual cognition but through participation in shared work practices and the guidance by expert others (Billett, 1998). Learning truly becomes a social experience.

3.3 Additional Adult Learning Theories

Workplace learning is an important activity both for the development of individual workers and contributing to the sustainability and competitiveness of organisations (Boud & Garrick, 1999). When discussing learning theories in the workplace our premise is that the learners are adults. Although there are young people, apprentices and trainees in the workforce, this exposition will concentrate on adult learning theories. The belief is that with better understanding of how people learn in the workplace better instructional strategies and interventions will be developed (Tynjala & Hakkinen, 2005).

As there is no one theory that accounts for all of human learning, there is no one theory of adult learning. There are a variety of models and theories which emphasise different aspects of the individual or context and are based in different disciplines and/or philosophies which all contribute to our understanding of adult learning (Hager, 1999; Merriam, et al., 2007; Russ-Eft, 2004). This section examined the three dominant theories; Behaviourism, Cognitivism and Constructivism, however two theories or perspectives yet to be analysed which have had an impact on adult learning theories are Humanist Learning and transformational Learning, including Narrative Learning.
These two orientations will be considered in the next section.

### 3.3.1 Humanist Theories of Learning

Humanist theories of learning consider the purpose of learning is to enhance personal growth and development (Driscoll & Carliner, 2005; Merriam, et al., 2007). Humanism suggests that individuals are self-directed and in control of their destinies, and therefore reject the notion that behaviour is predetermined, either by the environment or the individual’s unconscious drives (Peterson & Provo, 2000). Humanists believe that people are inherently good and strive for a better world, and therefore highly motivated to learn and take responsibility for their learning (Merriam, et al., 2007). Proponents of this perspective include Abraham Maslow (1943), Carl Rogers (1946) and Malcolm Knowles (1980).

Maslow (1943) was interested in the motivation of human beings and proposed that human needs were arranged in a hierarchy of influences. At the lowest level are physiological needs for air, food, water and shelter. Those things which we need to survive. If these needs are met then a new set of needs emerge which are classified as safety needs such as the requirement for security and protection. This is followed by the need for love, a desire for companionship, acceptance and affection from others. Once this need has been fulfilled argues Maslow (1943) it is followed by the esteem needs or a need for self-respect and the respect of others. It also involves a need for strength and achievement including a sense of mastery and power. The final need proposed by Maslow (1943) is one of self-actualization;

> it refers to the desire for self-fulfillment, namely, to the tendency for him to become actualized in what he is potentially. This tendency might be phrased as the desire to become more and more what one is, to become everything that one is capable of becoming (Maslow, 1943, p. 383).

It is therefore important in safety training to recognise that workers are influenced by psychological and safety needs, and methods and materials which invoke these fundamental factors should be incorporated into training programs (Wilkins, 2011). The motivation to learn originates from the learner, and for Maslow the goal of learning is to strive for self-actualization (Merriam, et al., 2007). However, in high risk industries, a fear of death and serious injury were the main motivators for complying with safety regulations and consequently responding to training and transferring that learning to the workplace (Burke et al., 2011; Wilkins, 2011).
Another leading figure who wrote from a humanist view is Carl Rogers (Merriam, et al., 2007). The idea that we are responsible for our own lives is exemplified in his work. He argues that people are controlled by their own values and choices rather than by other factors and they have an innate need to grow and develop. His client-centred theory is based on this belief and emphasizes the importance of the client’s personal understanding of his or her experiences instead of the counsellor’s interpretation of them (Rogers, 1946). This approach is reflected in humanistic learning theory which advocates self-directed learning and sees the learner as central to the process with teachers/trainers as guides or facilitators (Driscoll & Carliner, 2005; Merriam, et al., 2007) and is often typified in an online learning environment.

3.3.2 Principles of Adult Learning

Malcolm Knowles’s (1980) brought prominence to the field of adult education by promoting the concept of andragogy, which he defined as “the art and science of helping adults learn” (p. 43). According to Knowles pedagogy (helping children learn) and andragogy are represented on a continuum ranging from teacher-directed to student-directed. Both concepts can be appropriate with children and adults, depending on the circumstances (Merriam, 2001) however, in most situations adults prefer to be more self-directed in their learning (Camm & Cullen, 2002; Knowles, Holton III, & Swanson, 2005).

A review of the literature (Cercone, 2008; Knowles, et al., 2005; Merriam, et al., 2007) suggests the following characteristics of adult learners form the basis of the andragogical model:

- A need to know why they are required to learn something. Adults will weigh the benefits they will gain from learning the information and the negative consequences of not learning it. To help raise the level of awareness of learners as to why they need to invest effort in learning the information is to present real or simulated experiences in which learners discover for themselves the gaps between where they are now and where they need or want to be.

- A self-concept of being responsible for their own learning and thus capable of self-direction. However some adult learners can revert back to dependent learners in training situations as they are conditioned by their previous school experiences and expect to be taught. Some learners may need some type of structure to assist them in becoming more self-directed.
• An extensive reservoir of prior experience which they can draw upon. Adult learners can build on previous knowledge and experience by relating new information to past events and experience. Also adult learners learn more via practical methods rather than by more passive means. Hence the richest source for learning resides in the adult learners themselves, thus techniques such as simulation exercises, problem solving and group discussion that relate learners’ experiences to the concepts being learned are important.

• A readiness to learn what they need to know to cope with existing situations. Adult learners tend to know what they want to learn and prefer training programs organised towards their personal goals. As adults are goal oriented, objectives and goals should be clearly outlined early in a course.

• A problem-solving approach to learning and interested in effective application of knowledge. Mature learners want to see a reason for learning something, and learning should be applicable to work or home. Adults are practical and need to focus on what is important to them. Furthermore, adults learn new knowledge, understanding and skills more effectively when they are presented in the context of application to real-life situations.

• A motivation to learn, driven by internal rather than external factors. Some external factors that motivate adults include promotion, higher salaries and better jobs but more potent are internal motivators such as increased job satisfaction, self-esteem and quality of life. The motivation to learn can be hindered by low levels of self-efficacy as learners, time constraints, lack of resources and programs that violate principles of adult learning.

Based on these assumptions, pedagogy related to theories of adult learning was devised. For example with regard to the principle that adults become more independent and self-directing as they mature, Knowles (1980) recommended a supportive environment which kept the locus of control with the learner. In such an environment the teacher would act as facilitator, ensuring learners participate and share their experiences with feelings of acceptance and respect (Knowles, 1980; Merriam, 2001). Moreover, Knowles’ (1980) principles of adult learning can readily be applied to an online learning environment. In regards to self-direction, an online program can allow a high degree of learner control by letting learners choose the order and pace in which they complete the lessons (Cercone, 2008; Granger & Levine, 2010).

Although Knowles’ model provides valuable insight into the principles of adult teaching and conditions of learning it does not give a total picture on adult learning (Merriam, et al., 2007). The andragogical model does not acknowledge that learning and cognition are situated within a social context (Merriam, 2001; Pratt, 1993). It promotes the
individualistic nature of the adult learner where self-concept, past experiences and perceived needs are precursors to learning however the impact of socio-cultural influences are largely ignored (Pratt, 1993).

3.3.3 Transformational learning

Andragogy was not the only model of adult learning to gain prominence in the 1970s (Merriam, 2001). Transformational learning involved critical reflection by the learner to achieve autonomy and self-direction in learning (Baumgartner, 2001; Merriam, 2001, 2004). Transformational learning has roots in Piaget’s (1953) theory of cognitive development. Piaget’s theory states that schemas are constructed through the process of assimilation and accommodation to achieve balance or equilibrium. Hence, all human development begins with our awareness of some disequilibrium, a state of being uncomfortable when adjusting existing schemas to resolve conflict and become more comfortable. To restore equilibrium, we first try to assimilate the knowledge by selecting and shaping experiences in accordance with existing schemas, however if this is not successful we then need to adjust or change those schemas to ‘accommodate’ the uniqueness and complexity of new information (Powell & Kalina, 2009). Piaget’s theory highlights the importance of cognitive dissonance or disequilibrium to effect conceptual change (Brown, 2008).

Transformational learning is a theory that emphasizes the growth and development of adults over time, and that this change is almost always viewed as a positive process (Merriam, 2004). Since first introduced by Jack Mezirow in 1978, the concept of transformative learning has been a topic of interest and theory building in the field of adult education. Transformative theory is uniquely adult and grounded in the nature of human communication as it seeks to explain how adults make sense of their life experiences (Merriam, et al., 2007; Taylor, 2000). Mezirow (2000) defines learning as “the process of using a prior interpretation to construe a new or a revised interpretation of the meaning of one’s experience in order to guide future action” (p. 5).

Transformative learning seeks to explain how learners’ expectations, framed within cultural assumptions and presuppositions, directly influence the meaning we extract from our experiences. It is the critical reflection on their experiences that leads to a change in meaning structures (frames of reference that are based on the whole of individuals’ cultural and contextual experiences and that influence how they behave and
interpret events) which in turn leads to perspective transformation (Imel, 1998; Taylor, 1998). Mezirow (1991) differentiates between types of meaning structures, including meaning schemes and meaning perspectives. Meaning schemes are made up of specific beliefs, attitudes and emotional reactions that influence and shape a particular behaviour and are usually identifiable through our habits and expectations. Changes in learners’ meaning schemes can happen on a regular basis as individuals add to or integrate ideas into existing meaning schemes through learning (Imel, 1998).

A meaning perspective is a general frame of reference;

the structure of assumptions through which we filter sense impressions. It involves cognitive, affective and connative dimensions … It provides the context for making meaning within which we choose what and how a sensory experience is to be construed and/or appropriated (Mezirow, 2000, p. 16).

Mezirow (1991; 2000) purports that our frame of reference is composed of two dimensions, habits of mind and a point of view. A habit of mind is a set of assumptions that act as a filter for interpreting the meaning of experience. They are broad, abstract, determining, customary ways of thinking, feeling and acting influenced by our cultural, social, economic and political set of codes (Mezirow, 1991; 2000; Taylor, 1998). A habit of mind is expressed as a particular point of view. A point of view is made up of meaning schemes, and thus can change more easily than habits of mind because we are more aware of them due to receiving feedback (Merriam, et al., 2007).

Meaning perspectives act as perceptual filters that organize the meaning of our experiences. When we come across a new experience our meaning perspectives compose the lens through which each new experience is examined and given meaning. As the new experience is assimilated into these structures, it can reinforce the current perspective, be rejected or through transformational learning, be replaced with a new perspective if the meaning system is found to be inadequate in accommodating a radically different and incongruent experience (Merriam, 2004; Taylor, 1998). A transformed and more developed perspective is usually the result of a disorienting dilemma. This can occur either through a series of incremental changes in our meaning schemes (points of view) which eventually leads to a change in our meaning perspectives (habits of mind), or as a result of an acute internal and personal crisis, for example a serious injury, divorce, retrenchment, a death or a natural disaster (Merriam, et al., 2007; Mezirow, 1991; 2000; Taylor, 1998; 2000).
An example is illustrated in a study conducted by Billet and Somerville (2004) who describe how a mine worker’s transformation centred on adopting safer working practices and more ethical approaches to work. The environment in which this miner worked was inherently dangerous and male-dominated. This created a masculine work culture where risk taking behaviours, competitiveness, aggression, and face-saving attitudes (such as not wearing personal protective equipment as it might be regarded as a sign of weakness) were pervasive and the social pressure to conform intense (Billett & Somerville, 2004). The worker experienced a disorienting dilemma in the form of a serious injury due to a mine accident. This event led to a questioning of personal values and assumptions held about safety that had previously influenced his behaviour and work practices. Instead of accepting the dominant culture of masculinity he rejected those assumptions and tried to encourage colleagues to question their own work practices (Billett & Somerville, 2004).

A disorienting dilemma is only the first step. According to Mezirow (2000) the transformational process is made up of ten phases (see Appendix A for an outline of each of the phases). Three components central to the transformational process are; life experience, critical reflection and rational discourse (Taylor, 1998). Mezirow (2000) argues that the process of transformation begins with the learners’ experiences. However, just having an experience is not sufficient. The learner needs to make sense of their life experiences. They need to deconstruct and critically examine the assumptions and beliefs that have framed how the experience has been interpreted (Merriam, et al., 2007). However not all disorienting dilemmas result in transformative learning. For example a significant event such as a debilitating injury, does not always lead to a perspective transformation whereas other seemingly innocuous experiences, such as a lecture, sometimes do (Taylor, 2000). According to Taylor (2000) both personal and socio-cultural contextual factors influence transformative learning. His review of the empirical research on Mezirow’s theory uncovered a number of studies that found that certain aspects of the learner’s background and socio-cultural context shaped the nature of transformative learning (Taylor, 2000). Mezirow (2000) acknowledges the importance of social context and states “The justification for much of what we know and believe, our values and our feelings, depends on the context – biographical, historical, cultural – in which they are embedded” (p. 3).
When an experience cannot be assimilated into prior knowledge, transformative learning can begin using the process of critical reflection. Critical reflection involves questioning the validity of assumptions and beliefs based on past experience. It usually occurs as a response to an awareness of incongruous thoughts, feeling and actions (Taylor, 1998). Brookfield (2000) agrees that critical reflection is key to transformational learning. However his definition of critical reflection goes a step further as it also includes learners analyzing the power relationships encountered in learning situations and scrutinizing taken-for-granted or imposed assumptions that have come to constrain the way they perceive the world that they hold dear and which serve the status quo (Brookfield, 2000). According to Mezirow (1991; 2000), learners need to change these existing frames of reference to make them a more inclusive, discriminating and integrating perspective so that they may generate new understandings that will prove more justified to guide action.

The third major component in Mezirow’s (1991; 1995; 2000) theory is rational discourse. Rational discourse is the essential medium through which learners evaluate and discuss new meanings. In rational discourse learners set aside long held personal beliefs, assumptions, prejudices and biases to achieve a common understanding. Discourse requires only that participants have the will and readiness to seek understanding and to reach some reasonable agreement. Feelings of trust, solidarity, security, and empathy are essential preconditions for free full participation in discourse (Mezirow, 2000, p. 12).

Discourse in transformative learning relies on a number of assumptions including; needing to achieve understanding with others, conditions conducive to creating understanding, objectivity and actions and words which are open to questioning and discussion. Understanding is arrived through assessing the evidence and measuring the insight and strength of supporting arguments. Thus discourse becomes the medium for critical reflection to be used by learners, where experience is reflected upon and assumptions examined and questioned and where their frames of reference or meaning schemes and structures are ultimately transformed and acted upon (Taylor, 1998; 2000).

To foster transformative learning, Taylor (1998) suggests that teachers need to establish an environment that is supportive and caring, and encourages the development of compassionate relationships among learners. Mezirow (2000) outlines a number of
conditions necessary for learners to be able to participate more openly and fully in rational discourse including:

- More accurate and complete information
- Freedom from coercion and distorting self-deception
- Ability to weigh evidence and assess arguments as objectively as possible
- Openness to alternative perspectives
- Greater awareness of the context of ideas and able to critically reflect upon their own and others’ assumptions
- An equal opportunity to examine, question, rebut and reflect assumptions and to listen to others do the same
- Willingness to accept an informed, objective and rational agreement as a genuine test of validity (Mezirow, 2000, p. 13).

However Taylor’s (2000) examination of empirical studies elicited a number of other conditions necessary to establish the appropriate environment for transformative learning to occur. These include the need for teachers to be supportive, trusting, caring, sincere and moral; a focus on self-disclosure; the need to discuss and resolve emotions and feelings prior to critical reflection; the importance of evaluation and feedback; the need for hands-on learning activities; and the importance of privacy and self-dialogue (Taylor, 2000).

Differences in learning contexts, learners and teachers all impact on the transformational learning experience. Taylor (1998) suggests that not all learners are ready for transformational learning, nor are all teachers. Some adult educators may feel uncomfortable with a goal of transformative learning. In addition many learning situations may not be conducive to bring about transformative learning (Taylor, 1998). Taylor (2007) reveals that a vast majority of the research on transformative learning and its practice has been within formal settings, such as universities and educational workshops. There is a substantial need to explore other contexts, such as workplaces, where the learning situation can be more informal, less dominated by the instructor and more open to external factors such as the environment and community (Taylor, 2007).

Adults are facing an increasingly complex world, which challenges established ways of doing things in almost every sphere of life. Thus the need to learn continuously and transformatively is paramount in a world that demands higher order thinking. In the past, it was acceptable for workers to build on existing frames of reference to understand and respond to changes in their workplace (Marsick, 1998). Today, employers need to develop workers who can adapt to rapidly changing conditions in
their work environment; think autonomously and responsibly; exercise critical judgement; and engage in more effective collaborative decision making (Mezirow, 1997). In sum, adults need to transform deeply held frames of reference to understand their experiences in ways better suited to increasingly high-pressured and complex demands (Marsick, 1998).

3.3.4 Narrative Learning

Daloz’s (1999) psycho-developmental perspective of transformative learning not only focuses on its intuitive nature but also advocates the importance of mentors and narratives in the process. In his view, he saw the teacher serving as a mentor and the goal of transformative learning being personal self-development. Moreover, Daloz (1999) highlights the importance of mentors in the business world, especially at the beginning of workers’ careers or at crucial turning points in their professional lives. The mentor is viewed by protégés as someone who has succeeded in achieving the goals they aspire to and who offers encouragement and tangible support (Daloz, 1999). In the mining industry, Cullen and Fein (2005) state that there is a long tradition of mentors training new workers. These mentors are credible because they have successfully survived many years in an often hostile environment. New workers learn by listening to and believing the stories told by these mentors (Cullen & Fein, 2005).

Daloz (1999) recognizes the importance of dialogue in the process of transformation, however he emphasizes the importance of narratives (or stories) as a vehicle to expand the world view of learners, “a good story transforms our vision of the possible and provides us with a map for the journey ahead” (p. 23). Likewise, Clark (2001) argues that stories help learners make sense of their experiences, especially tragedies, as it offers enormous potential as a mode of personal change. So, it is when a learner can identify with a person who has changed, that he or she can envision and embrace the possibility of change for themselves (Clark, 2001). Stories of transformation can enable learners to engage with new knowledge, wider understandings and broader possibilities because they are familiar and memorable (Rossiter, 2002). According to Daloz (1999) the mentor can share stories with learners to help promote whole person growth and journey towards a more holistic and transformed view of the world (Merriam, et al., 2007). Furthermore, Cole (1997) suggests that stories can lead to empowerment of mine workers. As workers examine and integrate knowledge and
attitudes acquired from their own experiences with those learned from others this can result in changed perceptions, behaviours and work practices that can help reduce injuries.

Cullen (2003) asserts that stories are an integral part of the mining culture. Story-telling, is often used in training situations to convey complex information in a way that is understandable and memorable (Cullen & Fein, 2005). Stories about deaths, disasters and near-misses, stories about expert miners they have worked with, and stories about how things used to be are shared within this community. These stories not only provide important information about the mining environment they also instruct new comers into the culture and values that industry and mining site embraces (Cullen, 2003). Slater (2002) has researched the powerful nature of stories. He claims that stories are an effective method of increasing knowledge and influencing behaviour;

It is difficult to imagine another communication genre that can communicate beliefs, model behavior, teach skills, provide behavioral cues, and simulate consequences of behaviors over time in as compelling and involving a fashion (Slater, 2002, p. 170).

Cullen (2003) argues that the goal of safety training is to change learners’ behaviours. This is not easy, especially if you do not have the buy-in of learners. People will generally behave in a manner that is expected in their culture, and will only change their behaviour to comply with statutory requirements when they must. However behaviour can revert back to how things were usually done, especially when supervisors are not around to monitor actions, and particularly if the new behaviours contradict culturally expected behaviours (Cullen & Fein, 2005). Stories can therefore help provide the catalyst for learners to step outside their usual thinking and consciously examine their own belief systems and change old assumptions in favour of new ones (Cranton, 2002).

Narratives are effective because they are easy to remember, offer a way to organize information, they draw listeners in allowing them to learn with their heads and their hearts (Smith, 2005) and they connect learners to the experiences of others without having to go through the experience themselves (Bruner, 2005; Jonassen & Hernandez-Serrano, 2002). As stories are the oldest and most commonly used method of making sense of our world, they can be a highly effective tool in instruction. Collecting stories from expert practitioners not only provides relevant information that can be used for interpreting and understanding problem-solving tasks but also produces an array of
conceptual and strategic knowledge that can be incorporated in learning events (Jonassen & Hernandez-Serrano, 2002). Cole (1997) suggests that narrative-based problem solving is a very effective means of promoting increased awareness of hazards and risk factors while also promoting critical thinking to help reduce accidents and injuries. He identifies four criteria which are important for the effectiveness of narrative learning: First, they must be accurate in the detail of the accident or incident that occurred. Second, the narrative must be authentic with respect to the culture, people, language and situation for which the material is designed. Third, the stories should be examined, designed and analysed, not only as learning interventions but also as a means for accurately assessing attitudes, knowledge and understanding. Fourth, narrative learning materials are more effective when used in small groups engaged in collaborative learning and problem-solving (Cole, 1997).

### 3.4 Learning in the Workplace

In a global economy, where companies can change locations and benefit from lower wage costs of workers, employees need to increase their skills and adapt to changes in work organisation and technology. Traditionally, ‘training’ at work meant an intervention which was formally structured and involved the acquisition of a set of skills or competencies that were presumably transferred to the workplace. These skills were then honed over the span of a person’s career, hopefully with greater expertise as time went on (Agashae & Bratton, 2001).

Rapidly changing economic and technological conditions have resulted in the advent of the knowledge worker and the need for life-long learning. Companies are now realising that traditional training approaches will not produce employees with the ability to cope with and participate constructively in the ever fluid processes around their work (Pillay, 2006; Visser & Berg, 1999). Carol Limmer, Chief Manager of Executive Development and Recognition for the Commonwealth Bank said in an interview with BRW in March 2002 that, “We are competing on a global basis. We have to be responsive. We can’t stand still. Nowadays you are not going to stay in your job if you are not continually learning” (Limmer, 2002, p. 69). In the knowledge era learning is no longer focused solely on information or skills-based acquisition. People now need to learn how to think differently about their problems and change their behaviour accordingly (Agashae & Bratton, 2001).
Given the emphasis being placed on the importance of workplace learning, an examination of the concept and the elements involved in workplace learning is necessary. Workplace learning is a very broad field and encompasses a range of theories derived from various related disciplines including; sociology, cognitive psychology, human resources, adult education, anthropology, policy studies, economics and management theory (Hager, 1999). Most organisations do not know or cannot state explicitly what theory or philosophy underpins their approach to learning, but they have one all the same. This tacit theory unconsciously influences the choices made regarding learning within the organisation including; how learning is regarded, the preferred method of instruction, who will have access to learning programs, the outcomes expected and the benefit to the organisation (Driscoll & Carliner, 2005). Understanding workplace learning theories is important as it not only helps provide a better explanation of why certain decisions and approaches to learning are made but also will offer guidance on how to do it well (Hager, 1999).

As no single model or theory for understanding learning in the workplace exists, and many perspectives are relevant due to the diversity and multifaceted nature of work, workplace learning is a concept which is hard to define (Boud & Garrick, 1999). This section will focus on the cognitive theories of learning, including knowledge order and structure, the development of expertise, problem solving and transfer of learning. It will then investigate informal and incidental learning in the workplace which is typically not classroom based or highly structured. According to Eraut (2000) informal learning involves no awareness of learning and no explicit intention to learn. He argues that most learning occurs in informal contexts and that such learning is always situated in a community of practice (Eraut, 2000). Finally this section will examine competency based training (CBT) which is widely used in the mining industry. The Australian competency framework has been developed through federal government, education and industry partnerships resulting in institutionally recognised and legitimate industry competency standards (Solomon, 1999). Competencies focus on behaviourally stated and measurable objectives (Holton III, Coco, Lowe, & Dutsch, 2006). This explicit link of competencies to learning outcomes has generated a more process oriented approach to learning with the goal being the acquisition of skills and knowledge which leads to improved performance (Solomon, 1999).
3.4.1 Cognitive Learning in the Workplace

Cognitive theory maintains that learning occurs when new concepts and ideas are added to learners’ existing knowledge structure or schema. According to Anderson (1982) there are two major stages in the development of a cognitive structure: a propositional (or declarative) stage, in which facts about the skill domain are interpreted, and a procedural stage in which the domain knowledge is acted upon using a variety of strategies or procedures to perform the skill (p. 54). Billett (1998) highlights the importance of propositional and procedural knowledge in the workplace as they assist with organising activities and achieving goals through problem solving and transfer of learning.

Propositional knowledge comprises facts, information, opinions and concepts. This knowledge comprises different levels of understanding, ranging from simple factual information (such as names of places) to deeper levels of conceptual knowledge (such as how a piece of equipment works) (Billett, 1996b). In the mining industry typical propositional knowledge includes information related to using personal protective equipment (PPE), engaging in work practices to reduce risk, communicating health and safety information, and understanding employee rights and responsibilities (Burke, Holman, et al., 2006). As competence is attained, not only is a greater body of knowledge established (Owen & Sweller, 1989) but also the elements of that knowledge become increasingly interconnected so that instead of accessing disjointed fragments of information, experts are able to access coherent chunks (Glaser, 1989). Thus, depth of understanding is based on the established links and connections among concepts. For example, a hazardous waste worker may use his or her knowledge of the components of an air respirator to solve a problem by examining the components most likely to fail. By going beneath the surface features of the task the worker is able to access and connect related domains of knowledge to solve the problem (Billett, 2001; Burke, Holman, et al., 2006). Therefore learners who are presented with complex problems need to undertake higher order processes such as examining a wide range of evidence, analysing contradictory theories or explanations and developing solutions. A learner who only utilises lower order processes, such as memorisation or following simple procedures, will not be able to complete the task successfully (Biggs, 1991a; McAlpine & Clements, 2001). As Berryman (1993) points out, deeper understanding is needed as workplace tasks become more complex and conceptual knowledge more opaque and
Procedural knowledge, which includes techniques, skills and abilities to achieve goals, provides learners with the ability to be more adaptable to changing circumstances and apply existing knowledge to new situations (Billett, 1995; Ormrod, 1999). According to Garner (1990) strategies enhance learning, (even though they are not always needed when learners have a great deal of well-organised conceptual knowledge) and effective learners invoke the appropriate strategy to the situation when required. Stevenson (1991) suggests that in routine situations, specific procedures are employed to achieve specific goals, however such set procedures are not effective when new or unfamiliar situations are encountered. Observing and inspecting the workplace for potential hazards, and reporting those hazards involves recognition and awareness skills, controlling hazards and proactively preventing accidents and injuries involve analytical and decision-making skills. As such, workers in the mining industry need to be able to apply concepts and generate solutions to remain safe (Burke, Holman, et al., 2006). Therefore approaches such as monitoring, evaluation and selection of appropriate strategies need to occur to help solve non-routine problems. Finally, the highest order of procedural knowledge (also known as metacognitive skills), is used to determine when to invoke the appropriate strategy by constantly monitoring and organising tasks and activities and by changing between different strategies when needed (Garner, 1990; Schunk, 2004; Stevenson, 1991). However, many experts are not even aware of the procedural knowledge that is guiding their actions. This is referred to as tacit knowledge and is usually acquired from experience (Munby, Versnel, Hutchinson, Chin, & H., 2003; Sternberg & Hedlund, 2002). Tacit knowledge is more than a set of abstract procedural rules, it is context-specific and used to solve problems or perform various tasks in various situations, but is not readily articulated or openly communicated (Sternberg & Hedlund, 2002). By making tacit knowledge more explicit, novices will develop the procedural knowledge necessary for successful performance in their jobs (Gott, 1989).

In the knowledge society, many organisations are becoming increasingly reliant on experienced learners being able to apply what they have learned to unique and demanding situations for a competitive edge. Complex tasks require high level skills, involving analysis, synthesis, critical thinking, decision making and problem solving. Successful workers use metacognitive skills to facilitate knowledge access and skill
transfer across a range of different job and task requirements (Osman & Hannafin, 1992; Vazquez-Abad & Winer, 1992; Winn, 1993a). This kind of skill is thought to improve performance through efficient assessment of progress, awareness of comprehension problems and use of effective strategies (Munby, et al., 2003). Research has also shown that well designed training programs can enhance the metacognitive skills of novice and ineffective learners (Gott, 1995; Munby, et al., 2003).

However, having deep layers of propositional knowledge and extensive levels of procedural knowledge does not guarantee high performance or the ability to solve complex problems (Perkins, Jay, & Tishman, 1993; Schunk, 2004). Dispositions, often described as values, attitudes and preferences, influence how a learner puts his/her capabilities into action. Some learners operate in an automatic fashion and often miss significant irregularities in routine situations thus formulating premature and incorrect solutions. In contrast, learners who are open, thoughtful and alert are better able to examine information from new perspectives, create novel approaches to solving problems and are sensitive to the context in which they operate (Perkins, et al., 1993). Thus, dispositions determine whether learners value a work task enough to put in the effort needed to learn the required knowledge (Billett, 1996b). This is significant in a work environment as what usually distinguishes high performers from average workers is not just superior knowledge and understanding but rather their thinking dispositions or their willingness to be mindful, invest mental effort, organise thinking, explore new options and take calculated risks (Perkins, et al., 1993).

Further, Biggs (1991b; 1993) in his research on student learning in school contexts, has revealed that a combination of motive and strategy is an important criterion in learning effectiveness. His research highlights the importance of three motivational dispositions; surface, deep, and achieving orientation to learning, which influence how students approach learning (Biggs, 1991b). A surface approach is based on a motive to minimise effort, but also to minimise the consequences of not putting in the required effort; in other words to avoid failure but not work too hard to do it (Biggs, 1991b; 1993). Hence “surface learners are motivated to complete the task rather than assimilate the learning” (Garrison & Cleveland-Innes, 2005, p. 137). Often this means the learner focuses on selected, essential tasks and opts for rote learning to reproduce the information to be learned as accurately as possible (Biggs, 1991b; 1993). Learners who adopt this
approach see the task as a chore or an imposition, and concentrate on the surface features rather than trying to make connections between components of the task and other related tasks to maximise understanding (Biggs, 1991b; 1999).

Like the surface approach, an achieving orientation is also outcome focused, not task-focused, and is extrinsically motivated. The goal of a learner adopting this approach is to achieve high grades. The strategies this learner uses relate to task-management, including organising time, working space and study skills in the most efficient way possible (Biggs, 1991b; 1993).

A deep approach to learning is more intrinsic and based on a personal interest in the task. Through a desire to satisfy personal curiosity about the topic, the learner focuses on the underlying meaning of the task rather than on the surface features. The learner uses the appropriate strategies, such as reading widely, discussing with others, checking evidence, examining logic and engaging with ideas to find patterns of meaning to integrate with existing knowledge (Biggs, 1991b; Entwistle & Peterson, 2004).

However, it must be remembered that a surface strategy, such as using memorisation, has its place and that different learning contexts require different approaches. For example if the learner perceives the material as uninteresting or meaningless a surface approach may be more appropriate. It is important for learners to identify and access the appropriate approach when necessary (Prawat, 1989).

Dispositions are also socially influenced and expected to conform to what is valued in particular situations. As Billett (2001) illustrates, each profession has particular values that are fundamental to its conduct. For example doctors are expected to be discreet, airline pilots to be cautious (Billett, 2001), and miners to be macho. In addition, these values can also have different interpretations in different workplaces. Waiting staff in a trendy café may be cool and chatty, while their counterparts in a prestigious restaurant may be highly attentive and reserved (Billett, 2001). Hence, dispositions have aspects relating to individuals (their values, beliefs and attitudes), those of the profession (the caution of pilots) and those relating to the particular values of the work place. “Together, these social, cultural and personal dispositional attributes contribute to the requirements for and learning of the vocational knowledge needed for performance” (Billett, 2001, p. 54).
The three forms of knowledge, conceptual, procedural and dispositional, are all interrelated and when working in concert provide learners with the knowledge and skills necessary for high performance in complex, ill-defined work situations. Today’s business world requires workers who are capable of identifying, solving and anticipating new problems. High performers are continually learning and transferring their knowledge to new situations. The ability to consciously guide action in novel problem solving situations by monitoring performance and predicting likely outcomes is the distinguishing characteristic of an expert (Billett, 1995; 2001).

### 3.4.2 Novices and Experts

It is important to understand the learning processes of experts, as opposed to novices in the workplace as it provides a guide to the development of instruction that effectively prepares workers who can succeed in a dynamic, highly technical and competitive work environment (Gott, 1995). A review of the literature revealed that expertise does not appear to be due to innate intelligence (Ericsson & Charness, 1994), nor does it appear that experts are better ‘thinkers’ than novices (Glaser, 1984; Perkins, et al., 1993). From their research, Ericsson and Charness (1994) conclude that it is not the amount of information stored that is most important but how experts organise and index that information. Experts have streamlined mental representations of their knowledge domain which they continually update and refine as the job demands (Ericsson & Charness, 1994; Gott, 1995). Further, the mental representation of knowledge by experts is crucial to their ability to plan, select and evaluate the most appropriate response to different activities in a given domain. So when a problem arises they are able to form an immediate representation of the problem which systematically cues the appropriate knowledge. In contrast, novices have not yet achieved the efficient organisation of knowledge required for rapid access (Ericsson & Charness, 1994). Research has also shown that experts are able to carry out tasks with a high level of automation and working memory is largely unaffected by interruptions. Experts are able to perform an unrelated activity and then return to their task with no decrease in performance and with only a brief delay to recall and subsequent reactivation of relevant information (Ericsson & Charness, 1994; Glaser, 1989).

Another hallmark of expertise is the categorization of problems by the means of their solution (Glaser, 1984; Sweller, 1989). For example a teacher, on noticing a child not...
performing a task, will quickly begin to form conclusions about what interventions are the most appropriate. As a result of a rich supply of experiences in their profession, the breadth and organisation of experts’ knowledge allows this categorisation of problems to secure a solution (Chi, Feltovich, & Glaser, 1981; Owen & Sweller, 1989). Novices usually work backwards from the goal, trying out strategies and seeing whether they have moved the problem closer to the solution. Trial and error is a common tactic of learners who have limited experience or knowledge of a problem domain (Middleton, 2002; Sweller, 1989). When faced with new tasks, experts can search their existing knowledge base, and fill in any gaps in their understanding with the appropriate pieces of information to construct more effective solutions than novices (Billett, 2001). This appearance of “intuitive” problem solving is due to those rich sets of schemata indexed by numerous patterns of representations which increases their understanding of the underlying principles of the problem (Chi, et al., 1981; Gott, 1995). Thus novices, who have not had the opportunity to build the cognitive models that experts have developed and refined through practice, cannot utilise organised and conscious troubleshooting and solution finding approaches (Gott, 1989; 1995).

3.4.3 Transfer of Learning

A trainee’s application of knowledge and skills learned in a training program back on the job is generally referred to as transfer of learning (Burke & Huchins, 2007; Hawley & Barnard, 2005). According to Baldwin and Ford (1988), for transfer to occur “learned behaviour must be generalized to the job context and maintained over a period of time on the job” (p. 63). Within cognitive psychology, engagement in problem-solving tasks (both routine and non-routine) is important to learning and transfer (Billett, 1996b). People continually encounter new problems and situations, and draw on their previously acquired knowledge and skills in one context and transfer it to a different one (Eraut, 2004; Stevenson, 2002). Royer (1979) reviewed the differences between two types of transfer; specific versus non-specific transfer, and near versus far transfer. Tasks that have a clear similarity between the original learning elements and the transfer task are regarded as specific transfer. In non-specific transfer, the original learning task and the transfer task do not share any obvious elements (Royer, 1979; Stevenson, 1994). For near-transfer to be successful, tasks need to have the same or similar contexts. Far-transfer occurs when the learning and transfer contexts are different, thus knowledge is being transferred to a new situation (Royer, 1979). Well-
defined or routine problems have clear goals and all the information necessary for solving the problem, thus requiring little conscious effort or engagement of cognitive structures (Billett, 1996b). Near-transfer involves learning routine and procedural tasks that are performed more or less the same way each time they are done. Hence, transfer will be optimised to the degree that the tasks, materials, equipment and other characteristics of the learning environment are similar to those encountered in the workplace (Noe, 1999). In contrast, ill-defined or non-routine problems have ambiguous goals, unknown elements and no one ‘right’ solution exists (Billett, 1996b; Ormrod, 1999). Therefore complex tasks require higher-level cognitive processes as far-transfer performance involves using extensive judgement to adapt to various new situations. There are no steps for all cases and so the learner must tailor general guidelines to each unique situation. Effective far-transfer performance requires a schema based on understanding the concepts underlying the problem or the deep structure. When learners encounter a far-transfer work situation they must activate the relevant schemata to classify and define what type of problem they face, and draw on relevant associated knowledge to handle the new situation (Clark, 1999; Glaser, 1989; Gott, 1989; Winn, 1993b).

A novice’s transfer success depends primarily on the surface similarities between tasks. If two tasks appear similar the novice will attempt to apply what he/she has learned in the initial task to the new task. Success, however, will usually occur only if the deep structures of the two tasks are similar. If the deep structures are dissimilar, transfer is unlikely to be successful (Clark, 1999). As previously mentioned, experts demonstrate far-transfer when underlying principles of a known situation can be abstracted and applied to an unfamiliar setting. It is this ability which is important to develop in learners so they can compete in an ever changing workplace environment (Stevenson, 1994). Further, as business and industry invest money in learning and development, the expectation is to see a return on their investments through the acquisition of transferable knowledge and skills by workers (De Corte, 1999).

**Socio-Cultural Approach to Transfer**

Billett (1998) makes the point that much of the cognitive literature traditionally viewed the construction of knowledge as a purely mental activity, and undervalued the impact of cultural and social influences on learning and transfer (Billett, 1998; 2001). A socio-
cultural pathway to expertise is associated with participation in a community of practice (Lave & Wenger, 1991) where the novice appropriates the tacit knowledge necessary to develop the schema and actions of more experienced workers (Billett, 2001).

This knowledge is attained through learning experiences that are authentic and guided. This guidance may involve the learner in collaborating with others to solve real problems in the workplace. Consequently, learners develop the procedures and concepts necessary to become proficient and which they would not discover on their own (Billett, 2001; Stevenson, 1994). Lave and Wegner (1991) argue that knowledge cannot be in any way general, abstract or de-contextualised. Therefore transfer of learning to new contexts is unlikely to result, especially if what is learned is substantially different from the context in which the learning originally occurred (Brown, et al., 1989; Lave & Wenger, 1991).

By engaging in authentic activities that encourage collaboration and real-world problem solving (Bednar, et al., 1995; Oliver, 1999) learners are able to construct their own understanding and apply that knowledge effectively in the workplace (Bednar, et al., 1995; Duffy & Jonassen, 1991). Instruction should provide contexts and assistance that will aid the learner in making sense of the environment as it is encountered (Duffy & Jonassen, 1991). Situated learning does not involve learners working on contrived problems based on theoretical situations. In the real world, people do not solve complex problems by applying de-contextualised knowledge in a step by step process. Rather, they reason with what a situation affords is required in order to solve the problems that occur there. If how people solve problems is determined by the specific situation in which the problem presents itself, then learning how to solve problems is best achieved in light of the specific circumstance of those situations (Winn, 1993a). Thus if knowledge is learned in a context of how it will be used, it will then be used in that and similar contexts. This is especially important in learning in the workplace as

humans are not good at transfer when the surface features differ from the transfer environment. Out-of-context training risks a high rate of transfer failure. Learning does not translate into performance (Clark, 1999, p. 96).

In high risk industries like mining, this is even more important as experiencing real life scenarios, including errors and situations that do not go to plan, prevents routinization of situations and develops the knowledge and skills for handling unexpected and
dynamic emergency events or critical incidents (Burke, Holman, et al., 2006; Burke, Sarpy, et al., 2006). Thus in safety training the contextual features of the training program should be varied to enhance the generalisation of recognition and awareness skills needed for identifying and dealing with workplace hazards (Burke, Holman, et al., 2006). Further, Smith (2001) states that vocational learners such as apprentices, which make up a large proportion of the mining workforce, prefer structured environments which provide opportunities for learning through direct social interaction with their peers and instructors. Their strong preference was for learning through demonstrations, hands-on experience and practice and “exhibited a distaste for learning sequences that were presented through verbal means such as reading or listening” (Smith, 2001, p. 611). Billett (1996a) states that near-transfer of procedures and concepts across communities of practice is a more likely outcome than far-transfer, however it is possible. The reason why far-transfer rarely happens is that as the situation in which the knowledge is to be applied increasingly differs from the original learning domain, the greater the degree of abstracted understanding is required. Transfer will only occur “if similarities in the community of practice can be identified, seen as appropriate and regarded as worth expending effort upon” (Billett, 1996a, p. 269). Transfer is not about learners acquiring abstract knowledge and procedures to apply to many new situations rather it is about generating learning experiences that lead to the development of abilities which allow learners to participate in the activities and practices important to them (Tennant, 1999).

Refining this idea, by seeming to oppose specificity in all learning, Anderson and colleagues (1996) contend that training by abstraction can be very effective. They argue that often real-world problems involve a great deal of busy work and offer little opportunity to learn the desired competencies. They point to the need to direct learner attention to relevant cues in the problem activity. They assert that learning would best occur with a combination of abstract instruction and specific problem/instances (Anderson, et al., 1996). Likewise, Stevenson (1994) states that while it is important to situate learning in the environment in which it takes place, it is also necessary to dis-embed the learning so that the bonding to a particular context is overcome, and transfer of learning can occur to new situations (Stevenson, 1994). Further, Simons (1999) raises the issue of individuals’ perception of near and far-transfer and the strategies used to deal with them. He argues that the degree of distance, near or far, is subjective and
varies among learners. Also different approaches and strategies are required for near and far-transfer, so a strategy appropriate for near-transfer is ineffective or inappropriate for far-transfer and vice versa. Thus decontextualisation and application in a variety of different situations are important strategies for far-transfer, whereas practice and automatisation in a limited range of situations are suitable strategies for near-transfer. The challenge for learners is to know what strategies are needed to be successful and when (Simons, 1999).

3.4.4 Informal Learning in the Workplace

Over recent years there has been a shift away from prescribed learning in formal educational settings to an increased focus on work-based learning (Boud & Garrick, 1999). To some degree this shift has emerged as a response to the many limitations associated with formalised approaches (Clarke, 2004). Critics for example, have remarked that learning which does not take place on-the-job can often be removed from the realities of the workplace, making relevance to the learners’ needs more difficult to establish and ultimately hindering transfer of learning to the job (Bryans & Smith, 2000; Clarke, 2004).

Informal learning is usually unstructured, learner-centred and experience based and includes mechanisms such as networking, coaching, mentoring, self-directed learning and performance planning. Further, informal learning can be purposefully encouraged by an organisation or it can occur despite an environment which is not highly conducive to learning (Marsick & Watkins, 2001). Also included is incidental learning which is a by-product of learners going about their daily work and is often an unconscious process (Marsick & Watkins, 2001). Marsick and Volpe (1999) reviewed a number of studies on informal learning in the workplace and concluded that informal learning can be described as follows:

- It is integrated with work and daily routines.
- It is triggered by an internal or external jolt.
- It is not highly conscious.
- It is haphazard and influenced by chance.
- It is an inductive process of reflection and action.
- It is linked to learning of others (Marsick & Volpe, 1999, p. 5).

Unlike incidental learning which is unplanned, largely unintentional, unexamined and embedded in learners’ belief systems, informal learning can be planned or unplanned.
and usually involves a conscious awareness that learning is taking place (Watkins & Marsick, 1992). Thus some degree of reflection on their experience by individuals occurs in informal learning. However, when a learner focuses attention on certain tacit or underlying principles of a task or problem, other ideas, concepts, beliefs or elements of the situation can be excluded (Watkins & Marsick, 1992). This can result in rapid, intuitive and correct decision making (Eraut, 2000) or it can lead to mistakes, when inaccurate assumptions and judgements are made and never examined (Watkins & Marsick, 1992).

Informal learning is a social process that is situated in the natural daily activities of the workplace and is largely dependent on social interaction with other individuals in that context to give meaning to experience (Enos, Kehrhahn, & Bell, 2003; Watkins & Marsick, 1992). Thus decisions made and implemented in a context which is naturally social are often affected by implicitly or explicitly shared social norms, beliefs, values and history (Watkins & Marsick, 1992). Sometimes in this social context, learners do not clarify their understanding before acting, and therefore, it is easy to become trapped by blind spots, misperceptions and prejudices which again lead to misinterpretation of situations and thus to learning of error or no learning at all (Marsick & Watkins, 2001; Watkins & Marsick, 1992). As Slotte and associates (2004) point out, tacit knowledge can lead to bad habits and dysfunctional practices that do not necessarily serve the goals of the organisation.

Dodge (1998) gives an example of informal or incidental learning where the social context of the workplace directly impacts on learning and results in behaviour that is inconsistent with the safety policy of the work environment. For instance, Dodge (1998) illustrates how a worker is penalised for not reaching a production target who knows they can easily meet the target by dismantling the safety guards. The worker, immersed in a culture which is risk oriented and subject to masculine peer pressure, removes the safety devices. Subsequently, the worker is praised or rewarded when the target is met, the lack of safety guards either goes unnoticed or is ignored. Although the workplace has an active safety induction and training program the norms, peer behaviour and management actions and directives reinforce learning of unsafe work practices. While the learning is neither planned nor intentional it is very powerful (Dodge, 1998, pp. 111-112).
Likewise, Wadick’s (2008c) research into the safety culture of subcontractors in the construction industry revealed that safety knowledge is often tacit and primarily learnt on the job. In such a male dominated workplace there is an acceptance of traditional masculine values such as toughness, ingenuity and independence, and an oral tradition in which risk taking and bold behaviour is respected. In this environment most learning is informal and incidental with little regard for written theory. Safety is principally considered the responsibility of the individual worker and based on common sense (Wadick, 2008b). To ensure business survival in a highly competitive industry, subcontractors rely on their own resourcefulness and many safety shortcuts have become accepted practices. Thus OH&S requirements are seen as an imposition rather than a benefit, as they reduce efficiency by tying up much needed time, money and resources (Wadick, 2008b).

Tynjala and Hakkinen (2005) suggest that workplace learning cannot be described by labels such as informal and implicit but can take different forms depending on the learner’s position in the workplace and on many situational factors related to the workplace context. They state that at least three basic modes of workplace learning can be identified:

1) incidental and informal learning which takes place as a side effect of work,
2) intentional, but non-formal learning activities related to work (mentoring, intentional practicing of certain skills or tool use, for example); and

Slotte and colleagues (Slotte, et al., 2004) recognise formal and informal learning as equally important aspects of workplace learning, they also emphasise that they involve different processes and outcomes. While informal and incidental learning are part of everyday work practices and tasks, and produces mainly implicit or tacit knowledge, formal learning takes place in the context of planned training and learning activities and is intended to foster explicit knowledge and skills (Slotte, et al., 2004).

However Billet (2001; 2004) challenges the descriptions of workplace learning as informal, non-formal, unstructured, concrete and incidental. He argues that learning outcomes are not necessarily concrete however this does not make them weak and that most activities in the workplace have inherent pedagogical properties. He also states that by characterising workplaces as informal or unstructured learning environments, is negative and imprecise and can lead to the erroneous assumption that such learning will
be inferior to formal learning, particularly in educational institutions (Billett, 2004).

3.4.5 Competency Framework

In the 1990s the Australian Government took the view that if the country was to be competitive in a global economy, it needed to increase the skill levels of its workforce and change current work practices (Beven, 1994; Gonczi, 2000; Kellie, 1999). Thus Competency Based Education and Training (CBET) was introduced to enable industry to be more globally competitive by establishing national standards of skills upon which to base vocational education and training which were appropriate to the changing needs of industry (Gonczi, 2000; Hase & Saenger, 2004). Originally the competencies were developed by Competency Standards Bodies, who represented industry interests, and approved and disseminated by the National Training Board (NTB). Subsequently, the Australian National Training Authority (ANTA) was formed to report on outcomes and to play a role in designing and further developing the CBET system so it was centred on industry needs and continued to provide a unified standards approach to skill development (Gonczi, 2000). A competency as defined by ANTA (1998) is the “specification of knowledge and skill, and the application of that knowledge and skill, to the standard of performance required in the workplace” (p. 10). It is very much an outcomes based model in which the focus was on observable performances, and whether the learner was competent as described in the written standard. By establishing clearly defined outputs a behaviourist framework for learning was utilised (Hoffmann, 1999). According to Hoffman (1999) this approach appears to work well for relatively straightforward tasks, however more complex, less tangible tasks are more difficult to describe and therefore harder to define as behavioural outcomes.

Initially, there was little or no attempt to involve educators in the process of competency development and implementation in Australia. Thus a major educational criticism of competency based education and training was its behaviourist focus on outcomes to the detriment of learning theory, and developing deep-level learning and problem solving capabilities (Beven, 1994; Gonczi, 2000). Concerns were raised that the modular approach to training failed to allow learners time to practice skills and reflect on their learning, thus making it harder for information to be stored in long term memory. Competencies were seen as focusing on the attainment of narrow, short term industry objectives rather than the achievement of long term skill development. Some educators
believed that with such a prescriptive approach learners may not recognise why certain actions are to be taken and how to apply this knowledge in a variety of situations (Gonczi, 2000).

Industry and employer groups also had reservations about the early forms of competency based education and training. Competency standards were regarded as overly prescriptive and inflexible. Companies also feared that by introducing the standards they could influence existing job classifications and conditions of employment. As a result of industry dissatisfaction, the link between the industrial and training domains was diminished and the simplified system is now known as the National Training Framework, with the chief component being the Training Packages (Gonczi, 2000).

The Training Packages were designed to allow learners to develop competence in a variety of unspecified ways with no set timeframes. The training packages comprise:

- Competency standards specifying workplace performance requirements and criteria by which the competency is evaluated;
- The rules governing the packaging of competency units into national qualifications and;
- Guidelines for assessing workplace competency under the particular package (Gonczi, 2000, p. 22).

To ensure that the national training system responds appropriately to new challenges, The Department of Education Science and Training (DEST) states in its Skilling Australia report that the workforce must be equipped with more flexible and adaptable skills, and that the quality and consistency of training must be a priority. DEST maintains it will continue to implement recommendations suggested by ANTA (Schofield & McDonald, 2003). This includes improving the design of the training packages to be more learner-centred and focused on the learning process rather than on teaching and assessment. Also to acknowledge the workplace as an authentic and relevant place of learning and implement strategies to integrate work and learning as much as possible. A focus on generic and employability skills rather than specific tasks, should help promote portability of skills and knowledge to a variety of work settings (Schofield & McDonald, 2003). Schofield and McDonald (2003) state that competency should be regarded in a broader context than just the ability to perform workplace tasks. They argue that competency should be defined as:

- effective performance in employment
• application of skills and knowledge within and across a number of work contexts and contingencies
• ability to transfer skills and knowledge across and within work contexts and within a changing context over time
• (where relevant) a combination of higher order skills (Schofield & McDonald, 2003, p. 5).

Further, Schofield and McDonald (2003) emphasise that competency attainment does not necessarily mean that learners can transfer acquired skills to any situation. They support Rumsey’s (2003) assessment that transferability of competency has not been well analysed or catered for within training package design or implementation. Rumsey (2003) argues that learning strategies have not been employed to help learners develop the skills or techniques to allow them to transfer learning to new situations. Nor has higher order skills involving complex cognitive and metacognitive processes and their assessment in work and learning contexts been successfully incorporated in competency standards, thus perpetuating a narrow, task oriented approach (Rumsey, 2003).

Wadick’s (2008b) research in the construction industry contends that the current approach to safety training of transmitting the ‘correct’ knowledge to workers would be difficult to engender a shift in perspectives, and hence behaviours, which have been socially constructed and emotionally embedded in the culture of the workplace. According to Wadick (2008b) many workers learn safety informally on the job and require participation in the workplace culture. Unfortunately, safety training ignores adult learning theories including socio-cultural learning and “views learning as the acquisition of cognitively-acquired individual competencies that will somehow be transferred to the workplace” (p. 26).

### 3.4.6 OH&S Competencies

In the mining industry, worker health and safety training has been dominated by the didactic instruction of safety rules and facts, especially as these are encoded in state and federal health and safety rules and regulations and the associated mandatory worker training (Cole, Wiehagen, Vaught, & Mills, 2001). According to the Queensland Coal Mining Safety and Health Regulation 2001, the coal mines’ safety and health management system must provide a training plan for individuals at each mine. The plan must include provision for the following:

a) induction training for coal mine workers and other persons at the mine;
b) refresher training for coal mine workers;
c) establishing the workers’ training needs about the safe performance of the mine’s coal mining operations, including, for example, training needs about the mine’s standard operating procedures;

d) recognising a worker’s current competencies and prior learning in establishing the worker’s training needs;

e) establishing a training program to meet the training needs using the endorsed components of the coal industry training package that are relevant for training and assessing the mine’s coal mine workers;

f) appointing persons who are competent to give the training and assess the workers’ competencies;

g) keeping and auditing records of training and assessment given and undertaken;

h) designating tasks that may only be carried out by a worker who has been assessed as competent to carry out the tasks;

i) training workers elected to be safety and health representatives (Coal Mining Safety and Health Regulation 2001, pp. 79-80).

The regulation goes on to state that each worker is trained, if necessary, and assessed to ensure adequate knowledge and understanding of processes, procedures and work instructions relating to each persons’ duties including materials and plant to be used. The training and assessment must be appropriate and can include formal or informal modes of delivery. As Torlach (1998) states in his report on a fatality in the mining industry,

Of particular note is the need to ensure that, not only are the safe-working standards of the operation communicated during the induction process, but also that some positive check is carried out to ensure that the message presented has actually been understood by the person receiving it (Torlach, 1998, p. 1).

According to a report by the Mining Industry Skills Centre (2007), the majority of training in the mining industry is delivered face to face and varies in content quality and consistency. It goes on to state that there are few processes in place to regularly review program content to ensure currency. The report contends that training programs were often delivered in a lecture style format which focused on passing the assessments in order to comply with legislation rather than providing the optimum mode of delivery to ensure improved learning and understanding. This traditional approach to learning, which assumes that everyone learns in the same way and has the same capabilities, does not always cater to the needs of adult learners. Moreover, the report highlights the importance of contextualising learning if mine workers are going to be able to effectively retain and apply their knowledge and skills safely. The report also states a need to develop innovative ways of delivering learning, such as simulator training and online learning to encompass the new generation of workers and the different skills and technologies being developed (Mining Industry Skills Centre, 2007).
3.5 Instructional Design Strategies

As previously discussed, the desire to produce workers who can solve complex problems and make critical decisions under extreme pressure has created a need in many organisations to continually update employee skills. Therefore employees need to have access to current and effective learning programs which are designed to meet their training, development and performance requirements to successfully respond to new opportunities in today’s competitive environment (Bastiaens, van Merrienboer, & Hoogveld, 2002; Meister, 1998). Traditionally, the instructional design of online learning or web-based training programs has not received as much interest as the technical aspects. However, instructional design is crucial for effective teaching and learning in an online environment.

Instructional design is a set of procedures for systematically designing and developing instructional materials using learning and instructional theory to ensure the quality of instruction (Merrill, 1996). It is the entire process of analysis of learning needs, the development of an instructional system that brings about desired changes in the learner’s knowledge and skills to meet those needs, the development of instructional materials, and the trial and evaluation of all instruction and learner activities (Reigeluth, 1983).

Although online learning has become more commonplace in recent years, there is still no standard approach to the development and implementation of online learning courses (Hsieh, 2004). Instructional design strategies still reflect an approach for developing professional expertise that is prescriptive and deterministic, despite the demand for new approaches when developing a continuous learning program using web-based technology (Driscoll & Carliner, 2005; Hutchins & Hutchinson, 2008; Pillay, 2006; Sims, 1997; 2006). This behaviourist philosophy is popular in workplaces as it is grounded in principles that efficiently produce clear and measurable outcomes (Driscoll & Carliner, 2005; Williams, 2002); a requirement of competency-based learning programs in the mining industry. An understanding of traditional instructional design principles and how online technology can be used is important as these approaches may be useful for delivering instruction of certain types of knowledge and skills via the web (Clark, 1999; Gustafson & Branch, 2002). However the potential of these models for developing skilled and knowledgeable performance needed in complex and dynamic
work environments is far from optimal (Bastiaens, et al., 2002; Pillay, 2006). Hence, when considering designing online learning in the workplace, it is important to understand the different instructional design approaches. This section begins with an overview of three of the major instructional design approaches; systematic design, cognitive load theory (CLT), and constructivist design principles, and the theories which underpin them, followed by a more detailed examination of each.

There are many approaches to the design of online learning. A popular method is the behavioural approach (see section 3.6), which maintains the objectivist view that knowledge exists independently of instruction (Jonassen, 1991b). Behavioural based courses are designed to ensure mastery of the content. Learner control is limited and structure is imposed by chunking, sequencing and pacing the content to be learned (Driscoll, 2002; Driscoll & Carliner, 2005). It is believed that by presenting simpler tasks first and organising information into smaller pieces, it is easier to remember and transfer the knowledge gained back into the workplace (Carroll, 1990; Reeve, et al., 1998; Sims, 1997; Wilson, Jonassen, & Cole, 1993). Instructional Systems Design (ISD) is a behaviourist based strategy for design of training programs that uses a systematic, step by step approach to identify what is required and how it can be delivered in an objectivist environment. It can provide an efficient method for diagnosing performance gaps and designing training solutions in the workplace (Noone, 1993). However Noone (1993) warns that companies are not interested in “elegant instruction that works superbly in the instructional setting but isn’t robust enough to survive workplace rigours” (p. 14). If the learner is unable to perform their jobs successfully, the instructional design is inadequate (Noone, 1993).

Some learning tasks, such as procedural or routine tasks, are best performed in well-defined settings in accordance with designed procedures that assume a more or less linear process that leads learners to attain well-defined instructional goals in predictable ways (Clark, 1999; Spiro, Feltovich, Jacobson, & Coulson, 1991). The highly structured outcomes that ISD tends to produce can cater efficiently for this sort of well-defined material. Structured programs definitely have their place, especially when instructing novices in a new skill or knowledge area (Clark, 1999), where immediate demonstration of outcome is required.

However in today’s mining workplace, employees must not only be able to recall facts
but also understand the context (both physical and social) in which the information can be used (Mallett & Orr, 2008). For example, the current mining situation is fast changing and physically demanding. Miners work in an increasingly sophisticated and complex environment where critical decision making capacities are required (Kowalski-Trakofler, et al., 2004). In dynamic work settings, where new technology is being introduced at an ever-increasing rate and potentially hazardous situations abound, workers need to be able to adapt quickly and apply existing and new knowledge to solve new situations (Kowalski-Trakofler, et al., 2004; Wadick, 2006).

Employees are continually learning and need to hone or improve their skills when and where they are needed. For continuous learning to be able to happen the learner should control the learning process (Howell & Silvey, 1996; Sims, 2006). As stated in the Mine Safety Technology and Training Commission (2006) report, improved “instructional designs should be applied to regulatory training to make it more interactive and interesting for miners” (p. 13). Winn (1997) suggests that the prescriptive approach to instructional design is not the only approach. Instructional principles should be used as guides for selecting methods of instruction rather than as unchangeable rules (Winn, 1997). Van Merrienboer and colleagues (2003) argue that there is growing evidence that authentic tasks based on real-life jobs as the motivating force for learning. Furthermore, Winn (1997) and others advocate that situating learning in context usually determines outcomes rather than prior knowledge or instructional method (Jonassen et al., 1997; Wilson, 1997; Winn, 1997).

With the need for workers to not only acquire knowledge and skills in complex and continuously changing environments, but also rapidly transfer expertise to other employees and organisations, more flexible models of instructional design are required. According to Bastiaens and colleagues (2002) this need provided the impetus for the cognitivist paradigm of instructional design to gain prominence. Unlike the behavioural approach which offered a clearly prescribed model of instruction, the cognitive approach is less clear due to differing cognitive models. For example, some models focus on cognitive strategies, such as information processing and decision-making functions, whereas other cognitive theories focus on content knowledge as the agency for inferring meaning (Tennyson & Breuer, 1997).

One cognitive theory, upon which a number of instructional design strategies are
founded, is cognitive load theory (CLT). CLT describes cognitive structures in terms of an information processing system. This involves long term memory, which is comparatively unlimited and working memory which performs all the conscious cognitive processing tasks. When dealing with unfamiliar information, working memory is severely constrained; it can only hold about seven elements of information and can process, in the sense of combining, contrasting or manipulating, no more than two to four elements. Hence, working memory screens information and selects one of three strategies to handle all the stimuli it is subject to including; eliminating the information from memory; retaining the information in working memory by rehearsal; or transferring the information into long term memory through rehearsal or by connecting it with information that is there already for later retrieval (Banikowski, 1999; Klingberg, 2009; Ratey, 2001). Unless the information is kept activated to be retained, almost all the contents of working memory are lost within about twenty seconds (Sweller, 2005a). Working memory can handle only a very limited number of new elements at a given time and is thus very limited in both capacity and duration (Paas, Renkl, & Sweller, 2003; Paas, Tuovinen, Tabbers, & Van Gerven, 2003). According to a number of theorists the fundamental tenet of CLT is that the role and limitations of working memory should be given greater consideration when designing instruction (Kalyuga, Chandler, & Sweller, 2001; Mayer, 2005; Mayer & Moreno, 2002; Paas, Tuovinen, et al., 2003; Sweller, 2005a). Two methods to help circumvent the limits of working memory are schema acquisition which allows information to be chunked into meaningful units and automation of procedural knowledge (Paas, Tuovinen, et al., 2003). When the cognitive load is unnecessary and interferes with schema acquisition and automation, such as the manner in which information is presented and the activities learners are required to complete, it is referred to as extraneous. Conversely, intrinsic cognitive load is determined by the amount of element interactivity and the expertise of the learner and therefore cannot be altered by instructional interventions (van Merrienboer & Sweller, 2005). Finally germane cognitive load is effective cognitive load. It is caused by learners’ efforts to process and understand materials. Thus appropriate instructional designs decrease extraneous cognitive load but increase germane cognitive load (Sweller, 2005a; Sweller, van Merrienboer, & Paas, 1998). By lowering extraneous cognitive load when intrinsic load is high the development and automation of schema can be achieved, subsequently generating the ability of learners to transfer acquired knowledge and skills (Paas,
Tuovinen, et al., 2003).

Cognitive ideas of instruction were not the only theories to become important in the search to develop the necessary knowledge and skills to enable continual learning. Theorists such as Wallace (1992) and Howell & Silvey (1996) suggest that instructors and designers should be more open to using a constructivist oriented approach to learning and online program design.

Although constructivism is more a philosophy than an instructional strategy, its view on learning has provided designers of learning programs with a general guide on how to create a constructivist learning environment. Bednar and colleagues (1995), Lebow (1993), and Savery & Duffy (1996) all present instructional models that utilise the following concepts, as they underpin the constructivist approach to instructional design:

- Learning is embedded in meaningful contexts such as real-world, problem solving situations,
- Encouraging learners to take control and to actively use what is being learned,
- Presenting information in a variety of different ways to reinforce important content,
- Supporting the use of problem solving skills to help learners expand their understanding,
- Assessing learners on their understanding through the transfer of knowledge and skills (Williams, 2002).

According to Wilson (1997) the constructivist approach to design is more holistic and less analytical. It relies on the cooperation of instructors and learners and the integration of materials, rather than imposing a sequential, content-based and cumulative process to instruction (Wallace, 1992). Consequently, constructivists believe learners should be encouraged to construct new knowledge for themselves by integrating information they receive from the program material or instructor into their existing knowledge base to create new knowledge (Brandt, 1997). Constructivists maintain that you need to be actively engaged in meaningful learning for new knowledge to be created. For learning to be meaningful, instruction must consist of authentic tasks which are directly relevant to learners’ real work situations (Bludau, et al., 1998).

The following section explores in depth the strategies used by three instructional design
approaches to facilitate learning; the systems method which is very structured and controlled, cognitive load theory (CLT) which aims to reduce working memory load and free resources to learn the required information, and constructivist design principles which advocate self-direction, collaboration and authentic learning.

3.5.1 The Systems Approach

The analysis and breaking down of content and/or tasks into specific behavioural objectives which are then criterion-reference tested, is the beginning of the systems approach to instructional design. Systems theory also prescribes for the designer a series of steps which must be moved through to develop effective instruction. Systems theory emerged during World War II as part of the development of large-scale military training, the aim was to find the most efficient and effective means to improve performance (Burton, et al., 1996). This approach to training was quickly taken up by the business world (Schiffman, 1995). Hannum & Hansen (1989) argue that this take up was because the following benefits were realised when compared to traditional instruction:

- increases in achievement
- greater mastery of tasks
- reduction in training time
- restriction in the range of achievement
- lower training costs
- more accountability for training results (Hannum & Hansen, 1989, p. 18).

There are a number of models of instruction based on the systems approach, each with several things in common. First, they are task-oriented and therefore always directed toward some specific content (Winn, 1991). Second, this approach is systematic and works towards achieving defined goals. Third, the development of behaviourist models of learning incorporates the following five stages; analysis, design, development, implementation and evaluation. Fourth, the parts of the system depend on each other for input and output. Finally, the entire system has built-in controls for review and revision to ensure the desired goals are reached (Hannum & Hansen, 1989).

Common Elements of the Systems Approach to Instruction

The systems approach generally begins with the analysis phase, which identifies what training is needed and determines the possible solutions. This includes the instructional goals and a list of tasks to be achieved through instruction. This phase is followed by the design phase, which describes how the instructional goals will be achieved, usually...
in the form of behavioural objectives. These objectives will determine the content, methods and media used to deliver training. Assessment criteria are also established during this phase and are based on the learning objectives. The third phase is the actual development of the training materials. This includes the lesson content, supporting documentation such as handouts or exercises and all media that will be used in the instruction, for example the computer hardware and software. The implementation phase follows and refers to the actual delivery of the instruction, whether it is classroom based or computer-based. The purpose of this phase is the effective and efficient delivery of instruction. The final evaluation phase measures the effectiveness of the instruction and the appropriateness of the training. Evaluation is often specified as best occurring throughout the entire instructional process but often both formative and summative evaluations are recommended (Dick & Carey, 1990; Hannum & Hansen, 1989).

Online learning programs can very simply provide for these phases, as explained by Driscoll (1998; 2000), who maintains that online learning programs can provide rich and meaningful feedback during learner practice. Systematic design that incorporated multimedia into the online environment might, for example, utilise graphics to illustrate solutions, audio to model correct responses, text to explain why the answer is wrong and animation sequences to demonstrate the correct steps (Driscoll, 2000).

**Simplification and Sequencing of Knowledge and Skills**

A major theme in the standard systems approach is the isolation, simplification and sequencing of knowledge and skills according to identified learning hierarchies. In practical terms, this first means stating clear objectives and the expected learning outcomes so that learners have a better understanding of what is expected (Driscoll, 2002; Hannum & Hansen, 1989). To help in the attainment of the stated objectives, the instructor needs to break down the content to be learned into smaller steps or chunks and classify the ‘knowledge’ according to levels of learning based on Gagne’s hierarchy (Gagne, 1985) or Bloom’s Taxonomy (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956). (See Appendix B for a description of these taxonomies). The aim is to present easier or lower level tasks first as they are pre-requisites for mastering more difficult or complex tasks. This information is then used to develop instruction in a linear progression, building on prior knowledge in a series of logical steps. Feedback on
performance is periodically given and learning success is evaluated by tests developed
to measure each objective (Reeves, 1992; Wallace, 1992). Focusing the learner on
information deemed essential and appropriate to their level of readiness ensures the
more consistent attainment of well-defined learning objectives set by the instructor. It is
believed that by systematically sequencing pre-determined learning activities,
understanding will result. This is demonstrated in successful performance of the
learning objectives and needs to be constantly reinforced through practice (Hannafin,
Hannafin, Land, & Oliver, 1997). The most well-known systems design model is Dick
and Carey’s Systematic Instructional Design Model (Dick & Carey, 1990). In later
editions they have included more recent trends in learning, including constructivism.
Using Dick and Carey’s (1990) model the procedure for designing, developing and
validating instruction progresses through predetermined steps in systematic fashion.
Thus each component within the process must be completed before continuing to the
next step (see Figure 3.1).

![Diagram of Dick and Carey's Systematic Instructional Design Model](chart)

Figure 3.1 Dick and Carey’s Systematic Instructional Design Model (Dick & Carey, 1990, pp. 2-3).

**Importance of Structure and Evaluation**

The behaviourist approach is widely used in developing online instruction as learning in
the workplace is often competency driven, focusing the learners’ attention on those
aspects of the course linked to the intended behavioural outcomes (Clark, 1999; Driscoll
& Carliner, 2005; Schwier, 1995). The intention is to impose structure on content and
limit learner misinterpretation by limiting their control or reinterpretation of content. Limited control means that learners remains on task and are not distracted or lost “in a sea of content” (Schwier, 1995, p. 123) especially for example by surfing the internet in an online learning environment.

Structure reduces demands on short-term memory by organising information into small pieces that are easy to remember and transfer into behaviours, especially in the workplace (Driscoll, 2000). It also helps learners focus on information the designer deems important and keeps the instructional goals in the forefront of the learners’ minds (Ritchie & Hoffman, 1997). This approach recognises that highly structured environments, where learner control is low, are less demanding on the learner’s mental processes. This is particularly important in situations where the learner is new to the content and not ready or inclined to take control of their learning (Wild & Quinn, 1998).

Evaluation and feedback are also essential features of the systems approach. As the emphasis is on defining a learner’s performance in terms of achievement of pre-specified objectives, tests are required that can measure the attainment of specific competencies all learners need to achieve. Thus criterion-referenced testing is a preferred evaluation tool (Dick, 1995; Shrock, 1995). Objectives are used to describe the setting in which behaviours must occur, and learners are individually assessed to determine they have achieved the competency level required. The over-riding aim is to ensure that the maximum number of learners achieve the objectives stated in the most efficient way possible (Dick, 1991).

### 3.5.2 Cognitive Load Theory and Instructional Design

As previously discussed, organisations have used the internet to deliver instruction based on a behaviourist paradigm. According to Tynjala and Hakkinen (2005) the aim of workplace learning is not to transmit knowledge but to transform and construct knowledge (Tynjala & Hakkinen, 2005). Current instructional theories are expanding to incorporate authentic learning tasks that are necessary to promote learning in complex, ill-structured work environments (van Merrienboer & Sweller, 2005). The general assumption is that such tasks help learners assimilate, organise and eventually transfer the knowledge, skills and attitudes necessary for effective performance in the workplace. However a risk of actively engaging learners in complex, meaningful tasks is that they have difficulties learning because they are overwhelmed by the nature of the
tasks (van Merrienboer, et al., 2003). Further van Merrienboer and Sweller (2005) argue that effective instructional design models should incorporate cognitive load theory. Because real-life tasks are often distinguished by many interconnected elements of knowledge and skills, designers should utilise an instructional model that can improve cognitive load in such highly complex tasks (van Merrienboer & Sweller, 2005).

As both extraneous and germane cognitive load (see section 3.5) can be manipulated by the instructional design of learning materials, there are a number of instructional strategies which can reduce working memory load and increase schema construction and automation (Brunken, Plass, & Leutner, 2003; Sweller, 2005a). These include the worked example (Kalyuga, et al., 2001; Sweller, et al., 1998), split-attention effect (Ayres & Sweller, 2005; Mayer, Heiser, & Lonn, 2001), redundancy effect (Sweller, 2005b), the expertise reversal effect (Kalyuga, 2005; Kalyuga, Ayres, Chandler, & Sweller, 2003) and modality effect (Low & Sweller, 2005; Mayer & Moreno, 2002).

A worked example consists of a problem followed by all the appropriate steps to solution, thus providing learners with the support to develop knowledge without excessive cognitive load (Sweller, et al., 1998). In contrast, conventional problem solving involves a means-ends search for the solution which places a heavy demand on learners’ limited working memory (Kalyuga, et al., 2001). According to Sweller and colleagues (1998) this type of unguided instruction can result in inferior schema construction and lower transfer performance. They further warn that too many worked examples can de-motivate learners and inhibit them from generating new and original solutions to problems as only standardised solution patterns are provided (Sweller, et al., 1998).

The split-attention effect occurs when attention must be split between multiple sources of essential visual information, thereby inhibiting understanding as learners cannot focus adequately on some of the presented material (Mayer, et al., 2001). By eliminating the need to mentally integrate multiple sources of information, extraneous cognitive load is reduced and learning is facilitated (Ayres & Sweller, 2005). A number of studies have been conducted that provide evidence of superior learning and transfer when instructional material has been restructured to integrate physically or temporally disparate sources of information (Chandler & Sweller, 1991; 1996; Mayer, et al., 2001;
Sweller & Chandler, 1994). In one such study, Chandler and Sweller (1991) found that electrical apprentices were presented instructional materials which contained many cases of split-attention. For example in learning about installation testing of electrical equipment the conventional instruction was to present the text and diagrams separately, including any related textual information. For their experiment, Chandler and Sweller (1991) modified the instruction by integrating the sources of information where possible. One group of apprentices received training using the conventional split-source format, the other was presented with an integrated design. By physically integrating the text and diagrams Chandler and Sweller (1991) demonstrated that the need to mentally reformulate the material is reduced thus freeing cognitive resources to learn the information. This resulted in superior performance compared to the split-attention group.

Ayres and Sweller (2005) emphasise that the split-attention effect only occurs when multiple sources of information are crucial for understanding, and therefore cannot be understood in isolation. Hence, integrating multiples sources of information which provide the same details in different forms will not be beneficial (Ayres & Sweller, 2005). Further, the split-attention effect only applies to high element interactivity material (Ayres & Sweller, 2005). According to Sweller and colleagues (1998), when intrinsic cognitive load is low the extraneous cognitive load imposed by split-attention does not overload working memory and therefore does not have an impact on learning.

The redundancy principle suggests that providing information to learners that is not essential inhibits rather than promotes learning. Redundancy occurs when multiple sources of information can be understood in isolation. Thus presenting the same material two or more times in different forms overloads cognitive resources as the information is difficult to ignore (Sweller, et al., 1998). Chandler and Sweller (1991) demonstrated the redundancy effect with both electrical engineering and biology instructional material. In the biology example, a diagram was presented to learners showing the flow of blood in the heart, lungs and body together with written information about direction of flow. The diagram also included arrows showing the direction of blood flow around the body and could be easily understood in isolation. Thus the statements about blood flow were redundant. Learners who received only the diagram and not the added redundant material performed better and quicker suggesting
that redundant information can impede learning (Chandler & Sweller, 1991; Sweller, et al., 1998). Unfortunately some designers assume that presenting the same information in different forms or presenting additional explanatory information can be advantageous to learners and if not will cause no harm. This approach contradicts the overwhelming evidence which demonstrates that redundant information is not neutral and is therefore detrimental to learning. Consequently, instructional designs that eliminate all unnecessary explanations, reducing the requirement of learners to coordinate multiples sources of information, can be superior to those that incorporate redundancy (Sweller, 2005b).

However a learner’s level of expertise is essential when determining what material is considered relevant. Information that is redundant for some learners and should be removed, may be critical for novice learners and best integrated (Sweller, 2005b; Sweller, et al., 1998). As levels of expertise increase with learning, additional explanations will probably become unnecessary and therefore redundant. Thus design principles that should help novice learners can have the opposite effect with experienced learners. This is termed the expertise reversal effect (Kalyuga, 2005; Kalyuga, et al., 2003). Novices lack the required domain specific schemas associated with a task or situation. Thus their long-term memory has no guidance for how to handle the given task or situation. Effective instruction can act as a substitute for missing schema and help construct the necessary mental representations. In contrast, experts possess a large number of domain specific schemas which are organised to allow them to access multiple elements of related information as a single, higher level element (Kalyuga, et al., 2003). This capacity, including the automation of repeatedly used schema, allows experts to free working memory to concentrate on other activities (van Merrienboer & Sweller, 2005). If instruction includes additional information to support schema construction and experts cannot ignore this information, working memory can be overloaded trying to cross-reference and integrate the redundant material (Kalyuga, et al., 2003). Kalyuga, Chandler and Sweller (2001) demonstrated in their work with electrical engineers that novice trainees benefited from textual information included in the diagrams of electrical circuits thus reducing split-attention as they were not able to understand the diagram-only format. However, more experienced trainees showed a preference for the diagram-only format and performed significantly better (Kalyuga, et al., 2003; Kalyuga, et al., 2001). The most important instructional implication to flow
from the expertise effect is that efficient instructional methods should be customised to the level of experience of intended learners (Kalyuga, et al., 2003). As van Merrienboer and Sweller (2005) suggest there is a need to;

> develop new methods for the assessment of expertise based both on performance and cognitive load and to use assessment to develop adaptive eLearning applications. By continuously adapting instruction to levels of expertise, the difficult task of predicting subsequent levels of expertise prior to the commencement of an instructional sequence is obviated (van Merrienboer & Sweller, 2005, p. 152).

Furthermore, Pollock and colleagues (2002) state there is a paradox in cognitive theory for assimilating complex information. They argue that very complex and highly interactive material cannot be understood without assimilating all the elements simultaneously in working memory. If the learner does not possess the relevant schemas in the first place, and therefore cannot process all elements simultaneously in working memory, how can schemas be constructed? The solution proposed by Pollock et al. (2002) and other theorists is to learn separate skills in isolation so they can be easily retained, integrated and processed in working memory. The result may be limited understanding initially, however once all elements are processed in working memory and the interacting elements connected and assimilated into long term memory, full understanding should occur (Pollock, et al., 2002; van Merrienboer, Clark, & de Croock, 2002; van Merrienboer, et al., 2003). This approach supports the theory of learning hierarchies which suggests that lower level skills are prerequisites to higher order skills (Bloom, et al., 1956; Gagne, Briggs, & Wager, 1992). Instructional theories are now recognising the importance of real-life learning tasks yet novice learners can be overwhelmed by the complexity of such tasks. Therefore, the challenge is not only to determine which elements, or sets of interactions, should instruction begin with but also how to gradually increase element interactivity while keeping the nature of the whole task intact (van Merrienboer & Sweller, 2005).

### 3.5.3 CLT and Multimedia Theory

Richard Mayer (2003; 2005) used the foundations of CLT and presented a theory of multimedia in terms of an information-processing model. Mayer described learning from multimedia as learning from any materials that combine more than one mode of delivery, such as auditory and visual stimuli, and proposed ways to reduce extraneous cognitive load.
According to cognitive theory visual and verbal materials are processed in different information processing channels. When the initial input is to the eyes, such as illustrations, animations, video or text, the learner begins processing that information as pictorial representations in the visual channel; when initial input is to the ears, such as narration or sounds, the learner begins processing that information as verbal representations in the auditory channel (Mayer, 2005; Mayer & Moreno, 2002). Thus the modality effect occurs under split-attention conditions when too many elements are required to be processed in visual or verbal working memory. This can lead to cognitive overload, reducing the amount of elements processed by the learner (Mayer & Moreno, 2002). To avoid this occurring, the instructional technique is to present some information in visual mode and other information in auditory or spoken mode instead of written form (Low & Sweller, 2005; Sweller, 2005a). Furthermore, the modality effect is particularly important in the context of online multimedia learning as this medium involves different presentation modes (Low & Sweller, 2005). Mayer and Moreno (2002) conducted a number of multimedia studies using meteorological tasks to demonstrate that learners performed better when information was presented as pictures and narration rather than as pictures and on-screen text. “In four out of four comparisons, the animation and narration group generated more solutions on the problem-solving transfer test than did the animation and text group” (Mayer & Moreno, 2002, p. 115). However, as with split-attention the modality effect only occurs when the instructional material has high element interactivity and both the spoken and written information are crucial to understanding (Low & Sweller, 2005; Sweller, et al., 1998).

Mayer’s multimedia theory is limited in the extent to which it takes individual differences such as age (Paas, Van Gerven, & Tabbers, 2005), and gender (Flores, Coward, & Crooks, 2010; Grimley, 2007) into consideration. As mentioned (in Section 2.7) age can have an impact on working memory resulting in reduced working memory capacity and subsequent slower cognitive processing ability especially with complex tasks (Paas, et al., 2005; Wallen & Mulloy, 2006). This decreased cognitive capacity can be compensated in multimedia learning by the modality effect where audio-visual information is presented rather than just visual material, and ensuring the lag between visual and auditory material is as short as possible thus lowering cognitive load and reducing difficulties with regulating and monitoring the flow of information (Paas, et al., 2005).
Gender can also impact on learning as research has shown that tasks which require spatial ability (particularly mental rotation), favour males (Halpern, 2004; Ruggiero, Sergi, & Iachini, 2008), whereas verbal abilities favour females (Halpern, 2004; Tallberg, Ivachova, Jones Tinghag, & Ostberg, 2008). Research by Flores and colleagues (2010) has discovered that “males benefit from a dual mode presentation, whereas females benefit from a single mode presentation” (p. 98) when the goal is to transfer learning to new contexts. This finding was revealed when Flores and associates (2010) conducted research involving males and females learning about common vision problems from a graphic organiser type format such as a matrix in a computer based training program. The information was presented either visually or auditorily. Hence the visual text was a single mode condition and the spoken text was a dual mode condition since it required both visual and audio senses. The findings suggested that words may be more effective when presented in spoken text for males and visual text for females. One explanation may be that due to superior verbal skill the females excelled in the visual text condition whereas the males may have needed the auditory input so they could use the visual channel for studying the spatial relations within the matrix. Therefore, according to Flores and colleagues (2010) the modality principle may not apply in all multimedia situations. Further, research by Grimley (2007) produced evidence to suggest that gender was an important factor to consider in relation to experience as “females appear to require well-designed materials for improved learning outcomes whether prior knowledge is high or low” (p. 479). To ensure optimum learning outcomes cognitive load theories may need to take into account a variety of individual factors including gender, age, cognitive ability and prior experience when developing online learning programs.

3.5.4 Constructivism and Real-World Learning

According to the constructivist perspective (see section 3.2.3), it is important that real world contexts, which are subject to changing demands and situational constraints, are used during instruction to help learners construct their own understanding and apply that knowledge effectively in the workplace (Bednar, et al., 1995; Duffy & Jonassen, 1991). With this approach learners should be self-directed and actively engaged in authentic activities that encourage collaboration and real-world problem solving (Bednar, et al., 1995; Oliver, 1999). Consequently, teaching methods in an online learning environment should recognise that learners come with their own set of personal beliefs,
motivations and understanding about the task and the knowledge to be taught. Therefore instructional strategies should take into account learners’ experiences and foster participation (Williams, 2002).

Authentic and problem-based learning environments require learners to interact with the complexities of the external world and with other learners. These environments should be challenging but also provide the necessary support to learn. Help should be supplied at critical times to real difficulties and should take the form of challenging the learners thinking and understanding of the problem rather than providing information (Savery & Duffy, 1996). Such supports, in an online learning environment, can be provided by the active involvement of the instructor, other learners, interactive technologies and learning resources.

For constructivists, interaction and collaboration are important in any learning situation (Visser & Berg, 1999). Those who participate in the learning process must be able to connect with each other. Research has shown that developing a critical understanding of the material to be learned is related to opportunities learners receive to explain issues in their own words, express their own points of view, formulate opposing or different arguments, and collaborate with others on projects and presentations (McIsaac & Gunawardena, 1996; Newman, et al., 1997). An online learning environment can facilitate this process by providing the means for learners to work collaboratively to solve given problems and displaying the solutions for others to view (Oliver, 1999).

Collaborative groups are important because we can test our own understanding and examine the understanding of others as a mechanism for enriching, interweaving and expanding our understanding of particular issues or phenomena (Savery & Duffy, 1996, p. 136).

Winn (1991) says that as learners interpret the world individually, learning outcomes will differ for each student. Designers who apply a constructivist approach aim to facilitate a learning process whereby outcomes are negotiated and agreed to by the learner and the instructor before or while they are being achieved (Winn, 1991). A misconception of constructivism arises from the notion that chaos will result from a multitude of unique perspectives. This misconception is based on the problem of how knowledge can be communicated and shared if all learners interpret information individually and construct their own meaning (Bludau, et al., 1998; Duffy & Cunningham, 1996; Jonassen, 1991b).
Mutually negotiated interpretations are an essential element of the constructivist approach. Constructivists argue that learners do not only rely upon peers and the instructor for input to help define problems but they also need to canvass and discuss a range of views with these people (Bludau, et al., 1998; Jonassen, 1991a; Winn, 1991). Such discussions are central to constructivism as it avoids lineal delivery and thus forces the learners to use their own words to define or redefine the issues or concepts that are central to the real world problems they are solving. Consequently, learners are more likely to be motivated by the applied nature of the tasks and the freedom to go about solving them (Bludau, et al., 1998; Jonassen, 1991a).

Since learners bring their own perspectives to a learning situation, differing interpretations and multiple perspectives are generated, and it cannot be assumed that there is one correct interpretation or perspective as would be the case in an objectivist approach (Duffy & Jonassen, 1991). A constructivist approach would claim that learning comes from the sharing of multiple perspectives (Reeves, 1992; Savery & Duffy, 1996) and changing or modifying existing knowledge constructs to absorb those perspectives (Bednar, et al., 1995).

The desire for multiple perspectives and branched design is well supported in the online environment, especially using the hypermedia of the world wide web in conjunction with the internet’s discussion facilities (Oliver, 1999). Spiro and colleagues (1991) argue that learners need to revisit the same material, at different times, in rearranged contexts and from different conceptual perspectives if they are to attain the goal of advanced knowledge acquisition. Online training can provide all of these elements, including presenting content from various perspectives.

We have referred to the need for rearranged instructional sequences, for multiple dimensions of knowledge representation, for multiple interconnections across knowledge components and so on. Features like these correspond nicely to well known properties of hypertext systems, which facilitate … multiple linkages among content elements (Spiro, et al., 1991, p. 29).

Constructivists believe that learners interpret what they learn individually, their learning outcomes will be different from one another, and therefore alternative methods of assessment need to be utilised. Jonassen (1991a) suggests a number of methods including; goal-free evaluation, authentic tasks, assessments based on knowledge construction, experience and context, multiple and multimodal perspectives and socially
constructed meaning.

Rather than relating evaluation to pre-determined goals, constructivists recommend that the instructor conduct a needs analysis and find out what the learners desire as their actual outcomes. Jonassen (1991a) argues that predetermined goals or objectives can negatively impact the learning process as the learning activities are controlled by those goals and any subsequent criterion referenced evaluation. Consequently, if instructors set goals for learners there is an overt assumption that these goals are more important. In the constructivist paradigm, the goals of the learners are important as meaningful construction occurs only when learners set their own goals (Bludau, et al., 1998).

Furthermore, as learners acquire new knowledge and skills through engaging in authentic tasks, evaluation should reside in similar rich and complex environments (Jonassen, 1991a; Lebow, 1993). Thus, learners should be assessed on the tasks they have performed in the real world rather than on decontextualised tasks. The type of activity undertaken will also determine the evaluation criteria. “If the tasks are authentic, then the real-world environment that is being modelled in the constructivist environment will recommend the most relevant variables” (Jonassen, 1991a, p. 30).

Therefore when designing training on a constructivist philosophy, Jonassen (1991b) recommends a number of design principles which are summarised below:

- Create real-world environments that employ the context in which learning is relevant,
- Focus on realistic approaches to solving real-world problems,
- The instructor is a coach and analyser of the strategies used to solve these problems,
- Stress conceptual interrelatedness, providing multiple representations or perspectives on the content,
- Instructional goals and objectives should be negotiated and not imposed,
- Evaluation should serve as a self-analysis tool,
- Provide tools and environments that help learners interpret the multiple perspectives of the world, and
- Learning should be internally controlled and mediated by the learner (Jonassen, 1991b, pp. 11-12).

Savery and Duffy (1996) believe that constructivism allows learners to think both critically and creatively, and to monitor their own understanding, that is it allows learners to develop metacognitive skills. They also state that collaborative learning encourages learners to examine the understandings of others as a way of expanding their
of particular issues or events. Jonassen and associates (1997) assert that knowledge is not something that is possessed entirely by one person or transmitted passively to another. It is an elusive phenomenon that might be represented both in complex interacting relationships in the world and in the learner’s head. They also argue against the deterministic predictability of the systems approach to learning and design. They believe that learning is much more complex and less certain than implied by this approach. For them it is impossible to be an objective observer of reality as the act of observation intervenes and changes the relationship to what is being observed as well as changing the thing observed and the observer (Jonassen, et al., 1997). Furthermore a myriad of components of learning systems are necessarily open because they can never be completely controlled nor can an individual’s interpretation or construction be completely pre-specified (Jonassen, et al., 1997).

3.6 What is the Right Approach in Today’s Workplace?

The exponential growth of information and the complexity of tasks that characterises modern organisations make the need for learning more important than ever. However, the sheer volume of what we have to learn and the speed at which we must learn it can be daunting. So much so that relying on traditional models of learning acquisition in all situations are failing organisations (Rosenberg, 2001). Meeting this challenge requires new thinking about how novices and advanced learners acquire knowledge, behaviours and skills. As Wadick (2006) states, workers are constantly faced with non-routine situations that require novel solutions and the development of new approaches. Teaching individual competencies to all levels of workers with the expectation this knowledge will be acquired and transferred to the workplace can be dangerous (Wadick, 2006). According to Loos and Diether (2001) online occupational health and safety training in America does not encourage higher order cognition, critical thinking or transfer of knowledge. They argue that the design of instruction needs to be learner centred (suitable for both novice and experienced workers), incorporate authentic situations encountered in the workplace, support the active construction of knowledge by learners and provide continuous quality feedback (Loos & Diether, 2001).

Sophisticated organisations acknowledge the link between superior instructional design and achieving the strategic goals of the company. To meet the objectives of the organisation and the needs of learners, the designer must have a thorough understanding
of learning theories to enable them to provide the appropriate learning environment (Meister, 1998). A ‘one size fits all’ approach to designing online learning programs is not the most effective method for skilling workers so that they achieve their goals of advancement and improvement and the organisations’ goals of remaining competitive in a global economy (Vazquez-Abad & Winer, 1992). Further, customised learning involves more than self-paced learning, a variety of multimedia elements, 24/7 access and a non-linear structure. To be truly customised, online programs should also account for contextual variables such as the learning needs of individuals, the characteristics of the learning environment, computer self-efficacy and company culture (Servage, 2005).

As Newton and colleagues (2002) state, online learning in the Australian mining industry must not only meet competency standards requirements, it must also be purposely designed to meet the needs of experienced and novice learners. A review of the literature commissioned by the American National Institute for Occupational Safety and Health (Cohen & Colligan, 1998) regarding characteristics of successful safety training in America are summarised below:

- Problem solving and hands on activities such as case studies produced the best training outcomes.
- Learning programs based on authentic situations encountered in the work environment made training more relevant and increased the likelihood of transferring learning to the workplace.
- Setting performance goals and providing feedback fostered learning during and after training.

This approach is supported in a more recent review of mine safety training programs in America which suggested the following improvements be implemented:

1. Greater emphasis upon learning that requires collaboration and active problem solving.
2. Greater integration of miners’ practical knowledge and experience with the mandatory S&H [Safety & Health] information they are required to receive annually.
3. Greater realism in training scenarios and greater fidelity of visual illustrations.
4. Greater use of training materials that are thoroughly authenticated and field tested (Peters, et al., 2010, p. 511).

Ultimately, the more realistic and engaging the method of safety training the more likely knowledge acquisition will occur, resulting in a reduction in accidents and injuries (Peters, et al., 2010).

Reigeluth (1991) and other theorists argue that the different instructional models have
their unique attributes, and a complementary mix of approaches should be used to achieve the desired learning outcomes (Reigeluth, 1991; Tennyson & Schott, 1997; van Merrienboer, 1997; Wild & Quinn, 1998). As Tennyson and Breuer (1997) state, instructional design exists to help solve learning issues; it is not intended to limit or impose a certain approach to all situations.

The goals of a given learning environment are sufficiently complex that no one approach would or could be appropriate except in the simplest of situations. A robust psychological foundation linked to a rich instructional base provides a strong means to tailor instructional solutions to the specific conditions of a given learning situation (Tennyson & Breuer, 1997, p. 124).

Clark (1999) supports this view by stating that designers of training in organisations need to adopt different instructional approaches depending on the background of the learner and the type of performance required. Thus knowing the theory behind different instructional strategies gives the designer more power to deploy these methods more effectively (Clark, 1999). The instructional strategy should depend upon how advanced the learners are and how complex the content is. The appropriate strategy it appears cannot be based on one particular model (Clark, 1999; Reigeluth, 1997). Hence elements from various learning theories are required to produce effective and meaningful online learning experiences for adults in workplace settings:

given the convergence of behavioural, cognitive and social learning that underlie, workplace learning, researchers and practitioners should integrate perspectives honed by other disciplines into workable models for designing effective e-learning designs (Hutchins & Hutchinson, 2008, p. 375).

### 3.7 Summary

This chapter provided an overview of the literature in the areas of individual learning and instructional design. A number of key models and theories were identified and discussed during this chapter, particularly in the areas of adult learning, workplace learning and instruction design of online learning programs. The chapter also revealed not only the type of instruction (competency based training) that is utilised in the mining industry but also suggested that miners responded more positively to learning situations which were embedded in a socio-cultural approach as they had a powerful impact on behaviours such as informal and narrative learning.

Online safety training in the mining industry is undertaken by adults in the workplace via an online, multimedia program. Therefore adult learning theory, particularly
principles of adult learning, with influences from workplace learning theory (cognitive learning in the workplace, novices versus experienced learners, and transfer of learning), online learning and cognitive load theory underpin the design and focus of the study. The key aspects which were identified in the literature and appear to have an impact on the successful learning of safety in the mining industry include:

- **Learner support** – as many mine workers were not familiar with computers and online learning, trainer support would be helpful. This external assistance should focus on learning support to help ensure successful learning outcomes but also encompass technical and administrative support to facilitate the learning process.

- **Self-efficacy relating to computer skills and online learning** - the more confident and comfortable learners are with their computer skills and learning online the higher the levels of satisfaction with the online mode of delivery. Therefore learners in the mining industry would need a certain level of computer knowledge and self-efficacy if learning online was to be successful.

- **Suitable and reliable technology** – the technology should suit the basic technological skill level of the industry and be functional and reliable.

- **Appropriate and varied multimedia** - the multimedia should cater to both the younger and older generations, particularly in regards to the amount of visuals and text. The interface should be user-friendly, simple and consistent.

- **Relevant and engaging content and learning activities** – to promote engagement and subsequent learning and transfer to the workplace, the online program should provide interaction, include relevant and authentic problem solving activities and stories.

- **Suitable level of learner control** – the opportunity to have control allows workers to be at the centre of training and tailor the learning experience to suit themselves including the pace, order and content to be learned. However the level of control should match the learners’ prior knowledge and level of understanding of the content area.

- **Learner-centred instructional design** – the online induction program should be customized to suit both novice and experienced learners including differing levels of ability. Elements of cognitive over load should be identified and eliminated and appropriate assessments incorporated. Finally, continuous
quality feedback should be provided to ensure understanding of the knowledge, skills and attitudes learned.

The following chapter on Research Design provides the theoretical foundations, research design and methods used to investigate the central questions.
4. RESEARCH DESIGN

4.1 Introduction

Appropriate learning theories and instructional design strategies are necessary in order to develop efficient and effective online site safety inductions for workers in the mining industry. Further, there is a dearth of literature on workers’ perspectives on learning via computer-based systems and whether they apply what they have learned in the workplace. Hence this study was carried out with the broad objective of discovering mine workers’ perspectives of how satisfied and effective they found learning via an online site safety program. The central research questions of this study examine mine workers’ perspectives relating to:

RQ1- What are the perspectives of mine workers on the effectiveness of online site safety inductions in the Australian mining industry?

RQ2 - What instructional design strategies assist adult learners in the mining industry to engage with online OH&S induction training?

This chapter is concerned with the theoretical foundations, research design and methods
used to investigate the perceived effectiveness of an online site safety induction program in the mining industry. The chapter is divided into several sections. In the first section the theoretical framework of the study, a qualitative approach complemented by interpretivism and symbolic interactionism, is described and justified. In the second section, the research strategy of using a single case study is discussed, and the chosen methods of interviews and survey are justified for use in this study. The focus of the third section is on the processes of data collection and analysis used to explore the research question, and details methods for recording and storing the data. Finally, issues of validity and trustworthiness of the data are considered.

By using both qualitative and quantitative methods in this study both breadth and depth of understanding was achieved. The sequence of data collection involved gathering quantitative data using a survey and then collecting qualitative data in the form of in-depth interviews to expand on the general themes identified in the survey data analysis. The information gathered from the survey was used to support the qualitative investigation, therefore the inductive nature of the study was dominant (Creswell, 2003). The data from both the survey and interviews were analysed separately with the results integrated at the data interpretation stage to provide a more complete picture of miners’ perspectives of the effectiveness of an online site safety induction program. Figure 4.1 provides a diagram of the phases followed in the study. Capitalisation of the words indicates the greater emphasis or priority.

Figure 4.1 Sequence of data collection for the study
4.2 Theoretical Framework

Positivism and interpretivism are two major philosophical paradigms which are based on different assumptions regarding the nature of reality (Williamson, Burstein, & McKemmish, 2002). This section examines both the positivist and interpretivist approaches to research, and justifies why a perspective-seeking approach is more suitable to this study.

4.2.1 Positivist Research

The understanding of what is knowledge (or ontology) of positivists is that only one reality exists and it is independent of human perception. Thus the researcher is able to study a phenomenon without influencing it or being influenced by it (Sale, Lohfeld, & Brazil, 2002). Positivists believe that the social world can be studied in the same way as the natural world; that is knowledge can only be based on what can be observed and experienced (Williamson, et al., 2002). Objectivism is the epistemology, or view of understanding and explaining how we know what knowledge is, of positivists as they believe careful research can attain the objective truth and meaning of an event or experience (Crotty, 1998). Consequently, positivists view their methods as objective and value-free; that is their values do not affect how they conducted their research and interpreted their findings (Teddlie & Tashakkori, 2009). Positivist research usually begins with theories and models, defines variables for study and seeks to explain their relationships through generating hypotheses that can be tested using statistical techniques. The term quantitative is often used when referring to a positivist approach to research as the preferred methods of investigation involve gathering and interpreting numerical information (Teddlie & Tashakkori, 2009) with the aim being to make generalisations or “discover and document universal causal laws of human behaviour” (Neuman, 2006, p. 82). Quantitative research is thus more closely associated with deduction or reasoning from general principles to specific situations (Wiersma, 2000).

Post-positivism replaced the purist stance of positivism in the 1930s and although their theoretical perspective continued that reality exists, post-positivists believe reality is not easy to discover due to the researcher’s human limitations (Mertens, 2005). Therefore, to ensure a reasonable degree of certainty regarding the phenomenon under investigation, researchers should involve the use of more natural settings and solicit the view of insiders (emic) rather than relying on the perspective of outsiders (etic).
Consequently, post-positivists advocate the use of multiple methods to capture as much of reality as possible (Denzin & Lincoln, 2008). However the knowledge, values and beliefs held by researchers can influence what is observed (Mertens, 2005).

A positivist framework did not suit the study due to the subjective nature of the information being collected and the presumed diverse meanings arising from the different perspectives of the participants. The study therefore requires a more inductive approach to understand mine workers’ experiences of an online induction program. Therefore interpretivism was explored.

4.2.2 Interpretivist Research

Interpretivism, where researchers “look for culturally derived and historically situated interpretations of the social life-world” (Crotty, 1998, p. 67) is a theoretical perspective firmly embedded in a constructivist epistemology (Crotty, 1998; Johnson & Onwuegbuzie, 2004; Sale, et al., 2002). Constructivists believe knowledge is constructed not discovered, and people continually test and modify these constructions in light of new experiences (see section 3.2.3). Further, people do not construct knowledge in isolation but develop understanding of their world through interaction with others (Schwandt, 2000). Hence constructivist researchers investigate the varied and multiple subjective meanings people have developed regarding their experiences (Creswell, 2003) as an independent reality or objective truth does not exist (Sale, et al., 2002). There are two types of constructivist approaches; one focuses on the personal constructions of individuals, and the second on shared meanings or social constructions (Williamson, 2006). As Crotty (1998) states;

It would appear useful, then, to reserve the term constructivism for epistemological considerations focusing exclusively on ‘the meaning-making activity of the individual mind’ and to use constructionism where the focus includes ‘the collective generation (and transmission) of meaning’ (Crotty, 1998, p. 58).

Researcher’s Positioning

As people are constantly involved with interpreting their ever-changing world, interpretive studies emphasize sense making of both the researcher and the research participants (Symon & Cassell, 2006). A researcher’s beliefs and feelings about the world and how it should be understood and studied influence what questions are asked and how the information is interpreted (Denzin & Lincoln, 2008). Therefore the concern
of researchers is to make sense of the situation and participants’ perspectives, knowing the difficulties of fully understanding the beliefs, feelings and interpretations of others very different to themselves (Williamson, et al., 2002). As the researcher’s intent is to interpret the meanings others have about the world, they treat theory as sensitising rather than directive, and favour an inductive process; reasoning from the specific situation to a general conclusion (Creswell, 2003; Wiersma, 2000). The study presented in this thesis positions itself in a constructivist philosophy and an interpretivist framework, as the ultimate goal was to ascertain the perspectives of mine workers on the effectiveness of an online induction program. It examines their experiences of learning and its application in the workplace.

Researchers aim to record “others’ life-worlds as fairly as possible” (Symon & Cassell, 2006, p. 308) using methods which can elicit the depth and detail necessary to make the participants’ world visible (Denzin & Lincoln, 2008). As in much qualitative inquiry, the researcher is the primary instrument for data collection and analysis, and can therefore maximise opportunities for generating meaningful information. Conversely, there are also opportunities for mistakes and biases as the human researcher is fallible (Merriam, 1998). As Walsham (1995) asserts the researcher is presenting “their interpretations of other people’s interpretations” (p. 78). Therefore the researcher needs to understand their role in the process, and the advantages and disadvantages of that role. Qualitative methods such as interviews, observations and document reviews are usually, but not exclusively, associated with interpretivism. Interpretivism involves the study of things in their natural settings (Denzin & Lincoln, 2008; Williamson, et al., 2002) and that the meanings derived from a study are specific to that setting and its conditions (Wiersma, 2000). However it is also important to realise that a researcher can be excluded from issues which “are regarded as too confidential or sensitive to be shared with outsiders” (Walsham, 1995, p. 77).

Moreover, Patton (2002) maintains that the credibility of the researcher is an issue that needs to be addressed in qualitative studies:

Because the researcher is the instrument in qualitative inquiry, a qualitative report should include some information about the researcher. What experience, training, and perspective does the researcher bring to the field?...What prior knowledge did the researcher bring to the research topic and study site? What personal connections does the researcher have to the people, program, or topic studied?...The principle is to report any personal and professional information that
may have affected data collection, analysis, and interpretation – either negatively or positively - in the minds of users of the findings (Patton, 2002, p566).

Thus it is appropriate to include some information about the researcher. I have a particular interest in online learning as I have post-graduate qualifications in education and training and I have worked in the corporate arena, designing and delivering both instructor-led and online training to adults. My focus shifted to the mining industry as my husband, who works in this field as an OH&S consultant apprised me of the challenges facing this industry, particularly in regards to online safety training. This exposure has given me some insight into the issues involved with online site safety inductions in high risk industries, the topic of this study.

From an interpretive stance, the task is to attempt to understand and represent mine workers’ experience of an online induction program from their own viewpoint, and how they apply that learning in their workplace (a mine site) with as little influence as possible from the researcher’s own assumptions and interpretations. Moreover, in the context of this study, the researcher took more of an outside observer approach due to limited time, resources and the masculine nature of the industry (the researcher is female).

4.2.3 Perspective-seeking Approach

Researchers who are concerned with discovering what is important to the people being studied so they can better appreciate their perspective are symbolic interactionists (Neuman, 2006). Symbolic interactionism is one of the oldest perspective-seeking approaches (Langenbach, Vaughn, & Aagaard, 1994) and stemmed from the teachings of George Herbert Mead, a professor at the University of Chicago (Charon, 2007; Crotty, 1998). Using the foundations Mead’s work provided, Herbert Blumer (1969) defined symbolic interactionism as the “study of human group life and human conduct” (p. 1). Blumer (1969) emphasised the importance of social interaction as it “is a process that forms human conduct instead of being merely a means or a setting for the expression or release of human conduct” (p. 8). Symbolic interactionism has been described by Blumer (1969) as resting on three basic premises:

The first premise is that human beings act toward things on the basis of the meanings that the things have for them … The second premise is that the meaning of such things is derived from, or arises out of, the social interaction that one has with one’s fellows. The third premise is that these meanings are handled in, and
modified through, an interpretative process used by the person in dealing with the things he encounters (Blumer, 1969, p. 2).

The first premise comes from a pragmatist philosophy and contends that although the world may have objective substance “the ‘world of reality’ exists only in human experience and that it appears only in the form in which human beings ‘see’ that world” (Blumer, 1969, p. 22). From this perspective, the meanings which people attribute to objects and relationships in the world are the real subjects of inquiry. Thus, this research inquired into mine workers’ perspective of the online induction program and how it impacts on their learning.

Blumer’s (1969) second premise recognises social interaction as the instrument whereby these meanings are generated. Further, it is through language and other symbols such as gestures and signs that people use to communicate which can help us become aware of the feelings, perceptions and attitudes of others and interpret their meaning (Crotty, 1998). In this study, the interaction of the workers and others help to define the meanings that participants of the online induction attributed to their experiences.

The third addresses the process through which the meanings are formed. This implies that meaning developed within a social context will be modified through an interpretive process (Charon, 2007; Neuman, 2006). Hence, in this study the researcher endeavoured to understand the meanings and resultant actions attributed to the participation in the online induction by workers as they engaged in everyday activities.

4.3 Research Strategy: Case Study

The preceding discussion has examined the theoretical framework that underpins this study. Within the interpretive and symbolic interactionism perspective, there are many different routes which could be taken to conduct a study. This section will detail the research strategy chosen, its design and how it was implemented for the study.

Case study research has been used extensively in the field of education (Gall, Gall, & Borg, 2007; Merriam, 1998) and is effective in gaining an in-depth understanding of a phenomenon and the perspectives of those involved in the phenomenon (Yin, 2009). Yin (2009), defines a case study as:

an empirical inquiry that
investigates a contemporary phenomenon in depth and within its real-life context, especially when
the boundaries between phenomenon and context are not clearly evident (Yin, 2009, p. 18).

This definition is more related to the research process and differs from Stake’s (2008) focus on the unit of study. Stake (2008) argued that a “case study is defined by interest in an individual case, not by the methods of inquiry used” (p. 119). Alternatively, Merriam (1998) asserts that the distinguishing characteristic of case study research is that it is a single unit around which there are intrinsic boundaries. Merriam (1998) goes on to state that a case study can be defined by its special features which are not mutually exclusive, and which include particularistic, descriptive and heuristic features. The particularistic feature focuses on a specific event, situation or program while the descriptive feature refers to the end product of the case. The final feature is that it is heuristic, meaning it enhances the reader’s understanding of the phenomenon in such a way that the study extends the reader’s experience (Merriam, 1998). Gall, Gall and Borg (2007) include the participant perspective in their definition of case study research, describing it as:

(a) the in-depth study of (b) one or more instances of a phenomenon (c) in its real-life context that (d) reflects the perspective of the participants involved in the phenomenon (Gall, et al., 2007, p. 447).

However what is common to most definitions of case study research is a focus on “a particular instance (object or case) and reaching an understanding within a complex context” (Mertens, 2005, p. 237). For example a case can involve the examination of a program, a process, an event, an individual, an issue or an activity (Anthony & Jack, 2009; Creswell, 2003; Gall, et al., 2007). In this study, it is exploring mine workers’ perspectives of an online induction program.

Case study research may involve the description of phenomenon, the generation and testing of hypotheses, or the exploration of topics where existing knowledge is limited (Darke & Shanks, 2002). Yin (2009) describes three types of case study; exploratory, descriptive and explanatory. In exploratory case studies the aim is to develop relevant research questions and hypotheses for further investigation. Explanatory or causal case studies try to interpret phenomena to the point of answering questions of ‘why’ and ‘how’. A descriptive case study describes the phenomenon within its context (Yin, 2009). Yin (2009) also acknowledges that case study research can be used for
evaluation purposes. According to Bassey (1999) evaluative case studies set out to examine some educational program, system or event in order to assess its value. The case may investigate whether the stated objectives have been attained or may be to provide insight into the phenomenon but is not necessarily intended to contribute to theory development (Bassey, 1999).

Stake (2008) provides a more flexible definition of case study research, identifying three further types; intrinsic, instrumental and collective. An intrinsic case study refers to a case which is of interest to the researcher. It is not undertaken because it exemplifies a certain attribute or problem, or to “understand some abstract construct or generic phenomenon” (Stake, 2008, p. 122) but is of interest for its own sake. In instrumental case study research, the case is studied to understand related issues or phenomena of interest. Hence, the case is chosen for its ability to enhance our understanding of a particular problem or issue rather than being the primary interest. A collective case study involves the researcher selecting more than one case “because it is believed that understanding them will lead to better understanding, and perhaps better theorizing, about a still larger collection of cases” (Stake, 2008, p. 123). The cases can be either intrinsic or instrumental.

The case study approach used in this study can be considered both explanatory and instrumental in nature as the case (mine workers) was studied to understand the phenomena (their experiences of an online induction program). The aim of this study was to use theory as a framework to investigate previous knowledge and inform the areas and approach used to gather data. However, it was important in an interpretive study to use theory as a guide and not be so inflexible that new issues or areas of interest may be ignored (Walsham, 1995). The ability to be open and not just looking for what the theory suggests “results in an iterative process of data collection and analysis, with initial theories being expanded, revised, or abandoned altogether” (Walsham, 1995, p. 76).

4.3.1 **Strengths of the Case Study Approach**

As a case study can accommodate a variety of research designs (both positivist and interpretivist) and methods for data collection and analysis including; surveys, interviews, observations and experiments (Darke, Shanks, & Broadbent, 1998; Hays, 2004; McGloin, 2008; Merriam, 1998; Mertens, 2005), there can be confusion over
what constitutes a case study (Anthony & Jack, 2009; McGloin, 2008; Smith, 2000). Consequently, the case study approach has been subject to criticism (Cavaye, 1996; Darke, et al., 1998; McGloin, 2008; Smith, 2000; Yin, 2009), especially in relation to the reliability and validity of the data collected (McGloin, 2008; Smith, 2000; Yin, 2009), the lack of generalisability of results from a single case (Cavaye, 1996; Smith, 2000; Yin, 2009) and “that they take too long and result in massive, unreadable documents” (Yin, 2009, p. 11). While rebutting the above accusations, Yin (2009) stated that good case studies are not easy to accomplish. The strengths of the case study approach therefore should not be underestimated.

Case study research is particularly suited to situations where the investigation and understanding of a phenomenon and its context is important (Cavaye, 1996; Darke & Shanks, 2002; Darke, et al., 1998). This includes areas where the situation is complex and there is a need to capture the interaction of variables and different aspects of phenomenon (Cavaye, 1996; Merriam, 1998). Case research is also valuable where there is limited understanding of how and why processes or phenomena occur (Darke & Shanks, 2002), and for developing and refining theories as opposed to hypothesis testing (Cavaye, 1996; McGloin, 2008; Smith, 2000). Case study research aims for depth of understanding (Cousin, 2005; Darke, et al., 1998; Merriam, 1998) and to produce results that are generalizable to theory and not to populations as a whole (Smith, 2000; Yin, 2009). As previously discussed, this research adopts an interpretive approach as the aim is understand the phenomenon through the meanings participants attribute to it, and focuses on their real-life context. Consistent with the notion of value-laden research, the researcher acknowledges their own subjectivity as part of this process (Darke, et al., 1998).

Either single case or multiple case designs may be employed in case study research (Cavaye, 1996; Darke, et al., 1998; Merriam, 1998; Stake, 2008; Yin, 2009). The purpose of a single case study can be description, discovery or testing (Cavaye, 1996) and may be selected for the following reasons; it is a typical case (it reflects a commonplace situation); it represents a critical case (it meets all the necessary criteria for testing a theory); it is an extreme or unique case (it is so rare that it is worth investigating); or where it is a revelatory case (it is a previously inaccessible phenomenon) (Yin, 2009). Further, a single case study research allows the researcher to
examine a phenomenon in depth to provide rich description and understanding (Darke & Shanks, 2002). By getting close to the phenomenon and revealing its deep structures the researcher is better able to build theory and refine concepts or test theory by confirming or disconfirming theory (Cavaye, 1996).

Multiple case designs allow the analysis and comparison of data across cases and the investigation of a specific phenomenon in diverse situations (Cavaye, 1996; Darke & Shanks, 2002). Yin (2009) proposes that the decision to study multiple cases is based on the idea of replication. That is, two or more cases are investigated because the researcher predicts the same results for each case (literal replication) or to produce contrasting results for predictable reasons (theoretical replication) (Yin, 2009). Multiple case studies can strengthen research findings as they provide greater certainty about generalising the data collected when further cases confirm those findings in other settings (Darke, et al., 1998). However, as previously mentioned, statistical generalisation is not the goal of case study research, (Cavaye, 1996; Yin, 2009) and multiple cases can reduce the total attention that can be given to any one of them, thus impacting on the researcher’s ability to provide deep and rich interpretations of the findings (Gall, et al., 2007; Wolcott, 1992). More replications may give greater certainty (Yin, 2009) nevertheless, where explanatory research is undertaken, a single case may provide the foundation for generating explanations of why a phenomenon occurs (Darke, et al., 1998).

A single case study approach has been taken in this study as the focus on a single case will ensure depth of understanding of the context of the phenomenon from the perspective of the participants. Also, due to resourcing and time constraints, it was not feasible to complete more than one case study; a significant reason to only use one case (Darke, et al., 1998; Yin, 2009).

4.4 The Case Study Setting

To initiate this study, the researcher attended a Mining Health and Safety Conference in Townsville, Australia with the aims of;

- identifying mining companies which require their employees to complete an online safety induction program and
net-working with suitable contacts such as OH&S Managers, CEOs, Site Managers and Training Managers from those companies.

Through extensive networking, a number of senior managers from different mining companies situated in central Queensland were identified and contacted. A Training Company was identified which provided online site safety induction training to a variety of mining companies in Northern Queensland. Through the Training Company, the researcher was able to target a number of mines to participate in the survey. A senior manager of each mining company received an introductory letter (Appendix C) and information sheet (Appendix D) from the researcher informing them about the aims of the research project and the methods of data collection being utilised. Each mining company was asked permission to approach their workers to participate in the research project and written and/or verbal consent to proceed was obtained.

4.5 Research Approach

As a case study approach can incorporate a variety of methodologies (Corcoran, Walker, & Wals, 2004; Darke, et al., 1998; Merriam, 1998; Mertens, 2005; Yin, 2009), this research used both quantitative and qualitative data collection methods. Quantitative data was collected from participants regarding their satisfaction with an online safety induction program. The data was collected using a survey. (The qualitative details are found in Section 4.5)

To reduce the likelihood of biases or misinterpretation in the collection and analysis of case data, various sources of evidence or triangulation is used to provide multiple perspectives from different sources to clarify meaning (Denzin & Lincoln, 2008). Thus case study findings are strengthened by the convergence and corroboration of information from a variety of sources (Darke, et al., 1998) to answer the research questions or prove a hypothesis.

Principles of adult learning (see section 3.3.2), with influences from online learning and instructional design theory, helped shape the questions used in the survey and interviews. The key research questions, with subsequent subsidiary questions are presented in Table 4.1.
Table 4.1 Research questions

<table>
<thead>
<tr>
<th>Major Research Questions</th>
<th>Subsidiary Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What are the perspectives of mine workers on the effectiveness of online site safety inductions in the Australian mining industry?</td>
<td>i) What are the perceived levels of satisfaction towards online learning among mine workers and managers?</td>
</tr>
<tr>
<td></td>
<td>ii) What factors do learners perceive may hinder their learning via computer-based systems?</td>
</tr>
<tr>
<td></td>
<td>iii) What are the perceived levels of effectiveness of knowledge acquired via online training programs among mine workers and managers?</td>
</tr>
<tr>
<td>2. What instructional design strategies assist adult learners in the mining industry to engage with online OH&amp;S induction training?</td>
<td>iv) What instructional design strategies used in the online induction program do learners feel aided their learning?</td>
</tr>
</tbody>
</table>

For the purpose of reporting, the methods used in data collection and analysis are considered separately in this chapter. Firstly, the survey process of data collection and analysis will be described after which interview gathering and analysis techniques will be explained.

4.5.1 Quantitative Sampling Method

The study group of interest to the researcher is called a population. The individuals from the population who participate in the study are called a sample (DePoy & Gitlin, 1998). It is important that the researcher identify what characteristics of the population are integral to the study to ensure that the sample selected is an accurate representation of the target population (DePoy & Gitlin, 1998; Fink, 2003b). In this study, the target population is all open-cut coal mine workers who have completed an online induction program within the last twelve months. To ensure that the sample selected was representative of the target population, a probability sampling plan was implemented. In probability sampling the objective is to ensure that the sample is representative of the study (Babbie, 2007; Fink, 2003b). The main type of probability sampling is termed random selection which means every member of the target population has an equal chance of being selected for the sample (Punch, 2005). According to DePoy and Gitlin, (1998) a randomly selected sample;

precludes the possibility of the sample being selected because of a special trait that is uncommon in the target population or of being exposed to an influence that does not theoretically affect the total population (DePoy & Gitlin, 1998, p. 168).

In this study, all coal miners who were scheduled to complete the same online induction were invited to participate in the study. These mine workers completed the online
induction off site at the offices of the Training Company which facilitates online learning. After finishing the induction program, each participant was asked if they were interested in completing a survey to provide valuable feedback about their online induction experience.

An ideal sample size and acceptable response rate could not be determined in advance as the number of potential participants varied from day to day and week to week. Mining companies usually schedule workers required to complete an online induction on a daily basis, and often workers cancel or reschedule so it was not possible to determine the size of the target population in advance. At the end of data collection 103 participants had completed the survey, and it was established that a total of 852 mine workers had completed the online induction program over a 6 week period between May and June 2010.

4.5.2 Data Collection Process

Initially, an online survey was used as there were a number of potential advantages, the first being ease of distribution and the elimination of postal costs. Secondly, receiving the data in electronic form reduced the likelihood of transfer errors when the data was imported into the statistical software program for analysis. Finally, large amounts of data could be collected from geographically disperse populations.

The survey was designed to be administered online and was therefore created in Opinio and placed on a University of the Sunshine Coast’s server and a link was sent to the training company. After answering the questions, the participants submitted the survey by clicking on the “finish” button at the end of the survey. Data was then exported by the researcher into SPSS in readiness for analysis.

However, early in the data collection phase it was noted that few participants were completing the online survey; 23 of a possible 852 were submitted in the first month. After discussion with the Training Company who was helping to facilitate the online survey, the decision was made to offer a paper and pencil format as well. A word-processed copy of the online survey was emailed to the Training Company. Once paper and pencil was offered more surveys were completed and no participants elected the online format. The completed paper and pencil surveys were scanned by the Training Company and emailed to the researcher who manually entered the data into the SPSS
program. Eighty surveys were received over the next 2 weeks, giving a total of 103 completed surveys. When discussing the online training program with the Training Company, the researcher discovered that one company used a different online induction program. Even though some of the content was similar, the design of the training program was different. The researcher made the decision to remove the data collected from this company, and it is not reported in this study, giving a final total of 91 responses.

Although the survey provided mainly quantitative data, it was not analysed from a purely statistical perspective, although, some statistical techniques were used in order to ascertain themes or categories in the data and possible associations between demographic factors and approaches to learning.

4.5.3 Developing the Survey

The aim was to collect data from a random sample of individuals working in the open-cut coal mines of Queensland, however a search of the literature did not produce a suitable survey. As no valid instrument had been constructed for adult workers learning about safety in the mining industry via an online system, a survey was developed for this study. To help formulate the questions for the survey, a themes table (see Table 4.2) was devised using adult learning theories together with technology rich delivery and instructional design literature. The themes related to the major focus of this study and were important in helping answer the research questions. Once the themes had been established, constructs were identified using the literature, especially in relation to adult learning and web-based systems. Instruments which had been used to measure participant satisfaction with online learning programs were also examined for suitable constructs (Muilenburg & Berge, 2005; Song, et al., 2004; Stewart, Hong, & Strudler, 2004). Question items were then adopted and examined to ensure they related to the constructs identified in the themes table. Consequently the survey consisted of three types of questions; those that were essentially the same as the question items in the above instruments (40%), question items similar to the literature but reworded to suit the context of the mining industry, especially using words appropriate to the industry and education levels of the participants (50%) and questions largely created in-house (10%).
Table 4.2 Themes table for survey development.

<table>
<thead>
<tr>
<th>Themes</th>
<th>Construct</th>
<th>Item/Question No.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td>Participant Characteristics</td>
<td>Mine site (Q1)/ Gender (Q2)/ Nationality (Q3)/ Age (Q4)/ Years Mining Experience (Q5)/ Type of Mine (Q6), Education (Q7)/ Job Role (Q8)/ When induction completed (Q9)</td>
</tr>
<tr>
<td><strong>Perceived satisfaction with the online induction program.</strong> (Research sub-question i)</td>
<td>Technical</td>
<td>Perceived satisfaction with the computer technology (Q12b&amp;13i)</td>
</tr>
<tr>
<td></td>
<td>Appearance</td>
<td>Perceived satisfaction with screen appearance (Q12a,12c,12g,12i)</td>
</tr>
<tr>
<td></td>
<td>Navigation</td>
<td>Perceived satisfaction with navigation of the program (12f,13b,13e,13h&amp;13j)</td>
</tr>
<tr>
<td></td>
<td>Multimedia</td>
<td>Perceived satisfaction with variety and quality of multimedia (12d&amp;12h)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Perceived satisfaction with ability to decide lesson order (13f)</td>
</tr>
<tr>
<td></td>
<td>Social Interaction</td>
<td>Perceived satisfaction with amount of interaction (Q13n)</td>
</tr>
<tr>
<td></td>
<td>Program procedures and expectations</td>
<td>Perceived satisfaction with program procedures and expectations (Q13a,13d&amp;14a)</td>
</tr>
<tr>
<td></td>
<td>Content delivery</td>
<td>Perceived satisfaction with the content including; order, relevancy, accuracy and amount of information (12e,14c,14e,14g,14h,14i&amp;14k)</td>
</tr>
<tr>
<td></td>
<td>Mode of delivery</td>
<td>Perceived satisfaction with computer based learning (14b)</td>
</tr>
<tr>
<td></td>
<td>Overall satisfaction</td>
<td>Perceived overall satisfaction with the induction program (13g,13q&amp;14n)</td>
</tr>
<tr>
<td><strong>Perceived barriers to learning via the online induction program.</strong> (Research sub-question ii)</td>
<td>Instructor Support</td>
<td>Self-reported access to trainer and quality of assistance (Q13l &amp;13o)</td>
</tr>
<tr>
<td></td>
<td>Learner Competency</td>
<td>Perceived ability to understand information (Q14f)</td>
</tr>
<tr>
<td></td>
<td>Computer Skills</td>
<td>Perceived confidence in using computers (Q10)</td>
</tr>
<tr>
<td></td>
<td>Learner Motivation</td>
<td>Perceived motivation to learn (13m,14d)</td>
</tr>
<tr>
<td></td>
<td>Time</td>
<td>Perceived satisfaction with time taken to complete program (Q13k&amp;13p)</td>
</tr>
<tr>
<td></td>
<td>Technical Issues</td>
<td>Self-reported technical difficulties (Q11&amp; 13c)</td>
</tr>
<tr>
<td><strong>Perceived effectiveness of the online induction program</strong> (Research sub-question iii)</td>
<td>Perceived acquisition of knowledge</td>
<td>Perceived learning (Q14j &amp; 14l)</td>
</tr>
<tr>
<td></td>
<td>Perceived application of knowledge in workplace</td>
<td>Perceived ability to apply learning in workplace (Q14m &amp; 15h)</td>
</tr>
<tr>
<td></td>
<td>Overall effectiveness</td>
<td>Perceived effectiveness of program to facilitate the learning of safety (Q16)</td>
</tr>
<tr>
<td><strong>Perceived effectiveness of the instructional design strategies used in the online induction program to aide learning.</strong> (Research sub-question iv)</td>
<td>Perceived effectiveness of the instructional techniques used in the program (Q15a-g)</td>
<td></td>
</tr>
</tbody>
</table>
Concurrently, decisions were made regarding the formatting of the question items. In this study, the questions were selected-response type items, where the participants choose from two or more options. This was important not only because it provided greater uniformity of responses but also made the survey quicker and easier to complete whilst still covering the research topic (Wiersma, 2000). Two open-ended questions were also asked to give participants the opportunity to compose any response they believe appropriate to the topic (Peterson, 2000).

As the main purpose of the survey was to collect data to enable the measurement of participants’ perspectives towards the online induction program, the majority of questions were in a Likert scale format. Likert scales are very useful when attempting to probe attitudes and opinions (Gall, et al., 2007). In this study, the terms attitudes and perspectives are used interchangeably as both relate to the individual’s particular point of view or assessment of the online induction. A variety of questions were asked in this research to find out participant’s views, feelings and self-knowledge regarding their experiences with learning via computer systems. A Likert scale composed of adjectives was used to measure the responses as this allowed the participants to choose from a range of alternative fixed responses such as ‘strongly agree, agree, neutral position, disagree and strongly disagree’

It was known that the level of literacy would vary considerably among potential participants, so it was important to keep the language of the question items as basic and straightforward as possible. To achieve this, the questions were short and simply worded, only one idea related to each question, double negatives were avoided, and clear, simple, relevant and appropriate language was used when constructing the questions (Creswell, 2008; Wiersma, 2000). The term online instead of web-based was used as participants were more familiar with this word. To help motivate participants to complete the survey, the purpose of the study and potential benefits from the information gathered were emphasised in the introduction.

### 4.5.4 Survey Layout and Design

The first page of the survey outlined the purpose of the study and gave clear examples and instructions on how to proceed. The voluntary and anonymous nature of the survey was emphasised. Also participants were informed that their consent was required, and this was assumed when they started the survey, however participants could opt out at
any time with no penalties or disfavour. (Ethics was sought and approved for the study – S/08/182)

After completing demographic questions, the participants were presented with questions relating to their perceptions of the online induction program. Table 4.3 provides a brief overview of the survey layout. (Refer to Appendix E to view the final version of the survey that was administered to the participants). The first nine questions were demographic in nature and were deliberately placed at the front to give participants an opportunity to become accustomed to the survey and to answer familiar questions. Two questions were asked about their computer competence and if they experienced any technical difficulties. Subsequent questions were separated into four sections. The four sections were not stringent in their criteria but were generally based upon the following; their reactions to the look and feel (appearance and navigation) of the program; how they found the experience of completing an online program, including their perceptions of the structure, usability and support provided; their thoughts and feelings about their learning experiences and their views on the variety and effectiveness of the learning strategies embedded in the training program. The sections were ordered from what was perceived to be the least threatening and most comfortable topics for participants to answer, to more challenging concepts.

Throughout the survey (apart from the demographic information), participants were asked questions to identify any perceived barriers to learning they may have encountered. The survey concluded with a general canvass of participants’ perceptions of the overall value of the online induction program through two open-ended questions which asked participants to state one good feature about the program and one issue with the program that needed improvement. At the end of the survey, participants were asked if they wanted to volunteer to participate in a follow-up interview.
Instructions

Aims

Demographic Information

Mine site                                Mine Type
Sex                                         Level of education
Nationality                                Job Responsibility
Age                                         Date completed induction program
Minning Experience

Participant Computer Competence

Technical Difficulties/Computer experience

Web Appearance

Participants’ perceptions of look and feel (including the colours, multimedia and text used) of the online program.

Structure and Expectations

Participants’ perceptions of the structure, usability, support provided and achievement experienced in the online program.

Learning Experiences

Participants’ perceptions of the quality of the content, assessments and feedback provided, and the level and detail of information used in the online program.

Learning Strategies

Participants’ perceptions of the learning strategies used in the program and their effectiveness.

Participants’ perceptions’ of the overall value of the online induction program

The best feature and one aspect that needed the most improvement of the online induction program

Request for follow-up interview

4.5.5 Reliability and Validity

Reliability is a statistical measure which determines the consistency of information collected by a survey instrument (Litwin, 2003). To be considered reliable, a survey instrument should produce similar scores on repeated occasions under comparable situations (DePoy & Gitlin, 1998). No survey instrument is perfectly reliable however researchers often conduct statistical tests to establish reliability. These tests of reliability concentrate on three aspects: stability, internal consistency and equivalence (DePoy & Gitlin, 1998). Stability of measurement over time is obtained via a test-retest procedure. That is administering the same instrument at two points in time and measuring the degree of similarity between the scores (Punch, 2005). The extent to
which the scores correlate is an indication of the stability of the instrument and its reliability (DePoy & Gitlin, 1998).

The main purpose of the study was to appreciate the perspectives of mine workers regarding their satisfaction with an online induction program. Therefore the principle rationale for the survey was to gather information from a large and diverse population to assist in identify themes which would be examined in more depth during the interviews, not to validate a research instrument. The low response rate, although disappointing, produced valuable information as the target population remained diverse, consisting of numerous occupations; (including managers, engineers, blasters, labourers, drivers, and tradespeople); a range of nationalities (Australians, indigenous people, Pacific Islanders, New Zealanders); males and females; different age groups; various mine sites; differing education levels and so on. For my formal analysis using chi-square tests any conclusions cannot apply to those who had been removed however they were relevant in the interviews. The sample was small and sometimes the data had to be analysed from a partially edited sample however the population remained large and diverse. Consequently a decision was made not to perform statistical checks such as Cronbach’s alpha to determine the internal consistency of the scales and factor analysis to verify whether items combined into scales (Creswell, 2003).

Validity is the “extent to which an instrument measures what it is claimed to measure; an indicator is valid to the extent that it empirically represents the concept it purports to measure” (Punch, 2005, p. 97). Therefore validity is an important measure of a survey instrument’s accuracy. There are three basic types of validity researchers use to assess the performance of a survey instrument; content, criterion and construct (Litwin, 2003). Content validity is a subjective measure of the degree to which items or scales represent the content of the domain of interest (DePoy & Gitlin, 1998). Content related evidence of validity is usually determined by content experts who review the instrument to ensure that appropriate items and scales are covered in the content domain (Gall, et al., 2007; Litwin, 2003).

Criterion validity determines whether the results from an instrument are a good indicator of the criterion they are expected to measure. To have confidence in the instrument, it is compared with another measure of the same construct that has shown to be accurate (DePoy & Gitlin, 1998; Punch, 2005). There are two types of criterion
validity: concurrent and predictive. Concurrent validity requires that the survey instrument in question be compared with a known standardised instrument that measures the same concept. A high correlation suggests good concurrent validity. However this is only feasible when another relevant, well-known and accepted measure exists (DePoy & Gitlin, 1998; Litwin, 2003).

Predictive validity is useful when the purpose of a survey instrument “is to predict or estimate the occurrence of a behaviour or event” (DePoy & Gitlin, 1998, p. 206). Over a short period of time, predictive validity is similar to concurrent validity as it involves comparing the scores of one instrument with the results of another administered around the same time. If the time frame is longer, and the second instrument is administered at a future date, then the assessment is of predictive validity (Litwin, 2003).

Construct validity is a measure of how significant, useful and meaningful the scale or survey instrument is when in practical use. It is one of the most complicated and difficult methods of assessing a survey instrument (Fink, 2003a), as its purpose is not only the measurement of a concept but also the theoretical constructs underlying the concept (DePoy & Gitlin, 1998).

In any data collected there will be some degree of error, however the aim is to reduce this risk so that the “data provide as accurate a reflection of the truth as possible” (Litwin, 2003, p. 5). To minimise the possible pitfalls that can undermine the validity of the survey instrument used in this study, careful planning was undertaken. This included the development of a themes table (see table 4.2) to facilitate the construction of appropriate survey or question items. These items were reviewed by academics who were knowledgeable in the content area and suggested changes were made. Content validity was further improved by pilot testing the survey with participants from the target population to uncover any deficiencies, such as individuals in the sample not interpreting the questions appropriately, which were not identified by academics when reviewing the survey (Gall, et al., 2007; Wiersma, 2000). The instrument was modified again to reflect the feedback given.

The revised survey was reviewed by academics and then once again pilot tested on a small sample of mine workers who had completed an online induction program. This ensured that the language was appropriate and the questions interpreted correctly. This
was an extremely important step in the survey design as the reported low literacy levels in the mining industry (Newton, et al., 2002) could have a great impact on participants’ understanding of the questions being asked. Suggested changes to language, layout and questions were made to the survey.

4.5.6 Data Analysis Techniques

The purpose of the analysis was shaped by the research questions, which was not to form generalisations regarding the characteristics of a population but to discover the perspectives of mine workers on their learning experiences with an online induction program. Further, due to the type of data collected, which was measured on nominal and ordinal scales, descriptive statistics and non-parametric statistical approaches were adopted. The disadvantages of using non-parametric statistics must be acknowledged. They are less powerful than parametric techniques and therefore may not identify significant differences between groups that exist (Pallant, 2001) and according to Gall, Gall and Borg (2007), the availability of non-parametric tests suited to issues experienced in educational research are limited (Gall, et al., 2007).

Descriptive statistics are statistical procedures used to summarise, organise and simplify data (Gravetter & Wallnau, 2009). They reveal general tendencies in the data such as the mean, mode and median, the spread of scores such as the standard deviation or a comparison of how one score relates to all others (Creswell, 2008). It can involve the description of scores on a single variable or the relationship between two or more variables, multivariate correlational methods allow the researcher to describe the relationship between three or more variables at a time (Gall, et al., 2007). In this study, descriptive statistics were used to give a picture of the demographic data collected, and a chi-square test was used to examine the relationship between independent and dependent variables.

A chi-square test is a non-parametric statistical test used to “determine whether research data in the form of frequency counts are distributed differently for different samples” (Gall, et al., 2007, p. 325). A chi-square test for goodness-of-fit involves classifying data into categories, and determining what proportion of the population is in each category (Gall, et al., 2007). In this study, a chi-square test for independence was used to determine whether two categorical variables are related. Hence, each participant in
the sample is classified on two separate variables. The data are then used to test a hypothesis about the resultant population frequency distribution and consequently determine the relationship between the two variables (Gravetter & Wallnau, 2009). In this study cross-tabulations were conducted between six of the nine independent variables and every outcome or dependent variable. The six independent variables which were cross-tabulated with the dependent variables were gender, education, age, years of mining experience, job responsibility and mine site (including multiple sites). The three independent variables which were not cross-tabulated were nationality, mine type, and when the induction was completed.

As mentioned previously, responses for the majority of outcome variables were collected using the five point Likert scale. For the analyses, the responses were initially explored with the five categories, which were then collapsed to three (agree, uncertain and disagree) to investigate if any interesting trends were accentuated and if statistically significant associations could be found.

The quantitative results are presented in Chapter Five. A discussion of the survey results together with the qualitative findings can be found in Chapter Seven.

4.6 Qualitative Information Collection and Analysis

As is common practice in social research, distributing the survey first allows the researcher to identify phenomenon that required more in-depth and complex exploration during the interviews (DePoy & Gitlin, 1998). In this phase of the study a face-to-face, semi-structured interview format using open ended questions was used to obtain the participants’ experiences and perspectives of the online site safety induction program. The semi-structured interviews were shaped by the research questions of the study and the broad themes identified from the survey. Due to the timing of the interviews and the initial slow response to the survey, only the information from the 23 participants who responded in the first four weeks was analysed prior to the commencement of the interviews. It was upon these responses that the interview guide was formed. Analysis of the remaining (68) completed surveys validated the questions formulated for the interviews. The following section describes in detail participant selection, the information collection process and analysis techniques, reliability and validity of qualitative data and limitations of the study.
4.6.1 Participant Selection

In this study, the intent to develop an in-depth understanding of a phenomenon (mine workers experiences of an online induction program) using a single case study approach. To best understand the phenomenon, the researcher intentionally selected mine workers in varying job roles who had completed an online site safety induction program. This purposeful sampling approach was appropriate as the aim was to select participants that were likely to provide deep insights regarding the phenomenon of the study (Gall, et al., 2007).

Qualitative sampling usually involves relatively small samples, even single cases. However there are a variety of purposeful sampling strategies used for selecting “information-rich cases whose study will illuminate the questions under study” (Patton, 2002, p. 230). Types of sampling methods which were considered included maximum variation and typical sampling. Maximum variation aims at identifying participants or sites that have different characteristics or traits relating to the focus of the study and to capture those multiple perspectives (Creswell, 2008; Patton, 2002). This method allows the researcher to examine multiple perspectives and discover if common patterns emerge (Creswell, 2007; Miles & Huberman, 1994).

Typical case sampling can be used when the study involves a site or individual that is regarded as standard to people who are not familiar with the situation (Creswell, 2008). Although its purpose is to highlight what is normal or average (Creswell, 2007), Patton (2002) warns that typical case sampling should not be used to make generalisations about participants’ experiences, but to describe what is typical to people unfamiliar with the setting studied (Patton, 2002).

In this study a maximum variation sampling approach was implemented as the aim was to understand and describe mine workers’ perspectives of an online site safety induction program. Consequently, multiple perspectives from a cross section of mine workers, managers and professionals would ensure a diversity of views regarding the online induction program. At least one of the subjects of the interview should be a key informant such as a manager or supervisor so they can provide information about whether they believe participants have applied what they have learned in the field.

The initial aim was to interview participants at their mining site after they had
completed the online induction program and had an opportunity to apply their learning in the workplace. Unfortunately a week before the researcher was due to conduct interviews, objections from site managers/supervisors (the belief that the interviews would cause too much disruption to their operations) and major changes occurring at the mine site, meant that the planned interviews could not proceed. The alternative was to conduct interviews at the Training Company with participants who had just completed their online induction training. The diversity of perspectives was achieved even though there was an element of randomness in the selection of participants.

The administrative staff at the Training Company had a matrix which included information such as name of participant, job role, mine site they were completing their online induction program for, time of start, time of finish and contact at the mining company. The researcher used this matrix to identify potential participants to ask if they would like to participate in a voluntary interview regarding their experiences with the program they had just completed.

4.6.2 Information Collection Process

In qualitative research, the researcher is the primary instrument for information collection and analysis (Creswell, 2007; Miles & Huberman, 1994; Patton, 2002). It is vital the researcher is involved in all aspects of data collection, coding, analysing and conceptualising as the information and its analysis are closely interwoven and recursive (Creswell, 2008; DePoy & Gitlin, 1998). Further, Richards and Morse (2007) challenge researchers to think of information collection as a collaborative and ongoing process in which the researcher and participants interactively negotiate information that is rarely fixed and unchanging. Making information is not a passive process as the researcher decides what questions to ask, what material is relevant and what to write down. Hence the researcher needs to be aware of their own assumptions, personal beliefs and values as any interpretation of the data collected will be shaped by this internal filter (Creswell, 2007; Mertens, 2005; Patton, 2002; Richards & Morse, 2007).

It is also essential the researcher provides a chain-of-evidence for conclusions drawn in the study by maintaining a case study data base which is a separate inventory of information with transcripts, notes, tables, memos and the like which can easily be made available to other interested researchers (Yin, 2009). (A schedule, including documents produced by the study can be found in Appendix F). This type of information collection
reflects the qualities of interpretive symbolic interactionism, the theoretical framework adopted by this study.

**Interviews**

Yin (2009) states that the most common evidence for case studies comes from six sources: documentation, archival records, interviews, direct observations, participant-observation and physical artefacts. Walsham (1995) stresses the importance of interviews as the primary method for interpretive case studies when the researcher is an outside observer. As it is through interviews:

> that the researcher can best access the interpretations that participants have regarding the actions and events which have or are taking place, and the views and aspirations of themselves and other participants (Walsham, 1995, p. 78).

Interviews are most valuable when the research requires an investigation of a real life event. The aim of the interviews is to probe deeply and analyse intensely a wealth of richly descriptive information of the particular case (Cavaye, 1996; Merriam, 1998). Further, as suggested by Lincoln and Guba (1985), probes can include silence to encourage participants to continue; questions asking for more information; and brief summaries to check understanding.

Interviews can vary in structure and content from close-ended questions that follow a predetermined format to unstructured and open-ended questions (DePoy & Gitlin, 1998; Minichiello, Aroni, & Hays, 2008). Consistent with an interpretivist approach, this study of mine workers’ perspectives on learning via a web-based system utilised a semi-structured interview format using open-ended questions. Semi-structured interviews allowed the researcher to ask a series of structured questions and probe more deeply with open-ended questions (Gall, et al., 2007). Although the wording and order of the questions varied to some extent, and some questions were not asked if they were spontaneously answered or covered in an extended reply to another question, the topics outlined by the researcher were covered. Subsequently providing interviewees with an opportunity to shape the flow of information and generate rich and informative material (Gall, et al., 2007). The formulation of an interview guide, shown in Table 4.4, assisted with the preparation of interview questions and ensured that similar issues were covered in all interviews. Managers and supervisors were also asked two additional questions to identify their perspectives of the effectiveness of transfer of learning to the workplace.
The two questions included: Have you observed your people putting into practice what they learned in the online induction? Give examples; and Have they applied what they learned to new situations? How? (see table 4.4). Interview questions were devised using preliminary information gathered from the survey and were shaped by the research questions of the study (see table 4.1). The survey data helped to focus in on areas which yielded interesting insights such as the barriers encountered by participants when using the online program, and to clarify any unusual results, including why the majority of participants believed the program was not a good way to learn safety.

<table>
<thead>
<tr>
<th>Question Type</th>
<th>Themes and Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background</strong></td>
<td><strong>Characteristics of Workers</strong></td>
</tr>
<tr>
<td></td>
<td>What is your main job responsibility at this mine?</td>
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<tr>
<td></td>
<td>How many years of mining experience have you had?</td>
</tr>
<tr>
<td></td>
<td>Was this your first OH&amp;S induction? Was it your first online induction?</td>
</tr>
<tr>
<td><strong>Opinions/Values (Research sub-question i)</strong></td>
<td><strong>Satisfaction with online learning</strong></td>
</tr>
<tr>
<td></td>
<td>How did you find the online induction program? (include probes about multimedia, technology, content)</td>
</tr>
<tr>
<td></td>
<td>How satisfied were you with this method of learning?</td>
</tr>
<tr>
<td><strong>Opinions/Values (Research sub-question ii)</strong></td>
<td><strong>Barriers to learning</strong></td>
</tr>
<tr>
<td></td>
<td>What, if any, difficulties did you encounter?</td>
</tr>
<tr>
<td></td>
<td>What changes, if any, would you like to see made to the online induction program? Why?</td>
</tr>
<tr>
<td><strong>Opinions/Values (Research sub-question iii)</strong></td>
<td><strong>Effectiveness– acquisition of knowledge</strong></td>
</tr>
<tr>
<td></td>
<td>How effective did you find learning via the online program? (What did you learn? Give examples)</td>
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<tr>
<td></td>
<td>If you didn’t learn, why not?</td>
</tr>
<tr>
<td><strong>Experience/ Behaviour (Research sub-question iii)</strong></td>
<td><strong>Effectiveness - Transfer of learning to workplace</strong></td>
</tr>
<tr>
<td></td>
<td>Describe how you have or would put into practice what you have learned from the online program.</td>
</tr>
<tr>
<td></td>
<td>How easy or difficult did you or will you find it? Why?</td>
</tr>
<tr>
<td></td>
<td><em>Managers/Supervisors</em></td>
</tr>
<tr>
<td></td>
<td>1. Have you observed your people putting into practice what they learned in the online induction? Give examples.</td>
</tr>
<tr>
<td></td>
<td>2. Have they applied what they have learned to new situations? How?</td>
</tr>
<tr>
<td><strong>Opinions/Values (Research sub-question iv)</strong></td>
<td><strong>Design of learning program</strong></td>
</tr>
<tr>
<td></td>
<td>Describe the activities or exercises in the online program.</td>
</tr>
<tr>
<td></td>
<td>What activities did you like? Why?</td>
</tr>
<tr>
<td></td>
<td>What did you think about the assessments?</td>
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</table>

The guide also helped the researcher to probe for more details and seek clarification with regards to interviewees’ perspectives and their experiences of the online induction program. The interview guide was based on three of Patton’s (2002) six categories of
question types. These include experience/behaviour, which asks about people’s actions and behaviours, opinion/values which ask about what people think about some experience or issue and background/demographic questions such as age and years of mining experience which identify characteristics of the person being interviewed (Patton, 2002).

Interviews with key informants, such as experienced mine managers/supervisors and the designer of the online induction program, were also conducted. Key informants are specific individuals who have “knowledge and/or expertise in a particular field” (Minichiello, et al., 2008, p. 52) and can have better communication skills and a different perspective from other members of the defined population (Gall, et al., 2007).

The managers interviewed needed to have completed the online induction program and had the opportunity to observe workers in the field who had also completed the program. The first question, ‘Have you observed your people putting into practice what they learned in the online induction program? Give examples’, was asked to obtain more information about how workers performed in the workplace after completing the online induction program and to see if the overall positive responses generated in the survey matched the interviews with the researcher, an outsider, and management feedback. The second question, ‘Have they applied what they have learned to new situations? How?’, was important to determine whether the overwhelmingly positive belief of workers in their ability to transfer learning to the workplace was generally supported by management. See Appendix H and I for the complete interview questions used for managers and workers.

Due to the proprietary nature of the online induction program (all content is owned by the individual mining companies) the researcher was not able to examine the induction program itself. However, a semi-structured interview was conducted with the Managing Director of the Training Company to determine what instructional strategies were used and why in the development of the program. The main interview questions are shown in Table 4.5 and focused on design and development issues from the perspective of the Managing Director, as this person was the primary developer of the online induction program.
Table 4.5 Interview questions for Designer of safety induction program

<table>
<thead>
<tr>
<th>Interview Questions</th>
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<tbody>
<tr>
<td>Opinions/Values (Research sub-question iv)</td>
</tr>
<tr>
<td>What is the primary goal of the site safety induction program?</td>
</tr>
<tr>
<td>How was the online induction program designed?</td>
</tr>
<tr>
<td>Were any learning theories or instructional design models used? If so what? How effective are they?</td>
</tr>
<tr>
<td>What are the learning activities? How is learning assessed?</td>
</tr>
<tr>
<td>Why was this method used?</td>
</tr>
<tr>
<td>What, if any, changes will you be making to the design of the online induction program?</td>
</tr>
</tbody>
</table>

Each interviewee was given a research project information sheet (see Appendix D) which detailed the purpose of the study; the potential significance of the study; details of participants’ involvement in data collection and proposed duration of the interviews. A consent form (see Appendix G) was also given to interviewees stating their willingness to participate in an interview and granting permission for the interview session to be taped. When the consent forms were being signed, the researcher emphasised that interviewee names and information would be protected by the use of pseudonyms and thus remain anonymous.

Nineteen, individual interviews were undertaken as it not only minimised disruption to participants’ work schedule (a priority of management), but also maintained the confidentiality of individuals during the interviewing process. Consequently this allowed the researcher to develop rapport with hesitant speakers and thus pursue the necessary lines of inquiry and “capture’ people’s interpretations in as effective way as possible” (Walsham, 1995, p. 78).

4.6.3 Information Analysis Techniques

In qualitative case study research, information collection and information analysis are often simultaneous and iterative activities (Creswell, 2008). Consideration should be given to proper information recording as the quality of the findings is dependent on the standard of information records, access to these records and their context (Richards, 2009). For this study, the information from the interviews were audio recorded, which were then transcribed verbatim to maximise understanding. The audio file was saved to the researcher’s computer. The original transcripts were stored separately from the analysed data. Back-up copies were made to prevent accidental loss of the original information and the findings. During subsequent analysis the audio file and the
transcripts were frequently accessed and correlated to ensure the accuracy of the information.

All transcribed interviews and the information collected from the open-ended questions of the survey were analysed with the help of ‘memoing’ and the use of an inductive process developed by Miles & Huberman (1994). The three main concepts of their model involve: data reduction, data display and drawing/verifying conclusions (Miles & Huberman, 1994). Data reduction and data display occurs continually throughout the analysis and includes editing, summarizing, memoing, coding, conceptualising and explaining (Punch, 2005). Coding involves categorising strategies such as sorting information, assigning labels to all parts of the data about a topic and ensuring access to everything relating to the topic under investigation (Maxwell, 2005; Richards, 2009). According to Richards (2009), qualitative coding is about information retention, the purpose is to learn from the material “to keep revisiting data extracts until you see and understand patterns and explanations” (p. 94). Data display involves assembling the material into displays such as tables, graphs and matrices which presents information systematically and clarifies the main direction of the analysis allowing conclusion drawing and action taking (Miles & Huberman, 1994).

Richards and Morse (2007) highlight the advantages of using software packages to help with organising and coding qualitative material as information systems can move and arrange categories to explore relationships more efficiently and flexibly (Richards & Morse, 2007). Coding allows you to return to the information you want to examine, question and interpret (Richards, 2009). Nvivo, a qualitative software program was used to help in the initial coding and identification of themes. In this study three levels of coding were used; descriptive, topic and analytical or pattern to ensure careful examination of the information (Miles & Huberman, 1994; Richards, 2009; Richards & Morse, 2007).

Descriptive codes “entail little interpretation. Rather, you are attributing a class of phenomena to a segment of text” (Miles & Huberman, 1994, p. 57). It involves describing a case by storing information known about the material items being studied, such as participants, events or contexts. The researcher can then retrieve this factual knowledge about the participant (age, gender, and so on), the setting (work, home), or context (type of training, which question was being answered) when developing
In this study, each interviewee was ascribed a code to preserve anonymity, while enabling the tracking of information within the study. All participants were numbered in the order in which they were interviewed. For example ‘1’ was used to identify the first interviewee, ‘2’ for the second and so on. Besides numbering an additional code was added to the interviewees. This was a letter given to identify whether the interviewees were workers, managers or supervisors. For workers, the letter ‘W’ was placed in front of the number, for managers ‘M’ and supervisors the letter ‘S’ were used; hence S1 was a supervisor and the first person interviewed; M5 was a manager and was the fifth participant interviewed. Once codes were allocated to the participants and descriptive information regarding their attributes such as age, gender and years of mining experience were stored in the Nvivo software package, it was possible to proceed with categorising the material collected according to topics.

Topic coding is used to identify all information relating to a subject. This allows the researcher to not only find material according to topics but also helps with interpretive work as everything coded in a topic can be reviewed and compared which aids in the development of theoretical concepts (Maxwell, 2005; Richards & Morse, 2007). Categories can also be labelled using words or phrases that occur in the data. This can help the researcher develop a ‘feel’ for the information and start thinking about themes rather than noting the topics discussed (Richards, 2009). Some initial categories were derived from the questions asked, such as perceived satisfaction with the online induction program, perceived barriers and beliefs about the effectiveness of the program including ability to learn and apply that learning in the workplace. Other categories and/or constructs were derived from the information by identifying patterns and pulling together “a lot of material into a more meaningful and parsimonious unit of analysis” (Miles & Huberman, 1994, p. 69). According to Punch (2009), descriptive and topic coding focus on identifying and labelling what is in the material, analytical or pattern coding involves interpretation and thinking about the meanings then placing the coded information into a more abstract framework. The goal being to order and integrate the analytical codes into a meaningful and coherent whole (Punch, 2005) which reflects the researcher’s understanding of the information in context. Codes in this category can be derived either from existing theory or from inductively developed theory (Maxwell,
The final stage of the information analysis, drawing and verifying conclusions, was to refine the constructs that have been developed from the case study into a set of propositions (Miles & Huberman, 1994). The memos and coding facilitated the identification of patterns and common themes that are recurrent in the concepts identified.

### 4.6.4 Reliability and validity of qualitative data

Instead of using reliability and validity as criteria to evaluate a qualitative study, Miles and Huberman (1994) suggest five main, though somewhat overlapping, standards: confirmability, dependability, credibility, transferability and applicability. *Confirmability* is concerned with ensuring that the researcher has not “overtly allowed personal values or theoretical inclinations manifestly to sway the conduct of the research and findings deriving from it” (Bryman, 2001, p. 274). To ensure confirmability, this study has maintained a complete record of (i) general methods and procedures of the study, and (ii) the actual sequence of how information was collected, processed and displayed (Miles & Huberman, 1994). To adhere to the criteria of confirmability, this study has retained all material, making it possible for further analysis if required.

*Dependability* refers to establishing the trustworthiness of the research. Miles and Huberman (1994) offer some guidelines to ensure the dependability of a study. Throughout the data gathering process, it is the responsibility of the researcher to confirm information is collected across the full range of appropriate settings, times and respondents. In this study, purposeful and random sampling approaches were utilised to ensure that information was collected from multiple sources.

To help validate the *credibility* of an interpretive study, the following questions posed by Miles and Huberman (1994) are pertinent; Do the findings of the study make sense? Are they credible to the people studied and to the readers? Is there an authentic portrait of what was studied? (Miles & Huberman, 1994). The major strength of a case study approach is using many different sources of information to check out the consistency of evidence across different material collection methods (Mertens, 2005; Patton, 2002; Yin, 2009). Thus, triangulation is used to help ensure the quality of a study by using
more than one method of information collection (Flick, 2007; Yin, 2009). Triangulation reduces the risk of limitations or biases of a particular method to provide a more complete and accurate account than either could alone (Maxwell, 2005). In this study, multiple data were collected through interviewing and surveys. The findings from the data gathered by the different sources and data collection methods were used to check for general consistency. However, as Patton (2002) asserts, triangulation does not necessarily produce a single, wholly uniform picture. Identifying and understanding when and why inconsistencies arise in a study is important as it may help elaborate findings or initiate a new way of thinking (Miles & Huberman, 1994; Patton, 2002).

In ensuring credibility, ‘thick descriptions’ or context rich and meaningful portrayals of the findings have been provided (Geertz, 1973). For any inconsistent findings a coherent account will be presented.

As the information of this study was particular to the context of the participants (miners completing an online site safety induction program) the findings relate specifically to this distinctive group. This can make the transferability of findings a difficult, if not impossible task, for the qualitative researcher (Lincoln & Guba, 1985). However, by developing a rich, detailed and concrete account of the phenomenon being studied, readers would have the opportunity to assess the potential transferability to their own settings (Miles & Huberman, 1994). In addition, a theoretical framework showing how information collection and analysis methods were guided by concepts and models provides the theoretical parameters of the research, which can be used by researchers to determine transferability to other settings (Marshall & Rossman, 1999). Further, the significant examples provided by the analysis and consequent interpretation of the findings and their generalisability to existing theoretical propositions, provides further opportunity for readers to make judgements about the transferability of findings presented in this study to other contexts (Lincoln & Guba, 1985; Miles & Huberman, 1994).

Miles and Huberman (1994) suggest a good qualitative study should enhance levels of understanding and complexity and the ability of participants, policy makers and practitioners to take appropriate action based on useful findings. In this study the substantive theory and recommendations developed from the findings aims to raise the level of understanding of stakeholders on mine workers’ perceptions of the online
induction program and present to them improvements to the design, development and implementation of the online induction program.

The above techniques can help establish a degree of trustworthiness in the study, but as Lincoln and Guba (1985) state “naturalistic inquiry operates as an open system; no amount of member checking, triangulation, persistent observation, auditing, or whatever can ever compel; it can at best persuade” (p. 329).

4.7 Ethical Considerations

As this research involved people, approval was sought from the Human Research Ethics Committee of the University of the Sunshine Coast. On 27th October 2009, approval was received to undertake the research using the methodology described, protocol S/08/182. The research of individual histories of workers participating in the online site safety induction program was not undertaken. Participants took part on a voluntary basis. All of them were invited to take part in the research by letters of invitation (see Appendix C). This letter complied with the guidelines of Human Research Ethics Protocols of the University of the Sunshine Coast. Gaining informed consent was a critical aspect of the research process; participants were made aware that their involvement was voluntary and that they had the right to withdraw from the research project at any time (see Appendix D). The nature and purpose of the research was explained to all participants, and they were asked to sign consent forms that would allow the researcher to use the information generated from the data collection processes (see Appendices E & G). Participants were assured that all data and information collected would be managed to respect confidentiality or anonymity. Pseudonyms and coding were used throughout the data analysis process and reporting. Mine sites and mining companies were also referred to by using code letters.

The researcher was also guided by Kvale and Brinkmann (2009), who advise a number of ethical questions should be considered at the beginning of a research project including; what are the potential consequences of the study for the participants?; and how will the researcher’s role affect the study? The consequences of the study need to be addressed with respect to possible harm to a participant. The researcher should be aware that the openness and intimacy of in-depth interviews “may be seductive and can lead participants to disclose information they may later regret having shared” (Kvale & Brinkmann, 2009, p. 73). Hence, the role of the researcher as a person of integrity and
his or her sensitivity and commitment to moral action is important. The researcher needs to be able to listen attentively but not engender a quasi-therapeutic relationship or appear cold and aloof (Kvale & Brinkmann, 2009). In this study, the researcher has had many years of experience interviewing people from a wide diversity of backgrounds and had some knowledge and understanding of the industry. If any participant were to show signs of anxiety, the researcher would acknowledge the person’s distress (both verbally and with body language), ask if they would like to take a break, and if so the recording equipment would then be switched off and the interviewee given a chance to recover before asking whether they wanted to continue. According to Legard and colleagues (2003) it is important to be “alert to changes in the dynamic of the interview and in the participant’s demeanour, to ponder what might be bringing about this change, and to shape the response accordingly” (p. 165).

All information that was collected has been treated confidentially and is currently stored in a secure location at the University of the Sunshine Coast. It will be accessible only to the researcher or by authorised people and will be stored for the requisite seven years.

4.8 Limitations of this Study

The inherent limitations of this study outlined in the following section may have an impact on the usefulness of the findings presented in later chapters. These are:

- A small sample size. The sample size of 83 may have diminished the ability to find significant associations.
- There was a change from online survey administration to a paper and pencil format. This increased the number of respondents, but the change in format may have had an impact on how participants answered the survey, as the researcher had no input into its administration.
- Potential bias in the sample. Only workers who expressed a willingness to participate were involved in the research study. Due to the self-selecting nature of the sample it is difficult to know precisely how much the sample does in fact represent the perspectives of online learners in the mining industry.
- Potential unreliability in survey questions. To accommodate a generally blue-collar workforce with varying literacy levels the research questions were posed as simply as possible and without any reference to theoretical and/or technical
terms such as scaffolding and transfer. This may have limited the potential of this research to derive particular findings that could guide and inform others.

- The interviews had to be conducted on the day the participants completed the online induction program. Some participants were tired and may not have had time to digest the program before starting the interview, especially novices to the industry and those who had not experienced online learning before.

- It was not possible to view the online site safety induction program in detail as the content was owned by the mining companies and was of a proprietary nature.

- Due to the male dominated nature of the workplace, some participants in the interview may have been a little hesitant and less forthcoming talking to a female outsider.

4.9 Summary

This chapter has described in detail the theoretical foundations, research design and methods undertaken for the study reported in this thesis. The design of this study was interpretive in nature to ensure that the data collected from mine workers completing an online induction program included both breadth and depth. Further, the whole process of data collection and analysis was consistent with a case study research strategy which focuses on a particular case to understand a complex context. Data was collected from a survey and one-to-one interviews. This chapter detailed the methodology and planning undertaken to develop the survey instrument and the semi-structured interview format, select the sample of participants and the processes followed to collect and analyse the data. Chapter Five provides an analysis of the quantitative data. Chapter Six provides an analysis of the qualitative data. A discussion of the research findings can be found in Chapter Seven.
5. QUANTITATIVE FINDINGS

5.1 Introduction

Chapter Four described the research approach used for this study, the development of the survey instrument and the administration of the survey. This chapter presents an analysis of the data collected in the quantitative phase and provides a description of participants’ perceptions of an online site safety induction program in the mining industry. A discussion of these findings together with the qualitative data is found in Chapter Seven.

5.2 Survey Findings

The survey was undertaken by 91 participants who worked at various open-cut coal mines in the Bowen Basin region of Queensland. However after initial exploration of participant profiles, it was discovered that due to the small data numbers for two categories within the education demographic variable, the decision was made to remove 8 profiles, leaving a total of 83 participants. There were only two participants who specified primary schooling as their highest level of education and both these people also nominated Pacific Islander and Aboriginal for their nationality. As we could not separate the effects of primary education and Pacific Islander and Aboriginal background, these two profiles were removed from the sample. Although the information collected in the survey from these two participants was not included their perspectives of the online induction program were not lost as they took part in the interviews. The six higher degree participants included two male workers who had nominated other for their nationality and three females. As all the other participants identified as either Australian or New Zealander, the decision was made to remove the two males who nominated other for their nationality. This left four participants in the
higher degree category, three females and one male. Due to the small numbers and the higher proportion of females in this group (which would result in a more female perspective of this variable in what is typically a male dominated industry), the decision was made to remove the remaining four participants. Further, due to the low number of females in the responding participants, the data was examined to discover if they were represented in all the demographic categories. Females were not represented in either of the multiple sites (X and Y), nor the 10+ years of mining experience category. Therefore, as there were insufficient females in the multiple sites and each of the categories for years mining experience, only males were used to study these two variables (multiple sites and years of mining experience). Additionally, to allow for cross analysis of age and years mining experience on a number of dependent variables, females were also removed from the age variable to ensure that gender did not influence the findings. However females were represented in all the other variables and two women were interviewed to ensure their perspectives were captured. Although the sample of 83 participants was small, possible associations, and interesting patterns, between the independent and dependent variables were still able to be examined using a chi-square test.

Surveys which were fully completed by participants and those which were almost completed (three questions or less unanswered) were considered appropriate to be included in the analysis.

The survey had a total of 62 items covering the following themes:

- Demographic information collected in the survey included the following:
  - mine site (including multiple sites), gender, nationality, age, years of mining experience, type of mine worked in, education, job responsibility and when participants completed the online induction.

- Perceived satisfaction with the online induction program.

- Perceived barriers to learning via the online induction program.

- Perceived effectiveness of the online induction program to facilitate learning.

- Perceived effectiveness of the instructional design strategies used in the online induction program.

The variables associated with the themes (see Table 4.2) of the survey (dependent
variables) were cross tabulated with each of the demographic (independent) variables of gender, education, age, mine site, multiple sites, years of mining experience and job responsibility to examine whether any of these demographic variables were associated with a difference in perception of the online induction program by participants. The results indicate there were two statistically significant relationships based on the chi-square test for independence:

1. There was a significant association between the education demographic variable and the dependent variable lack of clear expectations ($\chi^2=7.7, \text{ df}=2, p=0.020$).

2. There was a significant association between the job responsibility demographic variable and the dependent variable, amount of information to learn ($\chi^2=11.6, \text{ df}=4, p=0.020$).

Four of the results were under $p<0.05$, but failed the assumption of having no more than 25% of the expected values in the cross-tabulated cells under 5. Nevertheless there were interesting patterns in the distributions of cross-tabulated responses. The chi-square tests were always checked for validity, and if not the Monte Carlo method was used to compute P-values, relying on fewer assumptions and producing P-values appropriate when dealing with small sample sizes. Further, the results are presented with three response categories (agree, uncertain, disagree), after being collapsed from the five-point Likert scale (to ensure the tests were valid) as there were insufficient numbers in some of the categories. These findings are presented in Section 5.3 along with selected graphs. The remainder of the data can be found in Appendix J. A summary of the demographic data will be presented first, followed by the results of the associations between demographic and outcome variables.

### 5.3 Profile of Survey Participants

Using the demographic data we can profile the average mine employee working in open cut coal mines in the Bowen Basin region. Table 5.1 provides information regarding the gender, nationality, education and age of mine workers in this case study. The majority of participants were male (89%), and 95% of participants (all percentage will be rounded to the nearest whole number) identified as Australian. Secondary school education was nominated by 55% of all participants as their highest level of education followed by TAFE at 44%. Due to the small numbers in some of the age categories, the age variable was collapsed from five categories; 18-24, 25-39, 40-54, 55-64 and 65+ to three categories (18-24, 25-39, 40+). Table 5.1 shows that more than half (54%) of the
participants were aged between 25-39, with 27% of participants in the age bracket 40 plus and 19% of participants in the age bracket 18-24.

**Table 5.1 Demographic Data on Gender, Nationality, Education and Age**

<table>
<thead>
<tr>
<th>Gender</th>
<th>number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>74</td>
<td>89</td>
</tr>
<tr>
<td>Female</td>
<td>9</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nationality</th>
<th>number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian</td>
<td>79</td>
<td>95</td>
</tr>
<tr>
<td>New Zealander</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education</th>
<th>number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary School</td>
<td>46</td>
<td>55</td>
</tr>
<tr>
<td>TAFE</td>
<td>37</td>
<td>45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-24</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>25-39</td>
<td>40</td>
<td>54</td>
</tr>
<tr>
<td>40+</td>
<td>20</td>
<td>27</td>
</tr>
</tbody>
</table>

The data presented in Table 5.2 show that almost half (48%) of the sample had only 1-4 years of mining experience and more than half (57%) of the participants were employed as tradespeople at the mines. In subsequent data analyses the categories for years of mining experience was reduced from seven categories (None; less than 1 year; 1-4 years; 5-9 years; 10-14 years; 15-20 years and over 20 years) to the four shown in Table 5.2.

The job responsibility categories were also collapsed from ten categories (tradesperson, TA operator, labourer, engineer, trainer, supervisor, OH&S officer, surveyor, environmental officer and manager) to three: tradesperson, TA operator/labourer and professionals, to provide more relevant and representative categories for these variables (see Table 5.2). This was achieved by:

1. The first group - the tradesperson (someone who had a recognised qualification or was an apprentice in a trade such as an electrician, plumber or boilermaker and was working in that trade at the mine),

2. The second group - the Labourer/TA operators (unskilled labourers or semi-skilled workers; including truck drivers, janitors and trade assistants), and

3. The third group - the professionals (managers, supervisors and workers with specialist skills such as surveyors and health/environmental officers).
Table 5.2 Demographic data on Years of Mining Experience and Job Responsibility

<table>
<thead>
<tr>
<th>Years Mining Experience</th>
<th>number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to &lt; 1 year</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>1-4 years</td>
<td>36</td>
<td>48</td>
</tr>
<tr>
<td>5-9 years</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>10 years and over</td>
<td>10</td>
<td>14</td>
</tr>
</tbody>
</table>

**Job Responsibility**

- Tradesperson (Group 1): 47 (56)
- TA Operator/ Labourer (Group 2): 24 (29)
- Professionals (Group 3): 12 (15)

All participants in the survey completed the same online site safety induction program, regardless of mine site. Further, all participants completed the survey on the day they undertook the online program. Seven different mine sites and two mining organisations were nominated by participants as their place of work. The names of the sites and mining companies have been withheld for confidentiality reasons. Table 5.3 indicates that the majority of participants were from Mine Site A (22%) and Mine Site B (19%). As some participants were required to complete inductions for more than one site, they chose to nominate the company they were working for rather than listing multiple sites. Hence Company X and Company Y were organisations, not mining sites.

Table 5.3 Demographic data relating to the mine sites and organisations where participants worked

<table>
<thead>
<tr>
<th>Mine Sites</th>
<th>number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td>B</td>
<td>13</td>
<td>19</td>
</tr>
<tr>
<td>C</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>D</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>E</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>F</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>G</td>
<td>7</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multiple Sites</th>
<th>number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company X</td>
<td>8</td>
<td>50</td>
</tr>
<tr>
<td>Company Y</td>
<td>8</td>
<td>50</td>
</tr>
</tbody>
</table>

More than half the participants (51%) had worked previously in open-cut and/or the coal mining industry (59%), with fewer participants having worked underground (11%) and/or in the metal (gold) and non-metal (zinc, diamond, bauxite) sector (13%). Approximately 7% of participants had never worked in any type of mine before (Table 5.4).
Table 5.4 Demographic data of participants who have worked at different types of mines

<table>
<thead>
<tr>
<th>Mine Type</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>49</td>
<td>59</td>
</tr>
<tr>
<td>Mineral</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Open-cut</td>
<td>42</td>
<td>51</td>
</tr>
<tr>
<td>Underground</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>None</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

5.4 Associations between Demographic and Outcome Variables

This section presents graphical summaries of the outcome variables, with relevant clusters for demographic variables to show interesting trends. Where statistically significant associations were found using the chi-square test for independence, this is indicated in the text. All the results are presented with three response categories (agree, uncertain, disagree), after being collapsed from the five-point Likert scale for the statistical analysis. Also, some of the demographic variables were collapsed to better represent the data (refer to profile of survey participants section). The results are presented under the five key themes and associated constructs examined in the survey (see themes Table 4.2). The theme of perceived satisfaction with the online induction will be presented first, followed by perceived barriers to learning, perceived effectiveness, and finally perceived satisfaction with the instructional design of the program.

5.4.1 Perceived Satisfaction with the Online Safety Program

To examine participants’ perceptions of their satisfaction with the online induction program the survey included 29 questions grouped into the following ten constructs; technology, appearance, navigation, multimedia, control, interaction, procedures and expectations, content delivery, mode of delivery and overall satisfaction.

Satisfaction with the Technology

The survey data show that, overall, participants were satisfied with the technical aspects of the online induction program. There were two questions relating to technology and included satisfaction with the speed in which the program started and how comfortable participants were using the online site safety induction program. Overall 77% of participants believed the program started quickly. The p-value was low ($\chi^2 = 7.7$, df=2, $p=0.021$), suggesting an interesting association, however 33.3% of cells had an expected
count less than 5, violating one of the key assumptions of the chi-square test making the
*p*-value unreliable. Therefore a Fishers Exact test, using a Monte Carlo simulation with
1,000,000 samples was performed and found the *p*-value was 0.056 (99% confidence
interval from 0.055 to 0.057), thus indicating there was no significant association
(*p*<0.05). However, it was interesting to note that 80% of the male participants were
more positive in their perceptions concerning how quickly the online induction program
started compared to 55% of female participants. Further 44% of females were
uncertain the program started quickly enough (Figure 5.1). According to the literature,
females tend to prefer visual text rather than spoken text (Flores, et al., 2010). However
the online induction program was presented in dual mode which may have been
annoying to some females, especially if there was a perception that the speed in which
the program started was affected and/or the audio impacted negatively upon their
learning. See the Discussion Chapter for a more detailed analysis.

![Bar chart of gender against whether or not the program started quickly (Males:n=74; Females:n=9) ](image)

There was a generally positive response to participants’ perceptions on how comfortable
they were using the online program as, overall, 83% of participants agreed they were
comfortable. Figure 5.2 indicates that 100% of participants with 0 to < 1 year of mining
experience were comfortable using the online program followed by 83% of participants
with 1-4 years of mining experience. There was only a small proportion of participants
(11% with 1-4 years and 7% with 5-9 years of mining experience) who were not
comfortable.
Satisfaction with Appearance

Questions relating to screen appearance, and the amount and readability of text were asked of participants. Overall, 79% of participants were satisfied with the look of the online induction program. Figure 5.3 suggests that 92% of professionals liked the screen along with 78% of tradespeople and three quarters (75%) of labourer/TA operators. Only 17% of labourer/TA operators did not.
Overall, 82% of participants were satisfied with their ability to read the text on the screen. Figure 5.4 shows that 100% of participants who were working at mine sites A, D and G were the most satisfied, however participants working at mine site B were the least satisfied with 29% uncertain, and 14% disagreeing that it was easy to read the screen text.

Figure 5.4 Bar chart of mine sites against whether or not the text on the screen was easy to read (A:n=9; B:n=7; C:n=13; D:n=8; E:n=15; F:n=7; G:n=8)

Overall, 45% of participants did not believe there was too much text. Figure 5.5 shows that 54% of 25-39 and one half (50%) of the 40+ age groups were satisfied with the amount of text on screen compared to 14% of 18-24 year olds. However, the majority of 18-24 year olds were either uncertain (43%) or not satisfied (43%).

Figure 5.5 Bar chart of age against whether or not there was too much text on the screen (18-24:n=14; 25-39:n=40; 40+:n=20)
**Satisfaction with Navigation**

Participants’ perceptions of the navigational aspects of the program including; identifying links, ease of navigation, helpfulness of navigational instructions, ability to find important information and whether help was required to navigate around the program were also obtained. The results reveal that generally participants were satisfied with this aspect of the online induction program.

Overall (82%) participants agreed it was easy to identify navigational links. Figure 5.6 indicates that the most positive were the 40+ age bracket with 90% agreeing the links were easy to identify. This was followed closely by 86% of the 18-24 year olds and over three quarters (77%) of the 25-39 year olds who also agreed the links were easy to find.

![Bar chart of age against whether or not the navigational links in the program were easy to identify (18-24:n=14; 25-39:n=40; 40+:n=20)](image)

**Figure 5.6** Bar chart of age against whether or not the navigational links in the program were easy to identify (18-24:n=14; 25-39:n=40; 40+:n=20)

Overall, 74% of participants believed it was easy to navigate around the program. Figure 5.7 indicates that 67% of tradespeople, 79% of labourers/TA operators and 92% of professionals found navigating their way around the program easy. However 9% of tradespeople and 8% of labourers/TA operators did not.
Overall (71%) participants also found the program navigation instructions helpful. However 26% of secondary school-educated participants and 19% of TAFE participants were undecided about its helpfulness (Figure 5.8).

Questions were also asked relating to finding important information and the need for trainer help to navigate the online program. Overall, 51% of participants did not have problems finding important information in the program. Figure 5.9 shows that 64% of participants with 0 to < 1 year of experience believed they had no difficulty finding the important information along with 42% of participants with 1-4 years of experience and 60% of workers with 10 plus years of experience. Whereas 42% of workers with 1-4
years and 40% of workers with 10 years or more of experience had some trouble finding important information.

![Bar chart of years of mining experience against whether or not difficulty was encountered finding important information (0<1:n=14; 1-4:n=36; 5-9:n=14; 10+:n=10)](image)

*Figure 5.9 Bar chart of years of mining experience against whether or not difficulty was encountered finding important information (0<1:n=14; 1-4:n=36; 5-9:n=14; 10+:n=10)*

Overall, 55% of participants did not require trainer help to navigate around the program. However, almost one third (30%) of participants aged 40+ and 21% of 18 – 24 year olds felt they needed trainer help to navigate the program whereas 63% of 25-39 year olds and 57% of 18-24 years did not (Figure 5.10).

![Bar chart of age against whether or not trainer help was required to navigate around the program (18-24:n=14; 25-39:n=40; 40+:n=20)](image)

*Figure 5.10 Bar chart of age against whether or not trainer help was required to navigate around the program (18-24:n=14; 25-39:n=40; 40+:n=20)*

**Satisfaction with Multimedia**

Two questions were asked regarding the variety and quality of the multimedia used in the program. Again the responses indicated that participants were generally satisfied with the multimedia. Overall, 73% of participants believed there was a good mix of
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multimedia in the program. The data presented in Figure 5.11 shows that 83% of participants with 40+ years of age were satisfied with the variety of multimedia used in the induction program along with 76% of participants with 18-24 years. However 21% of participants with 25-39 years of age did not think there was enough variety.

![Figure 5.11 Bar chart of age against whether or not there was a good mix of multimedia in the program (18-24:n=14; 25-39:n=40; 40+:n=20)](image)

Overall 67% of participants believed the multimedia was of high quality. Further, professional workers (92%) tended to be the most satisfied with the quality of the multimedia compared to the tradespeople (58%). It is pertinent that no professionals believed there were any issues with the quality of the multimedia, such as clarity of the audio, whereas a quarter (25%) of the labourers/TA operators and 20% tradespeople did (Figure 5.12). This may be due to professionals having more exposure to computers and online learning through work and education than their more hands-on co-workers.
Satisfaction with Control

Participants were asked about their ability to decide their pathway through the online program. A chi-square test for association was conducted to look at the relationship between age and years of mining experience for each level of the dependent variable ‘able to decide lesson order’ and found no significant interactions ($p<0.05$) for every one of the chi-square tests. Therefore a decision was made to look at the relationship between ‘able to decide lesson order’ and age, and ‘able to decide lesson order’ and years of mining experience separately. Overall, 47% of participants believed they had sufficient learner control. Figure 5.13 reveals that participants with 10 plus years of mining experience were the most positive with 70% believing they could decide the order in which they completed the lessons compared to 57% of participants with both 0 to < 1 year and 5-9 years of mining experience and 31% of participants with 1-4 years of experience. However participants with 1-4 years were the least satisfied with 37% disagreeing they had control over the lesson order followed closely by 36% of the participants with 5-9 years of mining experience. It is cogent that Figure 5.14 indicates 58% of participants aged 40+ were satisfied with their ability to decide their pathway through the program compared to 28% of 18-24 year olds. Further, over one third (35%) of 25-39 year olds did not believe they had sufficient learner control compared to 28% of participants with 0 to < 1 year and 10% of participants with 10 plus years of experience. These results may be due to older, more experienced workers following the pathway provided and not feeling the need to exert control as they are not used to taking
responsibility for their own learning, compared to the younger generation who would be more familiar with computers and the concept of online learning.

**Satisfaction with Interaction**

Overall, participants’ perceptions regarding interaction were not as positive with participants either uncertain (32%) or disagreeing (30%) that there were sufficient opportunities for interaction whilst completing the online induction program. A chi-square test for association was conducted to look at the relationship between age and years of mining experience for each level of the dependent variable ‘sufficient opportunities for interaction’ and found no significant interactions ($p < 0.05$) for every one of the chi-square tests. Therefore a decision was made to look at the relationship between ‘sufficient opportunities for interaction’ and age, and ‘sufficient opportunities for interaction’ and years of mining experience separately. Figure 5.15 shows that 60% of participants with 10 years and over of mining experience felt there was enough interaction compared to one third (33%) of participants with 1-4 years of experience. However 43% of participants with both 0 to < 1 year and 5-9 years of mining experience did not compared to 10% of participants with 10 years or more of experience. The same question seen through the lens of age (Figure 5.16) indicates that one half (50%) of the older participants (40+ years of age) believed there were sufficient opportunities for interaction compared to 21% of 18-24 year olds. Further, one half (50%) of the younger workers (18-24 years of age) were not satisfied with the amount of interaction compared to one quarter (25%) of both the 25-39 year olds and
participants aged 40+. This is germane as the younger generation may have been accustomed to more interactive computer experiences through game playing.

Satisfaction with Procedures and Expectations

Participants were also asked about the online programs procedures and expectations, including the clarity of learning objectives and clarity of expectations. On the whole, participants were satisfied with these elements of the program, particularly with the clearness of the learning objectives for each lesson. Overall, 84% of participants believed the learning objectives for each lesson were clear. As Figure 5.17 shows, 100% of participants with 0 to < 1 year of experience felt that the learning objectives were clear for each lesson, along with 81% of participants with 1-4 years and 80% of participants with 10 plus years of mining experience. Only 8% of participants with 1-4 years of mining experience did not think the learning objectives were clear.
Overall, (80%) participants were generally not positive about what to expect in the program and there was a statistically significant relationship between education and level of satisfaction with expectations about the program ($\chi^2=7.7$, df=2, $p=0.020$). Figure 5.18 shows that 39% of secondary educated participants and 38% of TAFE educated participants felt they did not have a clear understanding of what to expect in the induction program. Further, over half (54%) of TAFE educated participants were uncertain about what to expect along with 30% of secondary school educated participants. However, 30% of secondary school educated participants believed they had a clear understanding of what to expect.

Figure 5.18 Bar chart of education against whether or not participants were clear on what to expect from the program (Secondary:n=46; TAFE:n=37)
Satisfaction with Content Delivery

A number of questions relating to content delivery were asked of participants, including the order and accuracy, the amount and relevancy of the information, and the appropriateness of the tests used to check understanding. On the whole participants were satisfied with the content delivery. The following graphs show interesting patterns based on the different demographic variables.

Overall, almost three quarters (74%) of participants agreed that they liked the order in which the lessons were presented in the online program. Figure 5.19 indicates that 92% of professionals and 73% of tradespeople were satisfied with the order of the lessons compared to two thirds (66%) of labourers/TA operators. Further, 17% of Labourer/TA operators were either uncertain or disagreed.

Although all mine sites must comply with legislation, how this is done and to what standard can vary from mine site to mine site. Also the culture and climate of each site can be different and can impact on workers both positively and negatively. Participants’ perceptions of the accuracy of the content was generally positive as overall, almost three quarters (74%) of workers believed the information in the program was correct. This was important as information revealed by a manager (at mine site B) in the interviews suggest that vital content such as SOPs (standard operating procedures), polices and job tasks were not always accurate or up to date. Participants at mine site G tended to be more sceptical with one quarter (25%) not believing the content was accurate, and 17% from mine site B concurring. Further one third (33%) of participants from mine site B

![Bar chart of job responsibility against whether or not the order in which the lessons were delivered was liked (Tradesperson:n=47; Labourer/TA Operator:n=24; Professional:n=10)](image-url)
were uncertain. Conversely 87% participants from mine site D felt the content was accurate (Figure 5.20).

![Figure 5.20 Bar chart of mine sites against whether or not the content of the program was accurate](image)

Figure 5.20 Bar chart of mine sites against whether or not the content of the program was accurate (A:n=9; B:n=7; C:n=13; D:n=8; E:n=15; F:n=7; G:n=8)

The following graph relates to participants’ perceptions of the amount of detail in each lesson. Overall, 84% of participants believed there was sufficient detail in the lessons, with the least experienced the most positive. As Figure 5.21 shows, 100% of participants with 0 to < 1 year believed there was enough detail along with 81% of workers with 1-4 years and 80% with 10 plus years of mining experience. However 20% of participants with over 10 years of experience were uncertain.

![Figure 5.21 Bar chart of years of mining experience against whether or not there was a sufficient amount of detail in the lessons](image)

Figure 5.21 Bar chart of years of mining experience against whether or not there was a sufficient amount of detail in the lessons (0<1:n=14; 1-4: n=36; 5-9:n=14; 10+:n=10)
Participants were also asked whether there was an excessive amount of information they were required to learn. There was a statistically significant result between job responsibility and quantity of information ($\chi^2 = 11.6, \text{df}=4, p=0.020$). Figure 5.22 indicates that 38% of labourers/TA operators compared to 19% of tradespeople felt there was too much information to learn. Moreover, 42% of professionals were uncertain and 58% did not think there was an excessive amount of information to learn (Figure 5.22).

![Figure 5.22 Bar chart of job responsibility against whether or not there was an excessive amount of information to learn (Tradesperson:n=47; Labourer/TA Operator:n=24; Professional:n=10)](image)

Participants were also asked if there was unnecessary information included in the online induction program. Overall, one half (50%) of participants believed there was unnecessary information in the program. It was cogent to observe that 64% of participants with 0 to < 1 year of mining experience believed that unnecessary information was included in the program compared to one half (50%) of the more experienced workers (5-9 years and 10+ years). This may have been due to novices completing a generic induction shortly before the online site safety induction program, which contained much of the same information. However, 39% of participants with 1-4 years of mining experience disagreed (Figure 5.23).
Participants were asked about their views on the appropriateness of the tests used to check their understanding. A chi-square test for association was conducted to look at the relationship between age and years of mining experience for each level of the dependent variable ‘tests too hard’ and found no significant interactions ($p<0.05$) for every one of the chi-square tests. Therefore a decision was made to look at the relationship between ‘tests too hard’ and age, and ‘tests too hard’ and years of mining experience separately. The general response was positive, as overall 70% of participants did not find the assessments too difficult. However, Figure 5.24 indicates that 30% of participants with 10 years or more of mining experience thought the tests were too hard compared to 14% of participants with both 0 to < 1 year and 5-9 years of experience. When seen through the lens of age, it is the 40+ age group who had more trouble with 30% believing the tests were too hard compared to 14% of 18-24 year olds. Further, three quarters (75%) of the 25-39 year olds did not think that the tests were too hard (Figure 5.25).
Overall, 72% of participants believed the assessments checked their level of understanding. The most positive were the secondary school educated participants with 78% believing the tests checked understanding compared to 65% of TAFE educated participants. Conversely, only 8% of TAFE educated participants believed the tests did not check their level of understanding (Figure 5.26).
**Enjoyment of Delivery Mode**

Participants were asked if they enjoyed computer based learning. Overall, 78% of participants enjoyed this mode of delivery however age impacted on perceptions, with the younger generation being the most satisfied. Figure 5.27 shows that all (100%) of participants aged 18-24 enjoyed computer based learning compared to 70% of workers aged 40+, whereas one quarter (25%) of participants aged 40+ were uncertain and 13% of 25-39 year olds did not enjoy this mode of learning.

![Figure 5.27 Bar chart of age against whether or not learning via a computer-based system was enjoyed (18-24:n=14; 25-39:n=40; 40+:n=20)](image)

**Overall Satisfaction**

Finally, participants were asked questions relating to their overall satisfaction with the online induction program. The results indicate that on the whole, participants were satisfied with the program. Overall, almost three quarters of participants (74%) would recommend the program to others. Figure 5.28 suggests that participants with the least mining experience tended to be the most positive as 93% of participants with 0 to < 1 year of experience would recommend the program to others compared to 64% of participants with 5-9 years of experience. Moreover, 29% of participants with 5-9 years mining experience were uncertain about recommending the program to others.
Participants’ responses to whether they felt the program met their needs were on the whole, positive with 73% overall agreeing. A chi-square test for association was conducted to look at the relationship between age and years of mining experience for each level of the dependent variable ‘felt program met my needs’ and found no significant interactions ($p<0.05$) for every one of the chi-square tests. Therefore a decision was made to look at the relationship between ‘felt program met my needs’ and age, and ‘felt program met my needs’ and years of mining experience separately. Interestingly, participants with the least mining experience were the most satisfied with 93% with 0 to < 1 year of experience believing the program met their needs compared to 60% of participants with 10 plus years of experience. Further, nearly one third (30%) of participants with over 10 years of experience were uncertain the program met their needs (Figure 5.29). Moreover, age had an influence on perceptions with this variable. Although statistically significant ($\chi^2 = 10.8$, df=4, $p=0.012$), with 55% of cells having an expected count less than 5 the $p$-values were unreliable. Therefore a Fishers Exact test, using a Monte Carlo simulation with 1,000,000 samples was performed and found the $p$-value was 0.011 (99% confidence interval from 0.011 to 0.011), indicating there was a significant association ($p<0.05$). All (100%) of the 18-24 year olds and 85% of 40+ year olds felt the program met their needs compared to 57% of the 25-39 year olds. Further, the 25-39 year olds were more critical with one quarter (25%) uncertain and 17% disagreeing (Figure 5.30).
5.4.2 Perceived Barriers to Learning

To examine participants’ perceptions of the barriers or problems they encountered whilst completing the online induction program the survey included 10 questions grouped into the following 6 constructs; trainer support, learner competency, computer skills, learner motivation, time and technical issues. The survey results for each construct are reported below.

**Trainer Support**

Participants were asked questions about their access to trainer support and the quality of assistance they received. In both instances, perceptions were generally positive. A chi-square test for association was conducted to look at the relationship between age and years of mining experience for each level of the dependent variable ‘lack of trainer support’ and found no significant interactions ($p<0.05$) for every one of the chi-square tests. Therefore a decision was made to look at the relationship between ‘lack of trainer support’ and age, and ‘lack of trainer support’ and years of mining experience separately. Overall, 74% of participants believed they had sufficient support. Figure 5.31 indicates that years of mining experience had some influence on how participants perceived the degree of trainer support provided. Participants with 0 to < 1 year of mining experience were the most satisfied with the amount of support, with 86% believing they had sufficient access to a trainer when they required help compared to
60% of participants with 10+ years of experience. Whereas 30% of participants with 10 years and over of mining experience felt they did not receive the required support from a trainer compared to 14% of novices (0 to < 1 year). When seen through the lens of age, 20% of participants aged 40+ were uncertain and one quarter (25%) felt they needed more trainer support compared to 14% of 18-24 year olds (Figure 5.32).

Participants’ views on how clearly they understood any instructions they received from a trainer were positive. Overall, 80% believed they received clear instructions. Figure 5.33 indicates that 83% of both labourer/TA operators and professionals thought the trainer’s instructions were clear compared to 76% of tradespeople. However 11% of tradespeople and 8% of labourers/TA operators did not think so.
**Learner Competency**

Participants’ perceptions of their ability to comprehend the information contained in the online induction program was another potential barrier to learning which was investigated. Overall, 62% of participants did not feel the information was difficult to understand. It was interesting to note, as shown in Figure 5.34, that the less experienced miners were more positive regarding their ability to understand the information than some of the most experienced miners. Eighty-six percent of participants with 0 to < 1 year of mining experience did not believe they had difficulty understanding the information in the online induction program compared to 40% of miners with 10+ years of mining experience. Again, this may have been due to their recent completion of the generic induction and/or their inability to accurately assess their level of understanding. Conversely, 40% of workers with 10 years and more of mining experience believed some of the information was difficult to understand.

![Figure 5.34 Bar chart of years of mining experience against whether or not some of the information was difficult to understand (0<1:n=14; 1-4:n=36; 5-9:n=14; 10+:n=10)](image)

**Computer Skills**

Participants were asked about their perceived level of computer skills. When education was cross tabulated with computer competency, although statistically significant ($\chi^2=12.4$, df=2 $p=0.002$) with 33.3% of cells having an expected count less than 5 the $p$-values were unreliable. Therefore a Fishers Exact test, using a Monte Carlo simulation with 1,000,000 samples was performed and found the $p$-value was 0.002 (99% confidence interval from 0.002 to 0.002), indicating a significant association ($p<0.05$). Overall, 52% of participants felt their computer skills were average and 37% believed
they were advanced. Figure 5.35 suggests that 57% of participants with a TAFE qualification believed they could use various applications (such as spreadsheets) on a computer very well as opposed to 22% of secondary educated participants. Also 61% of secondary school educated participants nominated average competency (i.e. could use email, surf the web) compared to 40% of TAFE educated participants. Finally, 17% of secondary educated participants indicated that they had hardly used a computer at all before starting the online induction program.

![Bar chart of education against perceived level of computer skill (Secondary:n=46; TAFE:n=37)](image)

**Figure 5.35** Bar chart of education against perceived level of computer skill (Secondary:n=46; TAFE:n=37)

**Learner Motivation**

Two questions relating to motivation were asked of participants, including their enthusiasm to start the program and whether they found the content interesting. Overall, the results were positive as 81% of participants were motivated to start the program. Figure 5.36 shows that 93% of participants with 0 to < 1 year of experience were motivated to start the program compared to 80% of participants with both 1-4 years and 10 plus years of experience and 71% of participants with 5-9 years of mining experience. Further, 21% of participants with 5-9 years of mining experience were uncertain.
Participants’ responses were more ambivalent regarding the lesson content. Overall, 67% of participants thought the lesson content was interesting. Figure 5.37 indicates that three quarters (75%) of professionals agreed the lesson content was interesting compared to 64% of tradespeople and 71% of labourers/TA operators. However over one third (34%) of tradespeople were uncertain along with one quarter (25%) of professionals and 12% of labourers/TA operators. Finally, 17% of labourers/TA operators did not think the content was interesting.

**Time Constraints**

Participants were asked two questions relating to the amount of time they had to complete the online induction program to see if this factor caused any problems. Generally the responses were positive with participants believing they had enough time
to complete the program and that they were satisfied with the amount of time it took to finish. Overall 72% of participants believed they had sufficient time to complete the program. In Figure 5.38, 73% of males believed they had enough time to complete the program and 67% of females concurred, however one third (33%) of females were uncertain there was enough time allocated.

![Figure 5.38 Bar chart of gender against whether or not there was enough time to complete the program](Males:n=74; Females:n=9)

Alternatively, when participants were asked about how satisfied they were with the time they took to complete the program, participants’ perceptions at the different mine sites were varied. Overall, 64% of participants were satisfied with the time they took to complete the program. All (100%) participants from mine site D were satisfied followed by 78% at mine site A. Over half (53%) from mine site E were uncertain along with 43% from mine site F. However 17% from mine site C and 14% from mine site B were not satisfied with the time taken to complete the program (Figure 5.39).

![Figure 5.39 Bar chart of mine sites against whether or not the time taken to complete program was satisfactory](A:n=9; B:n=7; C:n=13; D:n=8; E:n=15; F:n=7; G:n=8)
The same dependent variable “satisfied with time taken to complete program” was also looked at through the lens of multiple sites to see if there were any associations. This allowed a comparison between two different companies to ascertain if participants were satisfied or not, with the time taken to complete multiple inductions, as some participants were required to undertake up to five site inductions a day. Further, the interviews revealed that the more online inductions in one day participants were required to complete the longer it took and the more frustrated, fatigued and disengaged participants became, thus having a potential impact on learning. Although the results were not statistically significant they revealed that just less than half (47%) were satisfied with the time they took to complete the program and that 29% of participants from Company Y were most dis-satisfied (Figure 5.40).

![Figure 5.40 Bar chart of multiple sites against whether or not the time taken to complete program was satisfactory (X:n=8; Y:n=8)](image)

**Technical Issues**

Participants were asked two questions regarding technical issues they may have encountered whilst undertaking the online induction program. Generally, participants did not encounter many technical difficulties such as; program failures, slow response time, loss of power and computer breakdowns.

Overall, 96% of participants did not encounter any technical difficulties. Figure 5.41 indicates that the higher the self-reported computer skills the fewer technical difficulties experienced with only 11% of participants with limited computer competency reporting technical difficulties.
Overall, 77% of participants believed that any technical problems were fixed quickly. Figure 5.42 shows that the younger participants were the most positive with all (100%) of 18-24 year olds feeling that technical issues were resolved quickly compared to 85% of participants aged 40+ and 65% of 25-39 year olds. Further 23% of participants aged 25-39 did not think that technical problems were fixed quickly.

5.4.3 Perceived Effectiveness of the Program

To examine participants’ perceptions of the effectiveness of the online induction program the survey included five questions grouped into the following 3 constructs; perceived acquisition of knowledge, perceived application of knowledge in the workplace and perceived effectiveness of program to facilitate the learning of safety. 
The survey results for each construct are reported below.

**Perceived Acquisition of Knowledge**

Participants were asked two questions relating to whether they learnt from the online program or not. Generally, participants were positive regarding the learning effectiveness of the program. Overall, 86% of participants believed learning occurred. Nevertheless, Figure 5.43 shows participants’ years of mining experience impacted on their perceptions relating to whether or not they had learned from the online induction program. Unsurprisingly, the more experienced participants were the most negative. According to the literature experienced mine workers are less likely to be influenced by training as they believe they already know the required information (Laurence, 2005) and therefore there is nothing new to learn. Thirty percent of workers with 10+ years of mining experience felt they did not learn from the program compared to 21% of participants with 0 to < 1 year of experience. However, 93% of participants with 5-9 years of mining experience and 92% with 1-4 years felt they did learn from the program compared to 70% of participants with 10+ years of experience and 79% of participants with 0 to < 1 year of mining experience.

![Bar chart of years of mining experience against whether or not learning occurred](image)

*Figure 5.43 Bar chart of years of mining experience against whether or not learning occurred (0<1:n=14; 1-4:n=36; 5-9:n=14; 10+:n=10)*

Participants were also asked whether the program helped them to learn the required information. Overall, almost three quarter (74%) of participants believed the program helped facilitate learning. A chi-square test for association was conducted to look at the relationship between age and years of mining experience for each level of the dependent variable ‘program helped to facilitate learning’ and found no significant interactions.
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(p<0.05) for every one of the chi-square tests. Therefore a decision was made to look at the relationship between ‘program helped to facilitate learning’ and age, and ‘program helped to facilitate learning’ and years of mining experience separately. The findings indicate that 93% of the participants with 0 to < 1 year of mining experience felt the program helped them learn the training material compared with 64% of participants with 10 plus years of experience. The participants with 5-9 years of mining experience were less positive as 36% were uncertain. Also 20% of participants with 10 years or more of mining experience did not think the program facilitated learning (Figure 5.44). The same question seen through the lens of age shows that participants aged 18-24 were the most positive with 100% believing that the program helped facilitate their learning compared to 57% of participants aged 25-39. Further, participants aged 25-39 were less positive with almost one third (30%) uncertain and 13% disagreeing (Figure 5.45).

Perceived Application of Knowledge in Workplace

Participants were asked two questions relating to their perceived ability to apply what they had learned from the online induction program to the workplace. One question asked if they had used what they had learned in the program in their workplace, and the other asked if they believed they could apply what they had learned in the program in their workplace. This was to ensure that at least one question was applicable to both novice and experienced workers to the industry and/or a job role.
Overall, 62% of participants believed they applied their learning in the workplace. The professionals were the most positive with 92% indicating they applied their learning in the workplace. However the tradespeople were less confident with almost one third (32%) uncertain and 11% suggesting they did not (Figure 5.46).

![Figure 5.46](image)

*Figure 5.46 Bar chart of job responsibility against whether or not learning was applied in workplace (Tradesperson:n=47; Labourer/TA Operator:n=24; Professional:n=10)*

Overall 72% of participants were confident in their ability to apply their learning to the workplace. However it was the less experienced workers who were the most positive with 93% of participants with 0 to < 1 year of experience indicating they would be able to transfer learning to the workplace compared to 56% of participants with 10 or more years of mining experience. The participants with 10 years plus of mining experience appear more hesitant with one third (33%) uncertain, and 11% not confident (Figure 5.47).

![Figure 5.47](image)

*Figure 5.47 Bar chart of years of mining experience against whether or not what was learned in the program can be applied in the workplace (0<1:n=14; 1-4:n=36; 5-9:n=14; 10+:n=10)*
Overall Effectiveness of Program

Finally, participants were asked whether they thought an online induction program was a good way to learn about safety in the mines. Although no results were statistically significant participant perceptions were generally negative regarding the effectiveness of learning safety through the online induction program. Overall, 69% of participants did not believe the online program was a good way to learn safety. In Figure 5.48 three quarters (75%) of participants with 5-9 years of mining experience and 64% to 69% of the remaining groups did not believe the online safety induction was a good way to learn safety. Moreover, 29% of participants with 0 < 1 year of mining experience believed the program was a good way to learn safety.

![Figure 5.48 Bar chart of years of mining experience against whether or not the program was a good way to learn safety (0<1:n=14; 1-4:n=36; 5-9:n=14; 10+:n=10)]

5.4.4 Perceived Effectiveness of the Design of the Program

To examine participants’ perceptions of the effectiveness of the instructional strategies used in the online induction program the survey included seven questions grouped under one construct; perceived effectiveness of the instructional approaches used in the online induction program. The survey results for the above construct are reported below.

Instructional Design Approaches

Participants were asked seven questions relating to their views on the instructional strategies encountered in the online induction program including; the variety and relevancy of the learning activities, the type and effectiveness of techniques used to
support learning and the appropriateness of the activities.

Overall, 66% of participants were satisfied with the variety of learning activities provided in the online induction program. Figure 5.49 suggests that although statistically significant ($\chi^2= 10.4, \text{df}=4, \ p=0.033$), with 55% of cells having an expected count less than 5 the p-values were unreliable. Therefore a Fishers Exact test, using a Monte Carlo simulation with 1,000,000 samples was performed and found the p-value was 0.040 (99% confidence interval from 0.039 to 0.040), indicating a significant association ($p<0.05$). The data suggests that 92% of 18-24 year olds and three quarters (75%) of participants 40 years and older were satisfied with the variety of learning activities. Further, 30% of 25-39 year olds were uncertain and 18% of them disagreed that there was enough variety in the learning activities.

Conversely, participants were generally divided regarding the degree of repetition of learning activities. Overall, 41% of participants believed there was unnecessary repetition. It is interesting to note that one half (50%) of participants with 5-9 years of mining experience felt there was unnecessary repetition compared with 36% of participants with 0 to < 1 year of experience. Curiously, 40% of participants with 10 plus years of mining experience did not believe there was unnecessary repetition of learning activities (Figure 5.50). This contradicts what the literature and interviews revealed. However as more experienced workers tend to believe there is nothing new to learn in an induction they go straight to the assessments (Douglas & Oosthuizen, 2010) rather than completing each of the learning modules in the online program, hence avoiding the repetition.
Participants were also asked if the lessons were designed so that they helped build on existing knowledge and whether hints and examples were given if they didn’t know the answer. Overall, 71% of participants believed the lessons built on existing knowledge. Figure 5.51 shows that three quarters (75%) of labourer/TA operators thought that some of the lessons helped build on existing knowledge along with 72% of tradespeople. The professionals were not as positive with one quarter (25%) uncertain and 17% who did not.

Participants were also asked if authentic problem solving activities were used to help learning. Overall, 66% of participants believed real-life examples helped them to learn the information in the online induction program. Figure 5.52 indicates that 79% of
participants with $0 < 1$ year of mining experience thought that authentic problem solving activities helped their learning compared to 54% of participants with 5-9 years and 60% of participants with 10+ years of mining experience. As there were no authentic problem solving activities incorporated in the program, it was germane that 39% of participants with 5-9 years of mining experience were uncertain and 20% of participants with over 10 years of mining experience did not think so.

Figure 5.52 Bar chart of years of mining experience against whether or not authentic problem solving activities in the program helped learning ($0<1:n=14; 1-4:n=36; 5-9:n=14; 10+:n=10$)

Overall 66% of participants believed there were hints and examples given in the online program if the information was not initially understood. As Figure 5.53 shows, three quarters (75%) of labourers/TA operators and 67% of tradespeople believed that hints and examples were given, with 36% of professionals uncertain and a further 18% of professionals who did not think so.
Overall, 73% of participants believed that the hints and examples provided in the online program were helpful. Figure 5.54 indicates that 92% of participants aged 18-24 and 80% of participants aged 40+ felt that the hints and examples were helpful. However the 25-39 year olds were not as positive with 23% uncertain and 15% disagreeing.

Further, participants were asked whether the learning activities were too simple. This question was asked to ascertain if the program was pitched at the appropriate level. Overall, 41% of participants did not think the activities were too simple. The results in Figure 5.55 suggest that 31% of participants with 1-4 years mining experience and 30% of participants with 10+ years of experience believed the activities were too simple.
Furthmore, 64% of participants with 0 to < 1 year of experience were uncertain along with 20% of participants with 10+ years of mining experience. Further, one half (50%) of participants with 5-9 years of mining experience and 10+ years of mining experience did not believe the learning activities were too simple compared to 21% of novice participants (0 to < 1 year).

![Figure 5.55 Bar chart of years of mining experience against whether or not the learning activities in the program were too simple (0<1:n=14; 1-4:n=36; 5-9:n=14; 10+:n=10)](image)

5.5 **Responses to the Open-ended Questions**

The survey had two open-ended questions to discover what the participants liked about the program and what they would like to change. The two questions in the survey were:

- Please tell me the one best thing about the online induction program.
- Please tell me the one thing in the online induction program that needed improvement.

Pattern matching was used to analyse the responses to the above two questions. Each word (or phrase) was examined for meaning and similar concepts were grouped together. Each concept was then given a tally mark to record the number of times they were raised by participants. Table 5.5 displays participants perceptions of what they considered was the one best aspect of the online site safety induction program.
Seventy-five participants responded to this question. Over one third (35%) of participants highlighted the self-paced nature of the online program as the best feature followed by comments that it was easy to understand (21%) and quick to complete (17%). There were also a number of positive comments relating to the fact it was computer based (11%), easy to navigate (7%) and well designed (4%).

Again, pattern matching was used to tally the frequency of similar concepts which were identified when participants were asked to suggest the one thing they believed needed improvement with the online induction program. Seventy-nine participants responded to this question. Table 5.6 shows that the primary aspect of the program that participants felt needed improving was the amount of irrelevant information. Twenty-six percent of participants believed there was too much content which was not relevant to their job area. Consequently there were also suggestions that there should be less repetition (22%) of information and less reading (13%). There were also various other issues of concern such as the look of the program (10%), frequency of incorrect information (7%), navigational issues (6%) and the fact it was too easy to pass (4%).

<table>
<thead>
<tr>
<th>Best thing about online program</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-paced</td>
<td>26</td>
<td>35</td>
</tr>
<tr>
<td>Easy to understand</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>Quick/Fast</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Computer based</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Easy to navigate</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Good design</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>No writing</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Good information</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Finishing</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>75</td>
<td>100</td>
</tr>
</tbody>
</table>
### Quantitative Findings

#### Table 5.6 The one thing that needs improvement with the online induction program

<table>
<thead>
<tr>
<th>Needs improvement</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too much irrelevant information</td>
<td>21</td>
<td>26</td>
</tr>
<tr>
<td>Repetition of information</td>
<td>17</td>
<td>22</td>
</tr>
<tr>
<td>Too much reading</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>Overall look of program</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Incorrect information</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Not easy to navigate</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Do not have to read information to pass</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Takes too long</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Need more breaks</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Recognition of people with prior knowledge</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Help for computer illiterate</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Poor seating</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>79</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

#### 5.6 Summary of Key Results and Conclusion

This section presented the quantitative analysis of participants’ responses to the survey questions relating to the online site safety induction program they had completed. The analysis included an examination of participants’ perceived satisfaction with the program, perceived barriers to learning, perceived effectiveness of the program and perceived effectiveness of the design. From the analysis it was found that, on the whole, participants’ perceptions of the online site safety program were positive with most aspects of the program. This was mainly due to the ease and efficiency in which most participants completed the program and the fact that the online induction was a mandatory requirement to work on a mine site. Also, those who may have struggled in understanding the information were still able to complete and pass the online induction by guessing if they didn’t know the answers. However there were some elements of the program which participants indicated need improvement and would thus require further investigation.

In relation to participants’ satisfaction with the program, the younger generation felt there was too much text on the screen, and participants with 1-4 and over 10 years of mining experience had difficulty finding important information. Also there appears to be a perception, particularly from novice (0 to < 1 year) workers and young participants (18-24 year olds), that there was not enough interaction provided in the online program. Level of education had an impact on whether participants believed they had a clear understanding of what to expect of the program, with TAFE qualified participants less
certain. Further the unskilled workers (labourers/TA operators) were unhappy with the excessive amount of information they were required to learn.

In regards to perceived barriers to learning participants may have encountered, the results did not indicate any major issues. Participants generally did not perceive a problem with technical issues, support or learner motivation. However it was interesting to note that the experienced workers (10+ years) were more likely to have difficulty understanding the information in the online site safety induction program. Unsurprisingly, participants who had to complete multiple inductions for various mine sites were generally less satisfied with the time taken to complete the program.

In regards to the perceived effectiveness of the online site induction program, most participants believed they had learned from the program and were able to apply that learning in the workplace. However it was interesting to note that the younger (18-24 years), less experienced (0 to < 1 year) participants were the most positive, believing the program helped facilitate their learning. Participants were also asked whether they thought an online site safety induction program was a good way to learn about safety in the mines. Participant perceptions were generally negative regarding the effectiveness of learning safety through an online induction program. The interviews revealed that even participants who preferred the online method due to its ease and efficiency believed that much of the content in the induction should be learned face-to-face, especially for novices, and that applying new knowledge on-the-job with the guidance of an experienced mentor was a more effective way to learn safety.

Finally, participants were asked questions regarding the effectiveness of the design strategies used in the online site safety program. Overall, participants were satisfied with the variety, level and scaffolding (in the form of hints and examples) provided in the program. However the professional participants were more likely to feel that examples were not given if the information was not understood and the novice participants (0 to < 1 year of mining experience) were positive that authentic problem solving activities helped their learning.

In response to the two open questions, participants generally liked that the online site safety induction program was self-paced, fast and easy to understand. What they perceived needed improvement was the amount of irrelevant and repetitious information
Quantitative Findings

This chapter has provided a detailed analysis of the quantitative data collected from the survey. The responses to the survey questions were analysed under the following themes: demographics; perceived satisfaction with the program, perceived barriers to learning, perceived effectiveness of the program and perceived satisfaction with the design. The following chapter presents the qualitative findings of the responses to the interview questions.
6. QUALITATIVE FINDINGS

6.1 Introduction

This chapter reports the findings of the qualitative analysis of the interview data and where appropriate it is presented in categories similar to the quantitative themes presented in Chapter Five. However, new concepts emerged from the analysis of the interview data resulting in the modification of some categories and/or the creation of different constructs to capture interviewees’ perceptions of the online site safety induction program.

The key aspects recognised in the Literature Review as impacting on the successful learning of safety in the mining industry were used as a framework to validate the constructs identified in the interviews. These included:

- Learning support
- Self-efficacy relating to computer skills and online learning
- Suitable and reliable technology
- Appropriate and varied multimedia
- Relevant and engaging content and activities
- Suitable level of learner control
- Learner-centred instructional design.
Interviews were conducted with 19 mine employees who had completed an online site induction program to discover their perceptions of the program. An interview was also conducted with the Managing Director (MD) of the Training Company who was responsible for creating the program to understand his approach to developing the content and design of the program. Where appropriate, the results are summarised and displayed in table form to provide a more coherent understanding of the information. Direct quotations, where suitable, are also included to provide examples of themes commonly found in the data and occasionally to illustrate responses which differed from the perceptions of the majority of interviewees.

This chapter is divided into seven sections. The first section provides an analysis of the interview with the MD of the Training Company to give background understanding on how the program was developed and has been incorporated into the relevant themes and/or constructs identified by the researcher, providing context and/or support for the views expressed by interviewees who completed the online site safety induction program. The second section provides demographic information about the interviewees including a profile of their job role, years of mining experience, age, gender and whether the safety induction program was their first induction and/or their first online induction. The third section analyses interviewees’ responses regarding their perceived satisfaction with the online induction program, including their views about the method of learning and the multimedia used in the program. The fourth section examines interviewees’ satisfaction with aspects relating to the content and design of the online safety program. It also includes managers’ perceptions of workers’ satisfaction with the online induction program. The fifth section analyses interviewees’ approaches to learning the information contained in the online safety induction program. The sixth section analyses interviewees’ perceptions of barriers to learning they may have encountered while using the program. Finally, the seventh section analyses interviewees responses relating to the perceived effectiveness of the program, particularly whether they had learned the required information and could/or had applied this learning in the workplace. Managers’ perceptions of the effectiveness of the online induction program based on their observations of workers at the mine sites, was also included in this analysis.
6.2 The Training Company

This section outlines the development approach for the online induction program taken by the MD of The Training Company. The Training Company was not a registered training organisation (R.T.O.) and did not issue formal qualifications (but did provide certificates on successful completion of the induction). Due to the specific hazards and unique requirements of each individual mine site, each mine has a specific Safety Management System (SMS) and Standard Operating Procedures (SOP’s) containing controls to mitigate any adverse effects of the hazards present on the mine site. Consequently, when designing the online site safety induction program, the MD had to comply with all regulatory requirements and safety controls identified in the SMS and SOP’s. Given the differing safety controls on each mine site the induction for each mine is different. Therefore there is no nationally accredited site safety induction course to cover all mines. Hence the ‘certificate’ is not transferable to other mine sites, organisations, states or territories. The training can be audited in case of incidents or accidents as the content must comply with the identified competencies contained in the SMS and SOP’s, as identified in the Coal Mining Safety and Health Regulation 2001 and other associated legislation. There is no evidence that the Department of Mines and Natural Resources nor any industry body is seeking to standardise safety controls or site inductions across all mine sites.

The MD started delivering face-to-face site inductions 12 years ago but saw the need for online training. As he could not find a suitable “off the shelf” online program that catered for a blue collar workforce with potentially low literacy and computer skills, he decided to design his own online training program. The MD had no formal qualifications in education or design and based his approach on his experiences as an instructor. The constructs identified in Table 6.1 were extracted during an interview with the MD as he used these as a guide to the development of the online program.
<table>
<thead>
<tr>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid blanket approach, make it relevant</td>
<td>Customisation</td>
</tr>
<tr>
<td>Try not to regurgitate a procedure</td>
<td></td>
</tr>
<tr>
<td>Not too many bells and whistles. Not bland but has to be simple</td>
<td>Design</td>
</tr>
<tr>
<td>No ambiguous or misleading information</td>
<td></td>
</tr>
<tr>
<td>Not trying to trick participants</td>
<td></td>
</tr>
<tr>
<td>No scenarios or problem based learning activities</td>
<td></td>
</tr>
<tr>
<td>All content was designed under the methodology of breaking each module into three areas: What are the hazards, What are the controls, what are your responsibilities.</td>
<td></td>
</tr>
<tr>
<td>Mix up types of assessment questions; drag/drops, Yes/No, True/False, Multiple choice</td>
<td>Assessment type</td>
</tr>
<tr>
<td>If incorrect answer given, taken straight to relevant information</td>
<td>Assessment process</td>
</tr>
<tr>
<td>Require 100% pass rate</td>
<td></td>
</tr>
<tr>
<td>Not sure if they have read the content but at least all questions have been answered and are correct</td>
<td></td>
</tr>
<tr>
<td>Assessments at end of each module</td>
<td></td>
</tr>
<tr>
<td>Multimedia used for a bit of variety and a bit of interaction</td>
<td>Multimedia</td>
</tr>
<tr>
<td>Audio included to cater for literacy issues and those who don’t like to read</td>
<td></td>
</tr>
<tr>
<td>Participants like the graphics, images, etc.</td>
<td></td>
</tr>
<tr>
<td>Try to avoid big slabs of text</td>
<td></td>
</tr>
<tr>
<td>Legislation important, Mandatory Standard Operating Procedures (SOPs)</td>
<td>Compliance</td>
</tr>
<tr>
<td>Produce reports and statistical data</td>
<td></td>
</tr>
<tr>
<td>Ensure person doing induction is identified</td>
<td></td>
</tr>
<tr>
<td>Large amount of core or generic modules</td>
<td>Efficiency</td>
</tr>
<tr>
<td>Small component of site specific modules</td>
<td></td>
</tr>
<tr>
<td>Mine sites constantly changing therefore try to make it as generic as possible</td>
<td></td>
</tr>
<tr>
<td>After completed first site, more like gap training for other sites</td>
<td></td>
</tr>
<tr>
<td>Complete more sites in one day than the old way of classroom training</td>
<td></td>
</tr>
<tr>
<td>Take anxious participants through the first few modules</td>
<td>Support</td>
</tr>
<tr>
<td>No matter what location receive same induction</td>
<td>Consistency</td>
</tr>
<tr>
<td>Taking induction off site eliminated costs</td>
<td>Cost effective</td>
</tr>
<tr>
<td>Outsourcing reduced huge administration process for mining companies</td>
<td></td>
</tr>
<tr>
<td>Mining companies own content</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Updating of content dictated by sites</td>
<td></td>
</tr>
</tbody>
</table>

The Managing Director mapped out the training program on a whiteboard and separated the content into topics and/or tasks, and each topic/task contained learning modules. Where appropriate each module was broken down into the following three areas; “what are the hazards?, what are the controls?, and what are your responsibilities?” At the end of each module, there was a mandatory assessment. The MD believed the information contained in the online safety program should provide participants with an overview on what happens on site, what hazards to be aware of and what was required of their job role and department. In relation to the procedures, the MD’s approach was to pull out
the key critical elements and not “regurgitate a procedure” but to make it clear and straight forward. He did not want the program to be bland but it also had to be simple and consistent. The typical participant the online program was designed for was “a computer illiterate dump truck driver whose fifty years old” who would be confused by too many “bells and whistles”. Further, no matter the time or location, participants received the same online site safety induction.

Efficiency was another main focus in the design of the program. Most participants should finish the program in 3 to 4 hours, depending on experience and number of sites to complete. By having a large amount of core information and only a small component of site specific content those participants who had to be inducted into multiple sites were able to complete more sites in one day than the traditional instructor led approach:

“So effectively once they’ve done their first site, it’s just gap training for each of the sites thereafter. So the number of sites they can achieve here in a day would normally take them a week to a fortnight in the old school way.”

The core information covered in the online program included; mission statements, duties and responsibilities, reporting of incidents, mandatory procedures such as tagging, isolation, and road rules and any non-negotiable site rules. The different tasks were then grouped together, such as all the electrical information or information relating to dump truck operation. Depending on their job role at the mine site, participants were able to choose a site, department and job/task when they started. The aim of the MD was to enable participants to select a training plan relevant to them and keep the flow going in relation to the task. Modules varied in length from a 5 screen presentation and an assessment, to a 45 screen presentation and an assessment. The structure of the program was to guide participants through each of the learning modules before attempting the assessments. If participants answered incorrectly, the system took them straight back to the pertinent information. The goal of the program was to “reinforce the correct information rather than just let them have multiple stabs in the dark”. So once they had re-read the information they could re-attempt the assessment and then move on. The MD stated there was little margin for error in such a dangerous industry as mining, therefore he required a 100% pass rate on the assessments. The legislation only requires that participants be deemed competent. However he could not guarantee that all participants read the information to the fullest extent. The MD mentioned there were no scenario or problem based learning activities in the online site safety induction.
Qualitative Findings

program as the MD believed the sites were responsible for reinforcing learning. Further the more degrees of difficulty or levels of complexity introduced into the online program the more maintenance was required. As the mining companies owned the content, the MD was constrained by their priorities including how much they wanted to invest in upgrading and maintaining the online site safety program.

The MD commented that he was somewhat limited by the content, as it was mainly composed of mundane, step by step processes informed by mandatory standard operating procedures (SOPs). However he realised this needed to be balanced with interactive multimedia so as to try and keep the learner attentive. The multimedia elements of the online induction program included: animations, videos, text to speech and audio to overcome literacy issues and for those who did not like to read. He felt visuals worked well, however, he stated that it was not easy to make a procedure exciting unless it was turned into a game, which he believed would lessen the value of the training. As the mining companies owned the content they were still in control and any changes and/or updating of information in the online program were dictated by the mining sites. Any changes in legislation and/or new procedures developed at the mining sites needed to be communicated to the Training Company by the mining organisations so the new information can be developed into a training module. Once the content was in an online format it must be approved by the mining site before it was incorporated into the online site safety induction program.

When developing the online site safety program, the MD needed to take into consideration a number of competing priorities. The first was complying with regulatory requirements and taking onboard feedback from the mines inspectorate. The second was the mining companies and their goals of cost effectiveness and convenience. The companies wanted the inductions taken off site and delivered in areas where, predominantly, their workforce was located. This not only eliminated accommodation, travel and site rate expenses it also reduced the need for companies to be responsible for the huge amount of administrative processes involved both pre and post when conducting inductions. It also solved the problem of security and providing support for participants. At the Training Company, each participant’s identity was checked and validated to ensure “that the person whose got a record in this system actually came and did the induction”. Once the administrative processes had been finalised, staff seated
participants at a computer where they completed the induction individually. For participants who had computer literacy issues there were staff members who could provide help. Finally, the MD was always looking at ways to improve the online program, however keeping it efficient and cost effective was an overriding factor.

### 6.3 Demographic Profile of Interviewees

Nineteen individuals were interviewed regarding their perceptions of the online site safety induction program. Table 6.2 provides a profile of the participants interviewed in this research.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Job Role</th>
<th>Gender</th>
<th>Age</th>
<th>Years Mining Experience</th>
<th>Computer skills</th>
<th>First Online Induction</th>
<th>First Induction</th>
</tr>
</thead>
<tbody>
<tr>
<td>W2</td>
<td>Boiler Maker</td>
<td>Male</td>
<td>35</td>
<td>6 years</td>
<td>Moderate</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>W4</td>
<td>Field Technician</td>
<td>Male</td>
<td>25</td>
<td>6 years</td>
<td>Moderate</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>W6</td>
<td>Electrician</td>
<td>Male</td>
<td>34</td>
<td>5 years</td>
<td>Moderate</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>W7</td>
<td>Labourer</td>
<td>Male</td>
<td>27</td>
<td>1 year</td>
<td>Moderate</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>W8</td>
<td>Boiler Maker</td>
<td>Male</td>
<td>45</td>
<td>3 years</td>
<td>Low</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>W9</td>
<td>Blaster</td>
<td>Male</td>
<td>30</td>
<td>6 years</td>
<td>Low</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>W10</td>
<td>Fitter</td>
<td>Male</td>
<td>35</td>
<td>&lt; 1 year</td>
<td>Low</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>W13</td>
<td>Electrician</td>
<td>Male</td>
<td>27</td>
<td>8 years</td>
<td>Advanced</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>W14</td>
<td>Driver</td>
<td>Female</td>
<td>45</td>
<td>6 years</td>
<td>Advanced</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>W15</td>
<td>Maintenance Foreman</td>
<td>Male</td>
<td>50</td>
<td>15 years</td>
<td>Low</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>W16</td>
<td>Storeman</td>
<td>Male</td>
<td>42</td>
<td>10 years</td>
<td>Moderate</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>W17</td>
<td>Test &amp; Tagger</td>
<td>Female</td>
<td>23</td>
<td>None</td>
<td>Moderate</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>W18</td>
<td>Graduate Civil</td>
<td>Male</td>
<td>25</td>
<td>2 years</td>
<td>Advanced</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>W19</td>
<td>Machinery Operator</td>
<td>Male</td>
<td>47</td>
<td>4 years</td>
<td>Moderate</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>S1</td>
<td>Safety Advisor</td>
<td>Male</td>
<td>39</td>
<td>15 years</td>
<td>Moderate</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>S3</td>
<td>Supervisor</td>
<td>Male</td>
<td>51</td>
<td>9 years</td>
<td>Moderate</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>M5</td>
<td>Manager</td>
<td>Male</td>
<td>40</td>
<td>15 years</td>
<td>Moderate</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>M11</td>
<td>Manager</td>
<td>Male</td>
<td>50+</td>
<td>16 years</td>
<td>Moderate</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>M12</td>
<td>Manager</td>
<td>Female</td>
<td>45+</td>
<td>20 years</td>
<td>Advanced</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Legend: W = worker; S = supervisor and shaded light grey; M = manager and shaded dark grey

Of the nineteen individuals interviewed, 14 interviewees worked in various job roles including; unskilled labourers experienced tradespeople and professionals (W), two were supervisors (S) and three were managers (M).

Three females from differing job roles and years of mining experience were also
interviewed. The number of years mining experience ranged from a cleanskin (someone with no mining experience) to a 20 year veteran. For eight interviewees this was their first online induction and for one of them, this was their first exposure to site safety induction training. The remaining 11 interviewees had experienced both face-to-face and online safety induction training.

6.4 Perceived Satisfaction with the Online Induction Program

Interviewees were asked about their perceptions of the online induction program and whether they were satisfied with learning online. During these discussions, interviewees also spoke about their views of the multimedia used in the program, and what could be improved. The following section examines interviewees’ satisfaction with the method of learning and satisfaction with the multimedia.

6.4.1 Perceived Satisfaction with the Method of Learning

When asked about how they found the online induction program, all interviewees responded by comparing their experiences with instructor led courses they had attended in the past to the online program they had just completed. The degree of satisfaction with the online induction program was usually in proportion to whether they preferred instructor led training and the level of face-to-face interaction they experienced in this environment, or the more independent nature of online learning. Interviewees who preferred the more traditional face-to-face learning environment were either not satisfied at all with learning online or their level of satisfaction was lower compared to the other interviewees.

Interviewees who were satisfied with online learning invariably mentioned the benefits of self-paced learning, and the ease and efficiency with which they completed the program. They liked the fact they could learn at their own pace without interruptions or pressure from other people. In particular, the experienced interviewees (workers who have completed a number of inductions and had worked in the industry for five or more years) appreciated being able to finish the program quickly and not being held up by first time inductees.

Of the 19 interviewees, 6 were not satisfied with the online safety induction program and 13 were generally satisfied. Of the 6 who were not satisfied, 3 had not previously participated in an online safety induction training program and one interviewee was
under 35 years of age. The common constructs that emerged from the data of the 6 interviewees who were not satisfied with the method of learning are presented in Table 6.3. Constructs emerged as common words used by interviewees were grouped together. The table is sorted according to whether this induction was their first online experience.

Table 6.3 Perceptions of interviewees who preferred instructor led training

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>First Online Induction</th>
<th>Age</th>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W10</td>
<td>Yes</td>
<td>35</td>
<td>Help and direction from instructor and peers</td>
<td>Interaction Guidance</td>
</tr>
<tr>
<td>W18</td>
<td>Yes</td>
<td>25</td>
<td>Listening to experienced people</td>
<td>Interaction</td>
</tr>
<tr>
<td>W16</td>
<td>Yes</td>
<td>42</td>
<td>Talk to experienced people, find out real situation on mine</td>
<td>Interaction Real life scenarios</td>
</tr>
<tr>
<td>W8</td>
<td>No</td>
<td>45</td>
<td>Ask questions, clarify understanding</td>
<td>Interaction</td>
</tr>
<tr>
<td>W15</td>
<td>No</td>
<td>50</td>
<td>Ask questions, clarify understanding, input from others</td>
<td>Interaction</td>
</tr>
<tr>
<td>M5</td>
<td>No</td>
<td>40</td>
<td>Ask questions, discuss issues, real feedback</td>
<td>Interaction Feedback</td>
</tr>
</tbody>
</table>

These interviewees missed the interaction provided in face-to-face training. Interviewee M5 had completed many inductions in the past, both instructor led and online, believed that “nobody enjoys doing inductions” but site safety induction training was compulsory if you wanted to work on a mine site. M5 went on to state that instructor led inductions were better as long as the instructor was knowledgeable and competent, as workers could ask questions if they did not understand and discuss issues which were relevant to their particular job.

The remaining interviewees who were not satisfied with the online site safety induction program echoed the sentiments of M5. Interviewee W8 preferred instructor led because he was not good with computers and if you do not understand something “you can ask the bloke face-to-face”. W10 not only had literacy problems but also lacked basic computer skills. He found the induction easier to understand with the support of an instructor. He mentioned there was a lot of information that had to be learned and felt rushed in the process. Interviewee W16 believed you learned more from instructor led training as people talk about their experiences on the mines and you therefore obtain understanding of what the situation at the mine was really like. W18 liked the fact he could learn from more experienced workers in a face-to-face situation and that the online program was “more a formality” as it only took him about 1 hour to complete.

1 Where applicable ums and arhs have been removed from all quotes to ensure clarity of understanding
W15 mentioned that he did not do well at school nor did he like reading. He also made the comment:

“I prefer instructor led as you can ask questions if you are not sure of things. In the online, what you see is what you read, there is no other input…I’m not that comfortable with computers and that’s why I prefer face-to-face”

For the above interviewees who were not satisfied with the online induction program, all felt the need for interaction which was provided in traditional face-to-face programs and two were not comfortable using the computer. The need for interaction manifested in slightly different ways. Three interviewees directly commented about the lack of opportunities to ask questions and clarify information in an online induction program. One interviewee referred to the absence of feedback and one felt there was not enough guidance or direction in the online learning program. Another interviewee mentioned there were no real-life scenarios in the online induction program. Several responses specifically highlighted the lack of opportunity to learn from more experienced workers, and came from the three interviewees who had not completed an online induction training program.

Of the 13 interviewees who were generally satisfied with the online safety program, five had not previously experienced an online safety training program before and 6 were under 35 years of age. The most common constructs which promoted satisfaction with the online induction program was that it was self-paced, followed by efficiency and individualistic. Table 6.4 presents the perceptions of interviewees who preferred the online mode of delivery. The table is sorted according to whether it was their first online induction.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>First Online Induction</th>
<th>Age</th>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W17</td>
<td>Yes</td>
<td>23</td>
<td>Own pace, comfortable, no pressure</td>
<td>Self-paced Individualistic</td>
</tr>
<tr>
<td>W7</td>
<td>Yes</td>
<td>27</td>
<td>Own pace, not having to wait for other people</td>
<td>Self-paced Efficient</td>
</tr>
<tr>
<td>W14</td>
<td>Yes</td>
<td>45</td>
<td>Own pace</td>
<td>Self-paced</td>
</tr>
<tr>
<td>W13</td>
<td>Yes</td>
<td>27</td>
<td>Own pace, quick</td>
<td>Self-paced Efficient</td>
</tr>
<tr>
<td>W19</td>
<td>Yes</td>
<td>47</td>
<td>Own pace, not held up by others</td>
<td>Self-paced Efficient</td>
</tr>
<tr>
<td>S1</td>
<td>No</td>
<td>39</td>
<td>Self-paced, quick, not held up by others</td>
<td>Self-paced Efficient</td>
</tr>
<tr>
<td>S3</td>
<td>No</td>
<td>51</td>
<td>Quick, self-paced, efficient, not held up by others</td>
<td>Efficient Self-paced</td>
</tr>
</tbody>
</table>
Of the five who had not participated in an online safety program, W17 also had no previous mining experience. She said it was easier to learn via the online program as there was no pressure or feelings of being judged by other interviewees and she could work at her own pace:

“I enjoyed it a lot. Basically you could just do it, just you and the computer. You didn’t have to worry about anything else, really. I find it easier to learn doing the online induction because it felt more comfortable and I could work at my own pace I guess.”

W17 also mentioned that she went through the modules in the order they were presented and didn’t feel restricted or the need to diverge from this approach. Likewise W14 went through each module consecutively by choice but acknowledged that she could “jump around” if she felt the need. The electrician, W13, liked that you could work at your own pace and were not held up by the slowest in the class. A sentiment echoed by W7. Similarly, interviewee W19 was satisfied with the program as you could go at your own pace. He preferred the online program to the instructor led courses he had done in the past as:

“In classroom situations you have people who learn at different rates so you are left behind by the fast ones and waiting for the slow ones. With the online induction you could study at own pace. You didn’t have to listen to the class clown and didn’t get exasperated by the person who finds fault with everything.”

Of the remaining 8 interviewees, all had 5 or more years of experience in the mining industry and had completed both instructor led and online safety induction programs. The safety advisor (S1) was generally satisfied with the online safety program as it was self-paced and “you can rip through it and not listen to someone jaw on about their past life experiences”. He also mentioned that it only took him two hours to complete the
induction. His priority was to complete the online induction as fast as possible so he could get out to the mine site, so it was “fantastic for me as a good time saver”.

Similarly, interviewee S3 valued the efficiency of the online safety induction program as “time is money”. He was satisfied with the fact that he could get through the program quickly and was not held up by others as for him “I try to do things quicker and faster and more efficient”. Similarly, interviewees W2 and W6 were satisfied with the online mode of delivery as they could work at their own pace and it was therefore relatively quick. W9 also liked the fact he could work on his own without the pressure of a group situation.

The two senior managers were satisfied with their personal experiences of the online safety induction program. M11 commented that he personally had no problems with the online induction program and liked that it was self-paced and quick to complete. Similarly, interviewee M12 a Training Manager who has experienced many online and instructor led safety inductions, liked the self-paced nature of the online induction program. She preferred the online induction as she liked to learn on her own and not be constrained by the needs of a group;

“Online inductions are just as informative and I found it better for myself as I like doing it individually. In large groups everyone gets a bit sick of it and a bit bored. You can go along at your own pace and that’s what I find missing in face-to-face”.

Efficiency was another important consideration. Nine of the interviewees made positive comments about the online program being quick or efficient. Three interviewees felt there was less pressure or hassle doing the induction online especially as you did it individually and did not have to worry about other people’s opinions and/or reactions.

### 6.4.2 Perceived Satisfaction with the Multimedia

The multimedia elements of the program consisted of animations, snippets of videos, audio and text to speech throughout the program. Eighteen interviewees were generally positive in their opinions regarding the multimedia and the concepts of variety and quality were evident. Frequently used phrases included; “it was pretty good”, “it was quite excellent”, “there was enough variety”, “good use of graphics”, “good quality”, “everything was there, sound, video graphics”, “listening was good as you could take more in”, “professionally done” and “very straightforward”.
One interviewee, M5 was not impressed with the multimedia but had no specific issues except he was generally not satisfied, as he said “I didn’t like anything about the program particularly”. He found the program uninteresting, repetitive and annoying as he had to click a number of times to move onto the next screen. He understood it was aimed at workers with low literacy and understanding levels and that it was the responsibility of the Site Manager to ensure that everyone was inducted. However he believed that face-to-face was a better form of instruction for safety inductions as it was more interactive and site focused, especially if the trainer was experienced and knowledgeable.

Some minor issues regarding certain aspects of the multimedia were raised by 8 of the interviewees. They offered suggestions to improve those perceived faults. Table 6.5 provides a summary of elements in the multimedia which interviewees’ perceived could be improved. The table is ordered under the constructs of clarity, quality, visual and variety.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Key Words</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W15</td>
<td>Couldn’t hear the audio</td>
<td>Clarity</td>
</tr>
<tr>
<td>S3</td>
<td>Robotic voice</td>
<td>Quality</td>
</tr>
<tr>
<td>W13</td>
<td>Layout of mine missing</td>
<td>Visual</td>
</tr>
<tr>
<td>W14</td>
<td>Need more videos</td>
<td>Variety</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visual</td>
</tr>
<tr>
<td>W18</td>
<td>More visual materials</td>
<td>Variety</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visual</td>
</tr>
<tr>
<td>W19</td>
<td>Visuals, Maps</td>
<td>Variety</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visual</td>
</tr>
<tr>
<td>W4</td>
<td>More video interaction</td>
<td>Variety</td>
</tr>
<tr>
<td></td>
<td>Notes and graphics would be helpful</td>
<td>Visual</td>
</tr>
</tbody>
</table>

W15 found the background noise in the training room made it difficult for him to hear the audio which negatively affected his concentration. S3 said he did not like the text to speech program as it sounded too robotic and not like a normal person’s voice. W4 believed that “it needed a bit more video interaction with regards to some of the topics” and more graphics would help. W14 thought more videos would be of benefit as she had difficulty visualising some tasks such as backing up a truck anticlockwise. Similarly, W18 thought the program would benefit from more visual materials such as videos, whilst W13 and W19 suggested a map of the mine site would be helpful. Overall, most interviewees thought the multimedia was satisfactory, as it was of high quality and included all the media elements such as sound, visuals and graphics.
Training Company Development Approach

The MD believed that he built in enough multimedia into the program to provide participants with “a bit of interaction and a bit of variety”. As much of the content was not “compelling stuff” and very mundane and process oriented, he felt it was difficult to make it interesting and whenever possible he incorporated visual materials such as graphics and images.

6.5 Perceived Satisfaction with the Content and Design Effectiveness

Although interviewees were initially asked about their satisfaction with the content in the online program various design aspects were consistently raised, so for the purpose of clarity and coherence interviewees’ views relating to the theme content and design of the program have been incorporated into this section. This section will also include managers’ perceptions of worker satisfaction with the online induction program.

The common constructs which emerged when interviewees were asked about their perceptions of the content included:

- currency and accuracy;
- detail and clarity.

The common constructs identified by interviewees’ relating to design included:

- relevancy and repetition (both content and design aspects);
- Assessment type and process.

To a lesser extent the following design constructs were identified:

- User friendliness;
- Amount of text;
- Structure;
- Real life scenarios.

Overall, interviewees believed that the content in the program was up to date and was accurate. Further, the general perception from interviewees who had worked in the mining industry before and had completed multiple site inductions was that some of the content was not relevant to a site safety induction program and that there was a lot of repetition of information. Although this concept could also be seen as a potential issue of the online induction program, see section 6.7, the decision was made to include the data analysis in this section as it was more relevant. Interviewees were somewhat
divided regarding the types of assessments (for example multiple choice, true/false) and
the assessment process, such as the ability to go straight to the assessments without
reading the content. Finally, the interviewees who commented on other design aspects
of the program such as user friendliness, were generally positive.

6.5.1 Perceived Satisfaction with the Content

Fifteen of the nineteen interviewees thought the content was “good” or “fine”. When
asked what they meant by “good” or “fine” only twelve interviewees were able to
elaborate. Two other interviewees highlighted areas for improvement. Table 6.6
highlights key words (apart from good and fine) interviewees used relating to their
perceptions of the content in the online induction program. The table is sorted
according to interviewee’s job roles: workers then managers.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W8</td>
<td>Certainly had the detail</td>
<td>Detailed</td>
</tr>
<tr>
<td>W6</td>
<td>A lot of content, very detailed</td>
<td>Detailed</td>
</tr>
<tr>
<td>W10</td>
<td>Crammed a lot in</td>
<td>Detailed</td>
</tr>
<tr>
<td>W15</td>
<td>Pretty detailed, current</td>
<td>Detailed</td>
</tr>
<tr>
<td>W13</td>
<td>Enough detail, Up to date</td>
<td>Detailed</td>
</tr>
<tr>
<td>W9</td>
<td>Up to date</td>
<td>Currency</td>
</tr>
<tr>
<td>W19</td>
<td>No glaring inaccuracies</td>
<td>Accuracy</td>
</tr>
<tr>
<td>W18</td>
<td>Up to scratch, Covered all important areas, Questions clear</td>
<td>Accuracy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Detailed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clarity</td>
</tr>
<tr>
<td>W4</td>
<td>Pretty clear and concise, Nothing missing, Up to date, Topics discussed in detail</td>
<td>Clarity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accuracy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Currency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Detailed</td>
</tr>
<tr>
<td>W17</td>
<td>Information weird, not simple, Up to date,</td>
<td>Not clear</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Currency</td>
</tr>
<tr>
<td>W7</td>
<td>Easy to understand, clear</td>
<td>Clarity</td>
</tr>
<tr>
<td>W14</td>
<td>Site rules can be different from what learnt in the induction</td>
<td>Not Accurate</td>
</tr>
<tr>
<td>M11</td>
<td>Up to date Accurate</td>
<td>Currency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accuracy</td>
</tr>
<tr>
<td>M12</td>
<td>Not always up to date or accurate</td>
<td>Not Current</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not Accurate</td>
</tr>
</tbody>
</table>

Four interviewees mentioned that the program was accurate, six thought it was up to
date, three believed it was clear and therefore easy to understand, and seven felt the
content was detailed. Three of those interviewees (W8, W6 and W10) implied that
there was probably too much detail. Two interviewees commented on inaccuracies in
the content; M12, who has 20 years of experience in the mining industry believed there
was a high amount of inconsistency between the content and what was happening on site:

“The online induction needs to be continually updated as changes occur on the mine site. This is not done well. Not sure how that works. Maybe sometimes that doesn’t get done well. Sites move ahead but don’t inform the people running the inductions and kept them up to date.”

Similarly, W14 observed that what was learned in the induction did not always correspond with what was being enforced on site. Further, although W17 thought the content was “good” and “up to date” some reservations were expressed regarding the content; “I found the information in some of the modules and the questions they asked you put in a weird way.” When prompted further to explain what was meant; “just the wording they used I suppose, not keeping it simple”.

6.5.2 Perceived Effectiveness of the Design

This sub-section examines the constructs identified by interviewees’ relating to relevancy and repetition, assessment type and process and other design elements including user-friendliness and structure.

Ten of the more experienced workers were frustrated with the sheer amount of information due to the repetitious nature of the content, especially if they were being inducted into more than one mine site on one day. This is not about the amount of detail contained in each module, as mentioned previously, but the sheer volume of information they had to cover due to repetition. Further, five of the 10 interviewees thought aspects of the content were not relevant to their job role on the mine site, and two of those interviewees believed information contained in the program belonged in the Generic Induction (see glossary). Table 6.7 summarizes interviewees’ perceptions relating to issues of repetition and relevancy. The table is ordered according to years mining experience.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Years Mining Experience</th>
<th>Key Words</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W6</td>
<td>5 years</td>
<td>Rehash of what I’ve already done</td>
<td>Repetition</td>
</tr>
<tr>
<td>W2</td>
<td>6 years</td>
<td>Repetitive, answering same question 6 times, remove generic stuff</td>
<td>Repetition, Relevancy</td>
</tr>
<tr>
<td>W4</td>
<td>6 years</td>
<td>Very repetitious</td>
<td>Repetition</td>
</tr>
<tr>
<td>W9</td>
<td>6 years</td>
<td>Repetitive, need more job</td>
<td>Repetition</td>
</tr>
</tbody>
</table>
Two interviewees W2 and M5 also highlighted that not only was the information repetitious but exactly the same questions were asked numerous times. Regardless of the years of mining experience, 10 of the interviewees were quite vocal about the repetitive nature and relevance of some content.

M11 mentioned that in the past every site ran their own safety inductions, then the Generic Induction was introduced to “define the basics to everybody so that all got the same information” and the site inductions were supposed to cover anything that was particular to an individual mine site. However M11 believes that existing site inductions such as the current online site safety induction program includes a lot of information that should belong in the Generic Induction:

“The generic induction goes into stuff such as fighting fires, resuscitation, risk assessments and that type of thing. When you do the online induction you go back over the same information again. Some of the stuff in our site specific inductions belongs in the generic induction and then there would be more focus on the site specific stuff which people need.”

Similarly, W13 believed the content needed to be “tailor made to the specific mine site it was meant for” and that some of the information was not relevant to his role at the mine:

“One thing I noticed, they were telling me about tips or dumps and that’s an operator thing. I’m never going to drive a dump truck in my life, so why do I need to know how to dump over a low wall?”

Interestingly, S1 commented that if workers do not believe the content is relevant to
their roles, they were not interested in learning the information:

“If it is not relevant to them and their role they’re not interested in learning. For example blasting, they don’t give a rats about it, and won’t remember anything about it because they believe it’s not relevant to them and don’t care.”

A mix of assessment activity types such as; yes/no, true/false, drag and drop, and multiple choice were utilised throughout the online induction program and were a focus of interviewees. Two constructs emerged from discussions with 14 of the interviewees; assessment type and assessment process, with interviewees generally falling into one of two camps. Those (6 interviewees) who felt it was “too easy” and open to abuse as participants could easily cheat. In contrast the other seven interviewees liked the fact it was not difficult and that if you got it wrong it took you straight to the information containing the correct response. One interviewee, W10 stated he did not like exams but accepted it as a necessary part of the induction process. Table 6.8 summarises interviewees’ perceptions of assessment type and process. The table is ordered according to assessment type followed by assessment process.

Table 6.8 Summary of interviewees’ perceptions of the assessment type and process

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W2</td>
<td>Questions and answers good, easy</td>
<td>Assessment type</td>
</tr>
<tr>
<td>W6</td>
<td>Question and answer approach good, easy</td>
<td>Assessment type</td>
</tr>
<tr>
<td>W10</td>
<td>Don’t like exams</td>
<td>Assessment type</td>
</tr>
<tr>
<td>W19</td>
<td>Multiple choice good</td>
<td>Assessment type</td>
</tr>
<tr>
<td>W7</td>
<td>Multiple choice questions good, Took you to necessary information when you got it wrong</td>
<td>Assessment type, Assessment process</td>
</tr>
<tr>
<td>W18</td>
<td>Tick and flick exercise, Too easy as can go straight to the questions.</td>
<td>Assessment type, Assessment process</td>
</tr>
<tr>
<td>S3</td>
<td>Can take short cuts, Multiple choice easy</td>
<td>Assessment type, Assessment process</td>
</tr>
<tr>
<td>S1</td>
<td>Guessed to save time which is a down side of online</td>
<td>Assessment process</td>
</tr>
<tr>
<td>W4</td>
<td>Get given the information and given the questions Pretty basic</td>
<td>Assessment process</td>
</tr>
<tr>
<td>W17</td>
<td>If you got a question wrong it took you straight to the answer</td>
<td>Assessment process</td>
</tr>
<tr>
<td>W9</td>
<td>flipped you back to the appropriate information if you got the question wrong</td>
<td>Assessment process</td>
</tr>
<tr>
<td>W8</td>
<td>Good you can go back if you get it wrong</td>
<td>Assessment process</td>
</tr>
<tr>
<td>W16</td>
<td>Can go straight to the questions without reading information, Too many short cuts</td>
<td>Assessment process</td>
</tr>
<tr>
<td>W15</td>
<td>Can go straight to questions and click until you get it right</td>
<td>Assessment process</td>
</tr>
</tbody>
</table>
W15 felt that the multiple choice questions at the end of each segment were not an effective way to assess understanding as you could guess until you got them right;

“That’s the downfall to online induction is relying on the multiple choice. At the end of the day you get them all right. Don’t know if you get the question wrong three times does anyone notice and do something about it?”

Other constructs relating to interviewees’ perceptions regarding elements of design used in the online site safety induction program were raised by 10 interviewees and are presented in Table 6.9. As far as possible the table is ordered according to the constructs; real life scenarios, design structure, amount of text, user friendliness and navigation.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W16</td>
<td>Not getting real-life scenario stuff</td>
<td>Real-life scenarios</td>
</tr>
<tr>
<td>S3</td>
<td>Have scenarios where the learner has to identify the hazard</td>
<td>Real-life scenarios</td>
</tr>
<tr>
<td>W18</td>
<td>Scenario based learning would be great. Very text based</td>
<td>Real-life scenarios</td>
</tr>
<tr>
<td>S1</td>
<td>Need problem based scenarios Easy to use Too many power point slides</td>
<td>Real life scenarios</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User Friendly Interface design</td>
</tr>
<tr>
<td>W13</td>
<td>Flowed very nicely, Easy to follow Formatting not uniform</td>
<td>Design structure</td>
</tr>
<tr>
<td>W4</td>
<td>Structured pretty much parrot fashion, Easy to use Some modules had too much text</td>
<td>Design structure</td>
</tr>
<tr>
<td></td>
<td>Get given the information…so not very interactive</td>
<td>User Friendly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amount of text</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Content interaction</td>
</tr>
<tr>
<td>W17</td>
<td>Liked the order of the lessons Some had a lot of pages to read with barely any</td>
<td>Design structure</td>
</tr>
<tr>
<td></td>
<td>questions which was hard</td>
<td>Amount of text</td>
</tr>
<tr>
<td>W9</td>
<td>A fair bit of reading, Easy to use</td>
<td>Amount of text</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User Friendly</td>
</tr>
<tr>
<td>W8</td>
<td>I found this program easy to use</td>
<td>User Friendly</td>
</tr>
<tr>
<td>W19</td>
<td>Getting back to original window was hard</td>
<td>Navigation</td>
</tr>
</tbody>
</table>

Four interviewees commented on the need to incorporate real life scenarios in the program. Likewise four interviewees believed there was too much text in some modules. Further, three interviewees remarked on the structure, one suggesting it was very linear and didactic (“parrot fashion”) while the other two liked the order and flow of the program, however W13 also commented that different programs may have been used in the online induction as the formatting was not uniform and therefore noticeable. Four interviewees thought the online program was user friendly. Finally, one
interviewee felt there were too many presentation slides, one interviewee commented on a navigational issue and one interviewee commented that some modules needed more interaction.

**Training Company Development Approach**

According to the MD, each mine site is a constantly changing environment and therefore he tries to make the content as generic as possible, to reduce the need for amendments. When procedures need changing, the information should be passed onto the developer by the mining companies, however due to time lapses occurring in this process the content may not always be up-to-date and accurate. The MD also believed that having a large amount of core or generic information and only a small component of site specific content would improve efficiency so participants were able to complete more sites in one day if necessary. Experienced workers who know the terminology “can race through it rather quickly”. The program was also designed to reinforce important points in the content, so questions were asked about the critical elements of a procedure. The MD also mentioned his aim was to reinforce correct understanding by designing the program to take participants to the pertinent information when they made an error in the assessment. The MD required all assessments to be completed and answered correctly, however he could not guarantee that participants read and understood the information. He also stated there were no scenario or problem based learning activities in the program as he believed the sites were responsible for reinforcing learning. Further the design of problem based scenarios would involve more time, money and maintenance than currently required.

**6.5.3 Managers’ Feedback on Workers’ Perceptions of the Online Program**

Although the managers and supervisors were not asked about workers’ perceptions of the online induction program, through the course of the interviews observations and comments were made about their perceptions of workers’ feedback. Managers M11 and M12 believed that individuals’ views of the online site safety induction program generally depended on the age and experience of the workers. For young workers who had a few years or less mining experience the feedback was generally positive about the online site safety induction program, however the older more experienced workers tended to prefer instructor led inductions. M12 remarked that the younger generation
like the fact it was self-paced and they could get it done quickly. However the older generation would like more interaction so they could find out more about other workers’ experiences and get a better feel for the site and possible issues they could face;

“When we bring through our younger people, not an issue, our more mature age people would prefer to have someone there who they could ask questions of or have a discussion about things. They like the discussion and the interaction with others. It’s the talking about their experiences and what it’s like at the mine site and that’s what they like. They like getting the bigger picture and they just like talking to somebody. Whereas the younger generation coming through, they just want the information and you can get it online.”

Likewise, M11 noted that some of his older workers would prefer instructor led inductions as they find it easier, and they understand the information better if they have opportunities for discussion:

“Although some people have commented that they find it easier to read and understand things or tend to get more out of a face-to-face session. I don’t necessary go along with that but I have heard the comment from some people that they would prefer to be in a face-to-face induction.”

6.6 Interviewees’ Approach to Learning

This theme arose in conversation when interviewees were talking about their perceptions of how satisfied they were with online learning as a method of learning. Interview responses indicated a variety of approaches they used to learn the information contained in the online program. Table 6.10 summarises the approaches interviewees’ used to learn the information. The table is sorted under the following three constructs; reading, skimming and skipping.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Years Mining Experience</th>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W4</td>
<td>9 years</td>
<td>Read everything before answering questions</td>
<td>Reading</td>
</tr>
<tr>
<td>W15</td>
<td>15 years</td>
<td>I read through the whole lot regardless of whether I thought I knew the answer</td>
<td>Reading</td>
</tr>
<tr>
<td>W19</td>
<td>4 years</td>
<td>I like to read everything and not guess</td>
<td>Reading</td>
</tr>
<tr>
<td>W17</td>
<td>None</td>
<td>Took my time on the first site and kept reading it over and over. By the second one I just cruised through it. Some modules just went straight to the questions</td>
<td>Skimming</td>
</tr>
<tr>
<td>W7</td>
<td>1 year</td>
<td>I started to read everything, but as I got a bit further started to glance over it</td>
<td>Skimming</td>
</tr>
<tr>
<td>W10</td>
<td>&lt; 1 year</td>
<td>I just found myself going through it pretty fast, not reading it fully. Trying to rush through it, More skimming the information trying to look</td>
<td>Skimming</td>
</tr>
</tbody>
</table>

Table 6.10 Summary of interviewees’ approaches to learning the information
<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Years Mining Experience</th>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W18</td>
<td>2 years</td>
<td>Skimmed through materials to find answers then moved on</td>
<td>Skimming</td>
</tr>
<tr>
<td>W8</td>
<td>3 years</td>
<td>I had a quick gander through the stuff I want to know, I usually have a quick read then go straight to the questions</td>
<td>Skimming</td>
</tr>
<tr>
<td>W9</td>
<td>6 years</td>
<td>Quickly read over information but not read it too much as you would be there forever, I pick out bits</td>
<td>Skimming</td>
</tr>
<tr>
<td>W14</td>
<td>6 years</td>
<td>First hour read most things and then just went through the questions</td>
<td>Skimming</td>
</tr>
<tr>
<td>W13</td>
<td>8 years</td>
<td>There were times you were reading the words but not taking it in. I quickly perused the stuff I didn’t know or wasn’t confident in and the stuff I knew I skipped</td>
<td>Skimming</td>
</tr>
<tr>
<td>M5</td>
<td>15 years</td>
<td>Picked out the most important words while flicking through the modules and picked up parts not familiar but otherwise not reading the things you know</td>
<td>Skimming</td>
</tr>
<tr>
<td>M11</td>
<td>16 years</td>
<td>I don’t tend to read everything that’s there. Tend to brush over parts Picked out bits and pieces that I thought might have changed</td>
<td>Skimming</td>
</tr>
<tr>
<td>M12</td>
<td>20 years</td>
<td>A lot of information I already knew so I could whiz through it</td>
<td>Skipping</td>
</tr>
<tr>
<td>S1</td>
<td>15 years</td>
<td>Did not read 90% of the stuff just attempted the answers Used a process of elimination to choose the answers</td>
<td>Skipping</td>
</tr>
<tr>
<td>S3</td>
<td>9 years</td>
<td>Skipping through the information and going to the questions at the end</td>
<td>Skipping</td>
</tr>
<tr>
<td>W2</td>
<td>6 years</td>
<td>Skipped through information and went straight to the answers Didn’t get them all right so read the information</td>
<td>Skipping</td>
</tr>
<tr>
<td>W6</td>
<td>5 years</td>
<td>Breezed through it pretty quick as all the same</td>
<td>Skipping</td>
</tr>
<tr>
<td>W16</td>
<td>10 years</td>
<td>Went straight to questions and answered them</td>
<td>Skipping</td>
</tr>
</tbody>
</table>

The first approach involved reading through all the information contained in the online safety induction program. There was no guessing or skimming through the material. Three interviewees W4, W15 and W19 used this approach. The second approach usually involved reading some of the information but mostly skimming through the material trying to identify important and/or new information before attempting the questions. Interestingly the ten interviewees who used this approach, included all but one of the less experienced workers (less than five years of mining experience). The third approach generally involved skipping material and going straight to the questions.
without reading the information first and if you answered a question incorrectly they might read the pertinent information. The six interviewees who belonged to this category all had 5 or more years of mining experience.

6.7 Perceived Barriers to Learning

To discover interviewees’ perceptions relating to the barriers to learning, two main questions were asked of interviewees:

- What, if any, difficulties did you encounter?
- What changes, if any, would you like to see made to the online induction program? Why?

The data analysis from the interviews highlighted five main constructs these were:

- Technical issues
- Retention of information
- Lack of engagement
- Lack of instructor support
- Lack of customization

Repetition was also raised as an issue but is not discussed in this section as it is referred to in section 6.5.2.

6.7.1 Technical Issues

Technology issues related to whether interviewees had trouble using a computer and/or experienced technical issues with the online site safety induction program. Out of the 19 interviewees, 15 rated themselves as having either moderate or advanced computer skills. The remaining four interviewees rated their computer skills as low. The majority of interviewees (15) were comfortable using and navigating around the program, and only minor technical problems were experienced by four interviewees, who all had moderate or higher computer skills. Table 6.11 summarises the technical issues encountered by the 4 interviewees.
Table 6.11 Summary of technical issues

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Computer Skills</th>
<th>Key Words/Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>Moderate</td>
<td>Slow, had to click three times Error warning</td>
</tr>
<tr>
<td>W19</td>
<td>Moderate</td>
<td>Program crashed at one stage</td>
</tr>
<tr>
<td>W7</td>
<td>Moderate</td>
<td>Screen went blank</td>
</tr>
<tr>
<td>W13</td>
<td>Advanced</td>
<td>Program was a little bit slow When you thought nothing was going to happen it would keep going</td>
</tr>
</tbody>
</table>

Both M5 and W13 mentioned the program was a bit slow. For W19 the online program “crashed at one stage” but was quickly fixed. Finally, W7 said his screen went blank while completing the online induction but a staff person helped him by pressing escape.

Although the managers were not asked about workers’ attitudes towards computers, M12 expressed the view that even workers who had minimal exposure to computers were able to cope well with the technology. Conversely M11 stated that he has had some older workers complaining about the technology as they were not very computer literate and found it threatening:

“Some of the older people that are not computer savvy, they struggle with anything associated with the computer, mouse, keyboard and even reading the written word on the screen”.

Training Company Development Approach

The MD stated that the program was designed with the computer illiterate in mind. He said “when we started we even had blokes picking up the mouse and waving it around as they had never used a computer in their life”. The MD mentioned that if the program was not simple and easy to use it would “confuse our lowest common denominator” however it still had to be palatable to the more technologically knowledgeable. According to the MD, he had workers who began training not having or wanting to use a computer but after the induction were confident to go home and access the family computer.

6.7.2 Retention of Information

During open discussion the theme of retention evolved: Four interviewees believed they would have trouble remembering the content, and 3 managers and 2 supervisors (one of whom admitted he would not remember some of the information) mentioned problems with workers’ retention of information after completing the online safety induction
Qualitative Findings

program. In this section, learner retention refers to workers’ ability to retain the information they learned in the online site safety induction program. Table 6.12 summarises interviewees’ perceptions relating to retention of information. The table is sorted according to job role; workers, supervisors and then managers.

Table 6.12 Summary of retention of information

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Job Role</th>
<th>Key Words/Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>W14</td>
<td>Driver</td>
<td>Won’t remember a lot of the information</td>
</tr>
<tr>
<td>W8</td>
<td>Boiler Maker</td>
<td>Stuff that doesn’t relate to me I don’t remember</td>
</tr>
<tr>
<td>W17</td>
<td>Test &amp; Tagger</td>
<td>A lot of important information to learn which I couldn’t recall</td>
</tr>
<tr>
<td>S1</td>
<td>Supervisor</td>
<td>If you asked me something about it [mine site] I don’t really know the answer. I am asked questions from people who have gone through this induction the things they don’t remember</td>
</tr>
<tr>
<td>S3</td>
<td>Supervisor</td>
<td>They can’t remember what they learned two weeks ago</td>
</tr>
<tr>
<td>M5</td>
<td>Manager</td>
<td>It still needs to be drummed into them</td>
</tr>
<tr>
<td>M11</td>
<td>Manager</td>
<td>A lot of the finer detail is probably forgotten or not absorbed</td>
</tr>
<tr>
<td>M12</td>
<td>Manager</td>
<td>New people should go through procedures again … should be tested and reinforced on site</td>
</tr>
</tbody>
</table>

W14 mentioned she would not remember a lot of the information she would be assumed to know as an experienced truck driver, so she would need to review the content covered in the induction before she turned up for work at the site. Likewise W17 commented that there was a lot of important information to learn in the induction which she wouldn’t recall when she arrived on site and so would ask a more experienced worker for help. W8 admitted that information that he did not believe was important to him he did not pay attention to and would not remember.

S1 had trouble remembering information, even straight after completing the induction, and that poor retention of information was rife when workers arrived at the mine site after completing the online induction;

“There’s a guy who’s got no idea what he’s supposed to do. Now I am going to have to go back to site and pull out all the SOPs [standard operating procedures] and read them verbatim because I am going to get asked questions from people who have gone through this induction the things they don’t remember. I will then go through the SOPs with them”.

S3 believed that experienced workers had no problems retaining information relating to routine procedures, however in new situations they need to refresh their memories about what they learned in the online induction program. Further, M12 believed that as there were a lot of new people to the industry, the material in the induction program was
unfamiliar and these workers were having trouble remembering the information. Also, because there was a belief that once you have done the induction you should know everything, workers were not getting the support they needed to understand the information. M5 was very direct and advised that some workers needed the information to be “drummed” into them as he believed those workers did not think the safety induction was important.

M11 felt that some workers did not retain the information they learned because they have been overloaded with too much content and not had the time to digest the information, especially if they have completed more than one site induction:

“When they walk out of that room I think its information overload and so a lot of the finer detail is probably forgotten or not absorbed.”

According to M11 the major impediment to retaining information covered in the online safety induction program seems to be two fold, primarily it was the sheer amount of information that needed to be absorbed and secondarily, information that was not considered relevant was glossed over or ignored.

**Training Company Development Approach**

The MD stated that by having a large amount of core subjects and a smaller amount of site specific modules helped workers who were completing multiple inductions retain the information as there was less content to learn. He also commented that, in consultation with the client, the critical elements of the course were identified and highlighted.

**6.7.3 Lack of Engagement**

This construct focuses on how interested and/or involved interviewees were when completing the online safety induction program. Twelve of the nineteen interviewees were generally positive or neutral in their attitude towards the program and the learning activities. Typical comments included; “the activities were good”; “I liked the way it was”; “there was nothing I didn’t like”, “I found it interesting” and “I didn’t like it or not like it”. For the remaining 7 interviewees the words boring, monotonous and uninteresting were used frequently. Not surprisingly, all barring one of these interviewees (W8) were workers with 5 or more years of mining experience who had completed site inductions before. Five of these interviewees had also commented on the
repetitive nature of the online site safety induction program. Table 6.13 summarises the perceptions of interviewees regarding their lack of engagement. The table is ordered according to years of mining experience.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Years Mining Experience</th>
<th>Key Words/Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>W8</td>
<td>3 years</td>
<td>Not very interesting. Most of the modules were boring. Monotonous</td>
</tr>
<tr>
<td>W6</td>
<td>5 years</td>
<td>Monotonous. I wasn’t very interested</td>
</tr>
<tr>
<td>W9</td>
<td>6 years</td>
<td>Boring. You get sick of doing them</td>
</tr>
<tr>
<td>S3</td>
<td>9 years</td>
<td>Uninteresting. Necessary evil. Bores me to tears. Drove me nuts</td>
</tr>
<tr>
<td>W16</td>
<td>10 years</td>
<td>Nothing new. Boring</td>
</tr>
<tr>
<td>M5</td>
<td>15 years</td>
<td>Not interesting</td>
</tr>
<tr>
<td>M11</td>
<td>16 years</td>
<td>Routine and monotonous</td>
</tr>
</tbody>
</table>

S3 made a couple of comments about the online induction being uninteresting and boring but because it was a statutory requirement he perceived it as “… a necessary evil to me. I’ll do it to get on site”. The remaining six interviewees all referred to the online induction as boring, monotonous or uninteresting or a combination of the three. M11 believed the perception of experienced workers, himself included, was that there is nothing new or different in the online safety induction program so the attitude was “oh shit we’ve got to do that again”.

**Training Company Development Approach**

The MD was aware that the training program needed to be interesting but also had to be simple to cater for all levels of workers. Even though most of the participants were completing the induction under duress, his aim was to make it as relevant and interesting as possible. However he did say that it was difficult to achieve the right balance between making the content suitable for workers with low levels of literacy and computer skills without insulting the technologically knowledgeable and literate workers.
6.7.4 Lack of Trainer Support

The support provided to individuals who were completing the online safety induction program was usually the administrative staff at the Training Company who dealt with any technical or computer issues workers experienced. With regards to this construct, only the interviewees who had nominated they preferred the online program compared to face-to-face (see tables 6.3 and 6.4) were included, as the 6 interviewees who preferred instructor led had already highlighted a preference for more support.

Three interviewees, all experienced workers, believed they required some help in understanding the information (Table 6.14). When referring to support, interviewees mentioned the need for more feedback, and the frustration they felt at not being able to talk to someone about information they did not understand, including incorrect answers to questions.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Years Mining Experience</th>
<th>Key Words/Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>W19</td>
<td>4 Years</td>
<td>No opportunities to ask questions if didn’t understand</td>
</tr>
<tr>
<td>W14</td>
<td>6 Years</td>
<td>Need to have someone give me feedback</td>
</tr>
<tr>
<td>W13</td>
<td>8 Years</td>
<td>I still need to ask questions</td>
</tr>
</tbody>
</table>

Interviewee W14 required more help or feedback regarding problems with mine site terminology and operating instructions for example reversing trucks properly, to improve knowledge and confidence in performing at the work site. Similarly, interviewees W13 and W19 mentioned there were no opportunities to ask questions if they did not understand the material. W19 referred to himself as a “pedantic person” who likes to “know the task 100% and not guess”.

Training Company Development Approach

There was no trainer (apart from the MD when he was present at the Training Company facility) to provide guidance or answer questions regarding the information contained in the online site safety induction program. The MD mentioned that the mining companies preferred workers completing the online site safety induction at a training facility. This was not only for security reasons, but also to help people with computer literacy issues. The MD believed it was sufficient to take workers who appeared really anxious about the online induction, through the first couple of modules, and then let them continue on their own.
6.7.5 Lack of Customisation

The perception that the online induction program did not cater to the differing knowledge and abilities of workers was raised by 10 interviewees; 9 were experienced workers, including two supervisors and two managers; the other had 2 years of mining experience. This perceived lack of customisation has prompted their preference to have separate programs for novices and experienced workers rather than a ‘one size fits all’ approach. Two interviewees also highlighted the need for more follow-up and ongoing learning to occur. Table 6.15 summarises interviewees’ views relating to lack of customisation of the program. The table is sorted according to years of mining experience.

Table 6.15 Summary of lack of customisation

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Years Mining Experience</th>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W18</td>
<td>2 years</td>
<td>Aimed at all groups, pretty general</td>
<td>Customisation</td>
</tr>
<tr>
<td>W6</td>
<td>5 years</td>
<td>Should be some sort of RPL system …I understand new people have to do it but when you have been in the industry for awhile it’s a bit much</td>
<td>Customisation</td>
</tr>
<tr>
<td>W2</td>
<td>6 years</td>
<td>Smaller course for the experienced people</td>
<td>Customisation</td>
</tr>
<tr>
<td>W13</td>
<td>8 years</td>
<td>There should be a different induction for cleanskins and experienced workers</td>
<td>Customisation</td>
</tr>
<tr>
<td>S3</td>
<td>9 years</td>
<td>In the real world there is recognition of prior learning, separate program for experienced workers</td>
<td>Customisation</td>
</tr>
<tr>
<td>W16</td>
<td>10 years</td>
<td>This [online induction] would be difficult for cleanskins</td>
<td>Customisation</td>
</tr>
<tr>
<td>W15</td>
<td>15 years</td>
<td>People new to the industry don’t have the background, not learning anything. Nobody following them up</td>
<td>Customisation Follow-up</td>
</tr>
<tr>
<td>S1</td>
<td>15 years</td>
<td>Experienced workers do assessment and if they get any wrong have to go through information. Novices need something more, shouldn’t be allowed to guess</td>
<td>Customisation</td>
</tr>
<tr>
<td>M11</td>
<td>16 years</td>
<td>The novice or inexperienced need more of a hands on situation like a full induction</td>
<td>Customisation</td>
</tr>
<tr>
<td>M12</td>
<td>20 years</td>
<td>Sheep dip approach, one hit and you are done for life training needs to be continually reinforced and re-visited</td>
<td>Customization Ongoing learning</td>
</tr>
</tbody>
</table>

Two interviewees (W6 and S3) believed that experienced workers should be given the opportunity to have their experience and knowledge recognised through a Recognition of Prior Learning (RPL) system which would then either preclude them from having to complete site safety inductions or allow them to do a modified version.
W2 and W13 concurred, believing that the experienced worker should complete a different program to the “cleanskin” or novice worker. Similarly, S1 felt that experienced workers could do an assessment and only revise the material they answered incorrectly. Further, S1 mentioned that novices needed more support and guidance than presently provided in online safety induction program. Likewise, W15 and W16 felt that novices would find the current online program difficult as they did not have the background knowledge of the industry and there was not enough support and follow up. W15 also commented that if workers were required to complete multiple inductions, it became a long and drawn out process. Finally M11 believed that novices would benefit from an induction program that was more interactive and “hands on” where they can ask questions and clarify information.

M12 had a slightly different perspective, and likened the mentality of the industry to the induction as a “sheep dip” approach where not only did all workers completed the same online safety induction program, but also once they had finished the induction they were considered ready to work in a dangerous environment with little or no follow up or further training required. M12 believes the online safety induction should be a first step and that learning should be ongoing and layered to ensure knowledge is constructed appropriately and people working on a mine site understood the information.

Training Company Development Approach

The MD felt they delivered a customized program as it was based on the process of workers choosing a site, department and task when they started the online site safety induction program. He believed this choice of training plan suited the needs of each worker and made the program more meaningful to them.

6.8 Perceived Effectiveness of the Online Induction Program

This construct was divided into two areas, perceived effectiveness of learning the information, and perceived effectiveness of applying that learning to the workplace. Interviewees were asked two main questions:

- How effective did you find learning via the online program?
- If you didn’t learn, why not?

To discover if interviewees had applied this learning in the workplace two approaches were taken. The first was to ask interviewees if they believed they had applied the
knowledge gained from the online induction program to the workplace:

- Describe how you have or would put into practice what you have learned from the online program.
- How easy or difficult did you or will you find it?

The second approach was to ask the managers and supervisors whether they had observed their workers putting into practice what they had learned in the online safety induction:

- Have you observed your people putting into practice what they learned in the online induction?
- Have they applied what they have learned to new situations? How?

Analysis of interviewees’ perceptions of the effectiveness of the program to facilitate learning will be discussed first, followed by the perception of how effectively they applied this knowledge to the workplace, and will conclude with the managers’ and supervisors’ observations on whether learning was demonstrated in the workplace.

### 6.8.1 Perceived Learning Effectiveness

Learning effectiveness was characterised as successfully developing and applying the knowledge gained in the online site safety induction program to the workplace. Unsurprisingly, all 19 interviewees perceived they either knew the information or learned what they believed was important to their job role and to continue working on site (such as traffic rules and blood alcohol limits) from the online program. However, there was some disagreement over the perceived effectiveness of the program to facilitate the learning of safety, especially in regards to non-routine or new information.

Table 6.16 summarises interviewees’ perceptions of the learning effectiveness of the online safety induction program. The table is ordered by years of mining experience.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Years Mining Experience</th>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W17</td>
<td>None</td>
<td>Yes, I felt I learnt from the modules,</td>
<td>Effective</td>
</tr>
<tr>
<td>W10</td>
<td>&lt; 1 year</td>
<td>Learnt some new stuff. It made me think a bit</td>
<td>Effective</td>
</tr>
<tr>
<td>W7</td>
<td>1 year</td>
<td>Pretty good as it made me think</td>
<td>Effective</td>
</tr>
<tr>
<td>W18</td>
<td>2 years</td>
<td>in terms of learning, not so good, I don’t think it encourages learning</td>
<td>Not effective</td>
</tr>
<tr>
<td>W8</td>
<td>3 years</td>
<td>It brings things back, I know this, I know that.</td>
<td>Effective</td>
</tr>
<tr>
<td>W19</td>
<td>4 years</td>
<td>Very effective as it highlighted safety</td>
<td>Effective</td>
</tr>
<tr>
<td>W6</td>
<td>5 years</td>
<td>Alright, just a few little things I didn’t know,</td>
<td>Effective</td>
</tr>
</tbody>
</table>

...
Qualitative Findings

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Years Mining Experience</th>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>W2</td>
<td>6 years</td>
<td>Learnt some things about the site, more of a refresher</td>
<td>Effective</td>
</tr>
<tr>
<td>W9</td>
<td>6 years</td>
<td>It was reasonably effective, Learnt a few things</td>
<td>Effective</td>
</tr>
<tr>
<td>W14</td>
<td>6 years</td>
<td>Good, but will sit and read things tomorrow to make sure I understand the different terminology</td>
<td>Effective</td>
</tr>
<tr>
<td>W13</td>
<td>8 years</td>
<td>It was effective but it could have been better, It did make me think</td>
<td>Effective</td>
</tr>
<tr>
<td>W4</td>
<td>9 years</td>
<td>Didn’t learn anything new, Didn’t have to think much</td>
<td>Not effective</td>
</tr>
<tr>
<td>S3</td>
<td>9 years</td>
<td>Not effective for learning</td>
<td>Not effective</td>
</tr>
<tr>
<td>W16</td>
<td>10 years</td>
<td>Not effective at all</td>
<td>Not effective</td>
</tr>
<tr>
<td>W15</td>
<td>15 years</td>
<td>Not learning anything new, more a refresher; more to do with memory</td>
<td>Not effective</td>
</tr>
<tr>
<td>M5</td>
<td>15 years</td>
<td>Wasn’t very effective, learnt nothing new, everything is pretty standard</td>
<td>Not effective</td>
</tr>
<tr>
<td>S1</td>
<td>15 years</td>
<td>A couple of questions made me think, the 3% [laughs] From a learning and safety perspective, poor.</td>
<td>Not effective</td>
</tr>
<tr>
<td>M11</td>
<td>16 years</td>
<td>In general the e-induction is an adequate way of getting information across</td>
<td>Effective</td>
</tr>
<tr>
<td>M12</td>
<td>20 years</td>
<td>Effective for me, a lot of information I already knew.</td>
<td>Effective</td>
</tr>
</tbody>
</table>

Twelve interviewees believed the online program was effective including four of the less experienced interviewees (less than 5 years of mining experience) and eight experienced workers. For the more experienced workers the program was seen as a refresher, however a common element was that they learnt something new and/or it made them reconsider certain situations. M11 was less adamant in his response as he characterised the online induction as “adequate” because workers have to read the information regardless of their learning preferences but they will not fully understand it until they are physically involved doing the work on site.

The seven interviewees who did not think the program was effective included an inexperienced worker, two supervisors and one manager. According to W18, a young professional with 2 years mining experience, minimal thought or effort was required to complete the induction program and so “I don’t think it encourages learning that much, more a formality”. W4 commented that he did not learn anything new because he already knew the content and he felt there was nothing in the online induction that encouraged him to think about the information. Similarly M5 and W15 believed they did not learn anything new from the online safety induction program and it was more
about memorising information and not learning. Further, S3 mentioned that the online safety induction was not effective in regards to learning, especially as he had done it many times before and there was nothing new. Finally, S1 believed that the online induction program was not the best method to learn safety as workers did not understand the information:

“I know the onus is back on me but if the company re-tested people’s knowledge they would find they didn’t know much at all.”

6.8.2 Perceived Effectiveness of Applying Learning in the Workplace

This construct investigated whether interviewees believed they could apply the information they learned in the online safety induction program in the workplace. Also feedback was sought from the Managers and Supervisors regarding their observations of whether workers applied their learning in the workplace. This helped to examine how accurate interviewees’ perceptions were regarding their abilities to transfer learning to the workplace. In the first section we will discuss the workers’ perceptions of how effectively they could apply their learning in the workplace, followed by supervisors’ and managers’ observations.

Again, it is not surprising to discover that the 14 workers believed they could apply their existing and/or acquired knowledge from the online site safety induction program in the workplace (see table 6.17). The table is ordered according to years of mining experience.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Years Mining Experience</th>
<th>Key Words/Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>W17</td>
<td>None</td>
<td>I have only been out to site once. I suppose traffic rules. The bits that are relevant to me I would be able to put into practice</td>
</tr>
<tr>
<td>W10</td>
<td>&lt; 1 year</td>
<td>Yes, when something comes up I will be able to do it. Mainly stuff around the mines such as distances</td>
</tr>
<tr>
<td>W7</td>
<td>1 year</td>
<td>Yes, could apply it straight away. For example towing and high walls</td>
</tr>
<tr>
<td>W18</td>
<td>2 years</td>
<td>Yes, operating procedures, road rules, environmental policy</td>
</tr>
<tr>
<td>W8</td>
<td>3 years</td>
<td>Yes, even though some of the stuff I will never use</td>
</tr>
<tr>
<td>W19</td>
<td>4 years</td>
<td>Yes, things such as in open cut your 30-50 meter rule regarding machinery.</td>
</tr>
<tr>
<td>W6</td>
<td>5 years</td>
<td>Yes, would easily put into practice what I learned, especially isolation procedures</td>
</tr>
</tbody>
</table>
The least emphatic was W17, a novice to the industry who believed that she would be able to apply the information that was relevant to her job role. Interestingly, W10 who had less than 1 year of mining experience stated that he would be able to recall the necessary information when required. The remaining twelve interviewees were confident in their abilities to apply their knowledge (whether pre-existing and/or acquired from the online safety program) in the workplace, especially if the content was connected to their job role and/or contained site specific information they perceived important. Interestingly six interviewees volunteered that they learned best with a “hands-on” approach especially when the teacher was experienced, receptive to questions, practical and calm under pressure.

The following section examines the observations of the supervisors and managers regarding workers’ ability to apply what they have learned from the online safety induction program in the workplace, and whether they can adapt to new situations. Table 6.18 summarises managers’ and supervisors’ opinions regarding how effectively workers applied the online safety induction information in the workplace.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Years Mining Experience</th>
<th>Key Words/Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>W2</td>
<td>6 years</td>
<td>Can put into practice what was learned, rules and regulations were easy to apply such as permit systems, tagging and procedures for sites.</td>
</tr>
<tr>
<td>W9</td>
<td>6 years</td>
<td>Pretty easy to put into practice what I learned such as radio communication and site specific rules.</td>
</tr>
<tr>
<td>W14</td>
<td>6 years</td>
<td>Yes, especially the site specific rules as you need to know them.</td>
</tr>
<tr>
<td>W13</td>
<td>8 years</td>
<td>Yes, things specific to my job as an electrician such as isolation procedures.</td>
</tr>
<tr>
<td>W4</td>
<td>9 years</td>
<td>Most definitely, can easily put into practice all vehicle interaction on a mine site and things regarding isolation procedures.</td>
</tr>
<tr>
<td>W16</td>
<td>10 years</td>
<td>Can put into practice what learned such as tagging out things.</td>
</tr>
<tr>
<td>W15</td>
<td>15 years</td>
<td>Yes I can. If you have the background knowledge it would be fine.</td>
</tr>
</tbody>
</table>

Table 6.18 Summary of supervisors & mangers’ perceptions of learning application
### Qualitative Findings

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Years Mining Experience</th>
<th>Key Words/Phrases</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hazard identification on site very poor. Good operators but that’s all …can’t solve problems Maybe able to put into practice what they have learned as long as it is pertinent to them.</td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td>9 years</td>
<td>People OK at applying learning to workplace, Doesn’t help them develop problem solving skills</td>
<td>Learning applied if: • routine</td>
</tr>
<tr>
<td>M5</td>
<td>15 years</td>
<td>Novices would be hopeless, Not always dealing with the highest educated people … some people don’t think before doing things</td>
<td>Learning applied if: • experienced and/or • educated</td>
</tr>
<tr>
<td>M11</td>
<td>16 years</td>
<td>We do get people on site who have done the e-induction but are still confused when they get to site They think this is how it works then find themselves in trouble. Somebody that comes to site has to risk assess everyday so people who struggle would have a problem A lot of people learn by doing and doesn’t sink in when reading or being told</td>
<td>Learning applied if: • routine • On-the-job</td>
</tr>
<tr>
<td>M12</td>
<td>20 years</td>
<td>Yes, for a lot of new starters to site, especially the basic procedures, The company is sometimes conducting practices that are contrary to what’s in the induction. This makes it very hard to apply their learning</td>
<td>Learning applied if • routine and/or • basic • consistent</td>
</tr>
</tbody>
</table>

Interestingly, only one supervisor (S3) seemed positive in relation to workers applying what they had learned in the online site safety induction to the workplace. Although he also believed that the online program did not help workers develop critical thinking skills which would help them adapt to new situations. Subsequently at the end of the interview S3 stated that:

“A miserable old bugger was telling a rigger how to do his job and got it wrong which could have ended in a fatality”

M12 stated that novices were able to apply basic knowledge learnt in the online safety induction program in the workplace. However the novices would encounter some level of difficulty applying their knowledge as site practices, such as updating or changing procedures without proper notification, often contradicted what was learned in the
online program. M12 mentioned that larger mining companies had perfected a “mothership approach” where there was no latitude for variation so what was learned in the induction occurs at the mine site. However the approach taken by M12’s organisation for implementing processes and procedures was not systemic or systematic. M12 indicated that this inconsistent approach and the constant changes occurring at the sites not only impacted on the accuracy and currency of the program but also the lack of ongoing training and follow up could also have a negative influence on any workers’ ability to apply their knowledge in the workplace.

S1 observed that their people were working on site who had completed the online safety induction and were still making mistakes because they did not understand the information. He went on to say that it was not necessary youth or inexperience which was the problem but some workers’ inability to grasp basic safety knowledge necessary to operate on a mine site:

“I don’t want to sound degrading but the lowest common denominator is going to get through and this is what we should be protecting ourselves against. Idiots don’t have common sense unfortunately…. A 60 year old person broke a fundamental rule on site and could not understand what he had done wrong. He was an experienced person but a 25 year old picked it up quickly.”

Interestingly he added that the presence of an instructor to answer questions and help participants understand the information may not be the solution as many workers would expect to be given the answers, which is what currently happens in the face-to-face courses. S1 concluded by saying that there were workers who could apply their knowledge in the workplace however the information usually needed to be relevant to their job role and conform with standard work practices on a mine site.

M11 has observed that some workers have difficulty putting into practice what they learning in the online safety induction program. In his estimation there were a higher proportion of new people to the mining industry and for a variety of reasons (such as inexperience, age and educational level) they do not fully comprehend the necessity for the intensive safety training for a mine site. Further, some experienced workers were used to working in a certain way (which might not conform to the SOPs at the site), which has led to incorrectly applying the policies and procedures contained in the online safety induction. Subsequently, such workers could find it difficult dealing with any problem situations which may arise. M11 qualified this observation by adding that he
believed no amount of reading will give a worker complete understanding of what their job involved until they were actually physically involved doing their work. Further, workers who were new to site should participate in site familiarisation which usually involved finding out where the facilities were located and checking and recording paperwork. This was usually carried out by a supervisor or experienced worker.

Finally M5 believed that most novices and some experienced workers were not putting into practice what they learned in the online safety induction program at the mine site as there were workers who did not have the capacity to understand the required information and therefore needed to be constantly monitored and told what to do.

“From experience from seeing how some people work … you are not always dealing with the highest educated people and that’s not being nasty that’s a fact. Some people don’t think before doing things.”

**Training Company Development Approach**

The MD stated that workers should be “challenge tested” when they arrived at site to ensure that the information in the online program had been learned and understood. For example if you were a driver you should be able to perform a pre-start inspection on your vehicle and this should be tested on site. He did acknowledge that practical testing did not always occur on site.

**6.8.3 Safety versus Productivity**

Although not directly related to the online site safety induction program, an interesting perception arose from the data relating to the culture of the mining industry and subsequent attitudes towards safety. M11 believed that some workers, especially younger workers, did not value safety training and only those who have experienced or seen an accident truly appreciated the dangers of working in a mine:

“If somebody’s had an accident they will probably have a different mindset to somebody that hasn’t had an accident. Some young fellows are pretty gung-ho and you only have got to see the rubber lines on the road to know that they believe they are bullet proof and they think they are beyond harm”.

Conversely, S1 felt that experienced workers paid “lip service” to safety, and this influenced the novices as they wanted to be accepted. S3 stated a “few older blokes don’t think they can be taught anything new. No real cowboys or maybe one [laughs]”. His perception was that about 50% of people he associated with thought safety
induction training was a “pain in the ass” and this included both managers and workers. Moreover W19 mentioned that his boss told him the induction was a waste of time and to finish it quickly so he could get back to work. Finally, W14 spoke about truck drivers (usually males) who were speeding on site to improve production quotas. She felt pressured to keep up with the other drivers even though it was against the rules to speed and you signed documentation to say you would not exceed the limit. This appeared to be condoned by management, however if an accident occurred the driver was at fault. Research shows that workers in a company which has a positive safety culture feel responsible for safety and pursue it on a daily basis by proactively identifying and taking measures to minimise unsafe practices and behaviours (Stephan, 2001). Further, management commitment to safety is linked to the success of safety initiatives, including how well safety training is emphasised and whether it is considered an integral part of workers’ training (Harvey, et al., 2001; Zohar, 1980). Hence it appears that at some of the mine sites safety was not the priority and that some workers had the perception that productivity was more important than safety.

M12 made the observation that when change occurred at the mine sites, workers were unsettled and this in turn impacted on their views of safety, especially if there was a discrepancy with what was learned in training and what was practiced at the sites. Not surprisingly, interviewees who had witnessed the aftermath of accidents were more likely to take safety training seriously. W7 commented that he had seen a few incidents and this made him more conscious of safety and its importance. Likewise W4 had seen the results of an accident that could have been avoided, and believes the rules and guidelines set by the mines were important to follow.

6.9 Summary of Key Results and Conclusion

The interviewees who preferred the online site safety induction liked the fact that they could learn at their own pace and not have to keep up or wait for the rest of the group. Not only was the program quick and efficient, it was less confronting, as interviewees did not have to worry about other people’s opinions and/or reactions. For the interviewees who were not satisfied with the online induction program, all felt the lack of interaction provided in the online program. They would prefer the opportunity to ask questions, clarify information, receive feedback and confer with more experienced workers. It was also suggested that the younger generation tended to prefer the self-
paced online induction program compared to the older generation, who liked to talk to colleagues and find out what was really happening at the site. This was generally supported in the interview data as only one interviewee (out of seven) under the age of 35 did not prefer the online method of learning.

In general, interviewees were positive regarding the quality and variety of the multimedia used in the online site safety induction program. Further the majority of interviewees thought the training content was current and accurate. Unfortunately this was not always the case, and was often due to the mining site not communicating to the Training Company changes in legislation and/or procedures in a timely manner so they could amend and/or update their training materials. Experienced workers also reported frustration with the repetitious nature of the training material and the inclusion of information they perceived irrelevant to their job roles and/or a site induction. Subsequently, some workers suggested that the information which they believed was covered in the Generic Induction should be removed from the online site safety induction. In regards to the assessment types and process, some interviewees thought they were too easy and open to abuse while others liked the fact they were straightforward and that an incorrect response resulted in being directed to the appropriate information. Interviewees also revealed the approaches they used to learn the training material; reading, skimming and skipping through the information. The interviewees who read the material all described themselves as either methodical or pedantic. However it was alarming to note that all barring one interviewee, with less than 5 years of mining experience choose to skim through the information.

Interviewees also raised a number of barriers or issues with the online induction program. Retention of information and lack of customisation were two major concerns. Comments were made by workers and managers that information contained in the online program was not being recalled effectively. This could possibly be due to the large amount of material to learn, not enough time to digest the information and the habit of glossing over or ignoring content considered unimportant and/or irrelevant. Further, some experienced workers raised the issue of lack of customisation. They argued that having the one training program for all workers was not helpful. They believed more experienced workers should have a separate, shorter program or complete an assessment whilst novice workers should complete a full induction.
Although all workers believed they understood the information in the online site safety induction program and could or had applied that learning to the workplace there were a number of interviewees who did not believe the online program was an effective method of learning safety. From those interviewees the prevailing view was as there was nothing new in the induction program there was nothing to learn. Hence it appears that the memorisation of site facts believed to be necessary to work on site was the main approach used when completing the induction program instead of learning for understanding. Alarmingly, the feedback from supervisors and managers tended to support this interpretation as they seemed to be quite negative regarding workers’ abilities to apply their knowledge in the workplace, especially in non-routine situations. It appears that simple, routine procedures were likely to be applied by experienced workers and maybe some novices as long as the training material was consistent with what was occurring on site and they had on-the-job training. However there seems to be some doubt that even experienced workers were capable of comprehending and applying critical problem solving approaches to complex situations unless they were highly knowledgeable and educated.

This chapter has provided a detailed analysis of the qualitative data collected from the interviews. The analysis has provided valuable information regarding interviewees’ perceptions of an online site safety induction program in the areas of (a) satisfaction with the method of learning and multimedia; (b) satisfaction with the content and effectiveness of the design; (c) approach to learning the information; (d) barriers to learning; and (e) effectiveness of the program. The following chapter, Chapter Seven, further summarises these findings and integrates them with the findings of the study’s quantitative phase. The final concluding chapter of the thesis summarises the main points along with recommendations for practice.
# DISCUSSION OF FINDINGS

## 7.1 Introduction

Chapter Six discussed the results of the qualitative data and helped answer the major research questions that this study was designed to explore, namely, the questions about participants’ perspectives regarding the learning and instructional design effectiveness of an online site safety induction program in the Australian mining industry. This chapter integrates both the qualitative and quantitative research results and situates the findings in the context of the literature regarding theories of learning and instructional design, and discusses implications for practice.

The benefits of a case study using both quantitative and qualitative methods were evident, as the results of the interviews extended many of the survey findings, producing knowledge and insights inaccessible through the survey instrument. The interview findings not only provided elaboration and clarification of the survey data but also the necessary depth and detail of the participants’ perspectives, thoughts and beliefs regarding the online site safety induction program. Theories of adult learning and learning in the workplace have helped provide guidance and understanding of participants’ perspectives, both positive and negative of the online program. Moreover the literature refers to a number of critical factors which affect learners’ satisfaction and subsequent successful learning outcomes in online learning environments including; learner support, interaction, technology, learner control and course design (Burke & Huchins, 2007; Granger & Levine, 2010; Gunawardena, et al., 2010; Puzziferro, 2008).

In this chapter the themes identified in the findings have been organised under three

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<td>7.4.3 Effectiveness</td>
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</table>
```
dimensions; program design, program delivery, and program support. Program design encompasses the learning and instructional design processes and theories used in the development of the online site induction program; such as learner control, interaction, program content and activities and their ultimate effectiveness, transfer of learning to the workplace. Program delivery incorporates the method of learning, computer competency, the interface and technological aspects of the program including; interface and screen design, usability and navigational elements, multimedia and technical issues. Finally program support comprises any external assistance offered to participants during the training program, such as technical, administrative and learning support. Where appropriate, the theme of perceived barriers to learning has been embedded within the three dimensions. Elements of the delivery and support mechanisms provided in the online program were important as they influenced participants’ satisfaction with the online program, and will be discussed first in this chapter. The greatest impact on participants’ perspectives and subsequent outcomes were related to a number of design aspects of the online program and will be discussed in detail last.

7.2 Program Support

In the survey, participants were asked about differing aspects of trainer support including; their access to a trainer to support their learning, the quality of trainer assistance they received, and the standard of technical support offered. In the interviews, the issue of trainer support was raised by a number of participants, particularly the need for a trainer who could answer questions, clarify information and share knowledge and experience.

7.2.1 Trainer Support

No communication with a trainer or facilitator was built into the course, although the online program was delivered in a training facility. The administrative staff at the Training Company where participants completed the online induction program, were mainly responsible for checking identities, settling participants at their stations, fixing technological problems and issuing the required paperwork, but not the learning support. Further, the only feedback provided was online when participants answered a question incorrectly, they would be directed to the appropriate information. Apart from the Managing Director, who would sit down with participants who looked particularly distressed and help them through the first few training modules, participants were
expected to be self-sufficient in terms of their learning.

The data from the survey indicates that generally, participants were satisfied with the quality and degree of support they received. However it was interesting to note that one quarter (25%) the older (40+) and 30% of the more experienced (10+ years) participants felt they needed more trainer support compared to 14% of both novices (0 to < 1 year) and the younger participants (18-24 year olds). Research suggests that older and longer serving workers may be more conditioned to face-to-face training and not familiar with self-directed learning and therefore prefer the presence of a trainer (Newton, et al., 2002). Conversely, the younger generation is more likely to be familiar with computers (Kennedy, et al., 2008; Salajan, et al., 2010) and possibly not as daunted by online learning. Novices to the industry may have less knowledge about what to expect in regards to training in the mining industry and therefore more open and motivated to complete an online induction program.

The interview findings indicate the major reason why 6 interviewees stated they preferred face-to-face training was the need for direction and learning support. Although there was a mix of age, familiarity with online delivery and years of mining experience in the group, three of the group who preferred instructor led training also had limited computer skills and two mentioned literacy issues. Similarly, the issue of guidance and feedback was raised by three experienced participants who stated a preference for the online mode of delivery. Two of the participants were aged 45 or older and were new to online learning. They commented on the lack of opportunity to ask questions about information they did not understand, and receive direct feedback regarding their performance. A manager felt that to be effective, a trainer needs to be not only knowledgeable about the content but also understand how things operate on a mine site. Conversely, a supervisor did not think the presence of a trainer would improve learning as he believed workers would not take responsibility for their learning, and hence expect to be given the answers as in face-to-face training programs.

According to research, instructor presence in the form of facilitation and feedback is crucial in the success of online learning (Brown, et al., 2006; Garrison & Cleveland-Innes, 2005; Hutchins & Hutchinson, 2008; Swan, 2001). Further, success of safety training depends on a number of contextual factors, including whether learners are given the appropriate support to understand and perform the recommended procedures.
A range of individuals perceived the need for more trainer assistance, especially to provide guidance and learning support. Smith (2003) suggests vocational learners, such as apprentices and subsequently tradespeople (which make up a substantial proportion (40%) of the mining population, (SkillsInfo, 2011), prefer learning situations where an instructor leads the process, and have a preference for social contexts rather than independence. However it appears the background and degree of help provided by a trainer needs to be carefully considered if it is to be effective. Synthesis of the survey and interview findings suggest that participants’ with a combination of three or more of the following elements; poor literacy, limited computer skills, unfamiliar with online learning, aged 45 plus and/or over 10 years of mining experience, appeared to require the most help. By identifying these workers prior to training, processes could be put in place to ensure they receive the necessary support.

### 7.2.2 Technical Support

In reference to technical support the survey data indicated that overall, participants were satisfied with the speed and efficiency of the technical support they received from the Training Company staff and this was echoed in the interviews. The survey findings indicate that, overall, 96% of participants surveyed did not experience technical difficulties. Interestingly, 100% of 18-24 year olds and 85% of participants aged 40+ believed that technical issues were quickly fixed compared to 65% of 25-39 year olds. Further, almost one quarter (23%) of 25-39 year olds did not think problems were fixed quickly enough. The interview findings suggest only minor technical issues were encountered by participants, such as program crashing, slow response time and loss of power. Interestingly two out of the four participants who reported technical problems, fell into the 25-39 year old age demographic, and the other two were aged 40+ and only one participant expressed any dissatisfaction with the service provided by Training Company staff. This suggests that any frustrations and a subsequent decrease in motivation caused by technological breakdowns (Song, et al., 2004) were minor barriers for most participants. Further investigation may be required to discover why the 25-39 year olds appear less satisfied with the time taken to resolve any technical issues. Work by Song and colleagues (2004) indicate that it is important to minimise technological issues or breakdowns from the beginning of the learning experience by providing timely support. This appears to have been achieved in the program under study. Lack of
technical support did not appear to be a major issue in this program as interview participants who experienced problems were generally very positive regarding the efficiency and effectiveness of the staff to resolve any technical issues.

7.3 Program Delivery
Research has shown that learners who report higher levels of satisfaction in online training programs often demonstrate greater learning gains (Gunawardena, et al., 2010; Orvis, et al., 2009; Puzziferro, 2008). Conversely, if learners have a negative attitude or anxiety towards technology or are not proficient in the use of computers, this may have an impact on their ability to learn via computers (Long, et al., 2007; Song, et al., 2004) and transfer that learning to the workplace (Park & Wentling, 2007). Hence participants’ levels of perceived satisfaction with a number of aspects relating to the online site safety program such as the method of learning, computer competency, and the look and feel of the program could have a significant impact on their learning outcomes (Long, et al., 2007).

7.3.1 Online Method of Learning
The survey gathered participants’ perspectives regarding the mode of delivery, amount of control and time taken to complete the program. The survey findings indicate that on the whole (78%), participants were satisfied with the online mode of delivery. Over 70% in every age group (100% for 18-24 year olds) agreed they enjoyed computer-based learning with one quarter (25%) of participants aged 40+ uncertain. As expected the younger generation appears to be more comfortable learning via this technology (Manuel, 2002). The reason for participants’ satisfaction with the online mode of delivery was expanded in the open-ended responses in the survey and the interview data. According to participants, the best feature of the online induction program was that it was self-paced, and the third best element was its efficiency. This view is reflected in the interview findings with 13 of the 19 participants preferring the online delivery to instructor led mainly because it was self-paced and efficient. Other reasons given for their satisfaction with the online program were; not being constrained by the needs of a group, working at their own pace without interruption and not feeling pressured or judged by others. The demographics of this group varied in age, mining experience and level of computer skills.

As the induction program was mandatory, participants were aware they needed to
complete the program to work on site. However it appears efficiency was being equated with effectiveness by many of the participants, as the quicker you could complete the induction and get back to site the better. Hence there appears to be a clash between the learning goal and the production ethic. As one participant commented, his boss told him the induction was a waste of time and to finish it as quickly as possible and get back to work. This supports Wadick’s (2008a) research into the construction industry, where safety initiatives such as training are seen as an imposition as they reduce efficiency by tying up time, money and resources. There was also an impression from some workers that they were racing through the online program with the purpose of achieving their fastest completion time. Hence it seems as though some participants were treating the online program as a game or competition.

To identify any issues with time constraints the survey asked participants’ perspectives regarding the time taken to complete the induction program. The survey findings indicate that overall (72%), participants were satisfied that they had enough time to complete the program, one third (33%) of females were unsure. This could have been due to a number of reasons, including the possibility that as females tend to be more verbal (Halpern, 2004; Tallberg, et al., 2008), more time may have been taken reading the large amounts of text in the program. This would need further investigation, especially as there was a small proportion (11%) of female survey respondents, which is however reflective of the mining workforce of 13% (SkillsInfo, 2011). Further, participants at the different mine sites had varying responses regarding the amount of time they took to complete the online program: 100% from mine site D were satisfied with the amount of time, whereas 53% from mine site E and 43% from mine site F were uncertain. When looking at participants who nominated a company instead of a mine site as they were completing multiple inductions, 14% of those working for company Y, 63% for X were uncertain, and 29% from company Y were not satisfied with the time it took to finish. On average, one induction for an experienced worker takes about 3 hours, however, some workers were doing 4 or 5 inductions in one day, increasing the amount of time taken to complete the training. This often caused frustration and fatigue.

7.3.2 Computer Skills

The survey and interview data reveals that the majority (89%) of participants self-rated
their computer skills as either moderate or advanced. The survey findings indicate that 17% of secondary educated participants felt they had limited computer skills, with 61% believed they had moderate computer skills. Further, 40% of TAFE educated participants believed they had average computer skills, with 57% nominating advanced computer knowledge. This is not surprising as the highest level of education of a high proportion of workers in the mining industry (especially older, more experienced workers) is secondary school and may therefore have had less exposure to computers in the schooling system. Interestingly, when participants were originally asked to complete an online survey there was a very low response rate however once a paper and pencil format was introduced more surveys were completed and no participant elected to use the online format. The low response rate was not unusual, as seen by a similar study undertaken by Bahn & Barratt-Pugh (2011) who conducted a survey to discover how workers in the construction industry viewed a safety induction program. Their response rate was 4% with only 25 online questionnaires completed out of approximately 700 potential participants. They argued that this was an indication that online questionnaires were not supported by a participant group that was manual in their work practices, site based and not regularly working with computers.

The interview findings suggest that two of the four participants who nominated limited computer skills appeared to experience some trouble or anxiety using the computer to complete the online induction program. The experienced 50 year old worker revealed he preferred face-to-face training as he was not comfortable using a computer to learn. The 35 year old worker, with less than a year of mining experience, appeared daunted with the prospect of using a computer let alone as a vehicle for learning. This sentiment was supported by one of the managers who reported receiving negative feedback from some older workers as they struggled with the technology and the concept of learning online. This is a big challenge for the mining industry as the workforce is ageing (Mining Industry Skills Centre, 2007; National Centre for Vocational Education Research (NCVER), 2005). Work by Wallen and Mulloy (2006) suggests that older workers can have more difficulty learning via computer-based instruction resulting in lower levels of comprehension of complex information. Further if some older participants have a fear or dislike of using computers, their sense of self-efficacy or confidence in using computers to learn could negatively impact their effort, attention and active participation (Long, et al., 2007) in the online site induction program leading
to lower levels of satisfaction and learning (Park & Wentling, 2007; Sun, et al., 2008). The interview findings suggest that the Managing Director of the Training Company was very aware of the limited computer skills of the mining cohort and purposely designed the online program to cater to participants who have limited computer skills. On the whole, this goal appears to have been achieved, however, it may be of benefit to identify workers who have limited computer skills and/or are anxious about computer based learning before they begin the program and offer a greater level of support (rather than just fixing technical problems) so they can complete the program with a minimal amount of apprehension and/or frustration.

7.3.3 Technology and Multimedia
The survey and interview data highlighted that overall participants were satisfied with the hardware and software technology. All participants had access to a computer as the training was conducted off site at a dedicated facility thus eliminating this as a potential barrier (Newton, et al., 2002). The technology used in the development and delivery of the online training program also appears to provide the functionality and reliability that participants required as the survey data indicated that, overall (83%) participants were comfortable using the program. The most positive responses were novices (participants with 0 to < 1 year of mining experience) as all (100%) were comfortable using the program. Interestingly 80% of the male participants thought the online program started quickly compared to 55% of females. Further, 44% of females were uncertain. The interview findings also suggest two people, both male, having issues with the speed of the computer. This may require monitoring to see if a problem exists and under what circumstances.

The results of the survey also indicate that participants were generally satisfied with the quality and variety of the multimedia. Interestingly, 92% of professional workers believed the multimedia to be of high quality compared to 58% of labourers/TA operators. Overall, 73% of participants were happy with the variety of multimedia. Older participants (40+) were the most positive as 83% believed there was a good mix of multimedia in the online program. Conversely 21% of participants between the ages of 25-39 did not think so. The interview findings reveal that one participant questioned the quality of the audio used in the program. However, 4 participants (including two participants aged 25-39) felt more variety, particularly visuals in the form of videos and
maps would improve the program. The literature suggests that males and older workers benefit from instruction which incorporates more pictures and audio narration (Flores, et al., 2010; Wallen & Mulloy, 2006). Hence more appropriate visuals in the online site induction program may not only be advantageous to males but also older workers including females.

7.3.4 Interface and Usability

The survey findings suggest that participants were generally satisfied with the interface including the screen appearance and ease of reading screen text. However one aspect of the interface that did raise an issue was the amount of text on screen. The findings from the survey indicate that the younger age group (18-24 year olds) felt there was too much text on the screen with 43% not satisfied and 43% uncertain. Similarly, in the interviews, four participants raised the issue of too much text to read and three of those participants were 23-25 years old. Several researchers suggest that younger learners’ are more attuned to visual media and hence their text literacy may be less well developed than in older generations (Manuel, 2002; Oblinger & Oblinger, 2005). Thus the appearance of large amounts of text on screen may not only be unfamiliar to this games-based generation, but also daunting. Further, males tend to prefer more visual and audio learning in multimedia environments (Flores, et al., 2010). Hence limiting the amount of text (Manuel, 2002; Oblinger & Oblinger, 2005) by the use of bullet points and shorter sentences (Cook & Dupras, 2004; Hutchins & Hutchinson, 2008), and providing more interactive visuals is important as it will not only help engage younger workers but would also suit older workers and the largely male population of the mining industry. Also by presenting some information in visual mode and other information in auditory or spoken mode instead of text the modality effect (see section 3.5.3), which occurs when too many elements have to be processed in visual or verbal working memory, can be avoided (Low & Sweller, 2005; Mayer, 2005).

On the whole, both the survey and interview findings suggest that participants’ perspectives of the user-friendliness of the online site safety induction program were positive. The survey data indicates that participants were generally satisfied with the navigational aspects of the online program, particularly identifying links, understanding instructions and navigating around the program. However some participants felt they had difficulty finding important information. Interestingly, 42% of participants with 1-4
years and 40% of participants with over 10 years of mining experience had difficulty. Further, almost one third (30%) of participants aged 40+ felt they needed trainer help to navigate their way around the program. The interview findings indicate that the majority of interviewees did not have trouble navigating around the program. The one participant who mentioned a navigational issue had 1-4 years of mining experience and was aged 47. He had not completed an online induction before and also felt more trainer support would be helpful. It appears that older and/or more experienced workers may require more support when navigating around the online induction program. If mine workers have been conditioned to a classroom situation, where the information they need to know is given to them, then online learning would be challenging as they would not only need the ability to be self-motivated and self-directed but also the computer skills to navigate around a program (Long, et al., 2007). Further, the andragogical model developed by Knowles’ (1980; 2005) suggests that although adults are capable of self-direction they can revert back to dependent learners if they do not receive enough structure to support their efforts to become self-directed. Hence the degree of usability is an important element of the online induction program, especially for workers who are older, not highly computer literate and/or have not used this medium to learn. Several researchers (DeStefano & LeFevre, 2007; Lin, 2004) suggest that older learners can be more susceptible to distraction, and more structured, hierarchical hypertexts would be beneficial. Similarly, workers with less prior knowledge of the content area may be more prone to disorientation due to their lack of a conceptual structure of the content area, thereby requiring more support in the form of visual clues and hierarchical maps to provide an overall representation of the program can be helpful (Chen, et al., 2006). Interfaces which are easy to use (simple, consistent and clearly identified) not only help reduce learner disorientation and distraction (Hutchins & Hutchinson, 2008; Lee, et al., 2005) they can minimise the potential for user frustration, thus encourage confidence and satisfaction with learning online for mine workers (Newton, et al., 2002).

### 7.4 Program Design

This section discusses participants’ perspectives relating to various design dimensions of the online site safety induction program. To facilitate this discussion, design has been separated into three topics: content, learner and effectiveness. Content incorporates aspects relating to the structure of the program, accuracy and amount of
information, degree of interaction, design of the learning activities, and assessments undertaken. When referring to learner, this includes elements such as engagement, level of customisation, retention of information, learner control and overall satisfaction with the program. Effectiveness covers participants’ and managers’ perspectives of the program to facilitate the learning of safety, and the level of knowledge acquisition and ability to transfer learning to the workplace. However, it is important to emphasise that these topics are not mutually exclusive. They are interconnected and the combination of all components impacts on participants’ satisfaction and learning.

7.4.1 Content

The interview with the Managing Director of the Training Company revealed that the online site induction program was developed using his knowledge gained from delivering face-to-face induction training. According to the Managing Director his knowledge of the content, and understanding of the audience, especially in regards to what motivated workers in a face-to-face setting, was transposed to an online environment. Further his main focus was on the technological aspects of the program, ensuring that workers with limited literacy and/or computer skills were able to complete the online induction program with minimal problems. There was no conscious use of any learning or instructional design theories to develop the online site safety program however his method was very systems based (see section 3.6). According to Driscoll and Carliner (2005), even though most companies do not know what theory underpins their approach to learning, they have one all the same. This tacit theory unconsciously influences how training programs are designed.

The Managing Director broke down the content into more manageable “chunks”, sequenced the content to be learned and tested participants’ knowledge at the end of each module. This approach is not surprising as the type of content to be learned involved a substantial amount of processes and procedures. Behaviourism (section 3.2.1), underpins the competency-based training approach prescribed by the mining industry as it requires clear and measurable learning outcomes. It appears the online site safety induction program was primarily designed to ensure the minimum standard of competency was achieved by workers, thus complying with legislation. This may work well for routine situations, however more complex tasks may not benefit from a purely competency-based approach (Hoffmann, 1999; Stevenson, 1991).
The survey findings indicate that, on the whole, participants were satisfied with the online program’s structural and procedural elements. Participant satisfaction with the order of the lessons (74%) and the clarity of the learning objectives (84%) for each module was generally very positive. Likewise the interview findings suggest that participants were, on the whole, satisfied with the sequencing of the learning modules. According to Driscoll (2000), structure reduces the demand on short-term memory by organising the information into manageable pieces that are easier to remember and apply in the workplace. This approach would suit a lot of participants as it is less demanding and easy to follow. Also, several participants, including one who was a novice to the industry, specifically mentioned that they liked the order in which the lesson modules were presented and saw no need to deviate from the structure. This suggests that learners who are new to the content may not be ready or inclined to take control of their learning (Wild & Quinn, 1998). Conversely one participant, who was familiar with both the content and the online medium of learning, did infer that the program structure was very linear and didactic and needed more interaction. Hence not all workers may appreciate the systematic, step by step approach and could benefit from training which incorporate elements from a constructivist approach (see section 3.8) rather than a purely systems design approach. Further, the survey identified a statistically significant finding (p< 0.05) relating to participants’ expectations of the online program. Education level had an impact on whether participants believed they had a clear understanding of what to expect in the online program. Interestingly, 39% of secondary school educated participants and 38% of TAFE educated participants felt they did not have a clear understanding of what to expect; 54% of TAFE educated participants and 30% of secondary educated participants were uncertain. It appears that these non-professional participants (tradespeople, semi-skilled workers and unskilled labourers) needed more information concerning what was involved in an online site safety induction program before they began the training. This is important as more than two thirds (70%) of workers in the mining industry have either no formal qualifications or non-school qualification such as a certificate III or IV (SkillsInfo, 2011). Hence, providing workers, particularly trade and unskilled workers, with a formal introduction to familiarise them with the online program and what to expect may help alleviate participants’ concerns. This could include the online induction program’s purpose, what information will be covered, how long it may take, how it is structured and who it is aimed at (for example suitable for people with limited computer skills).
It appears from the survey data that overall (74%) participants were positive regarding the accuracy of the information contained in the online program. Interestingly, one third (33%) of participants working at mine site B were uncertain and 17% did not think the information was correct. Also one quarter (25%) of participants working at mine site G concurred that the content was not always accurate; this was confirmed in the open-ended response by a small proportion (7%) of participants. The interview findings were generally positive regarding the accuracy and currency of the content however two interviewees (one manager and one experienced worker) suggested this was not always the case. The manager supported the view of mine site B workers and indicated that due to regular changes occurring at mine sites controlled by this company the online induction program was not always accurate or current. Hence there were a lot of inconsistency between the content in the program and what was happening at the mining site. This opinion was reiterated by an experienced worker. According to the manager, this was not an omission on behalf of the Training Company but a fault of this particular mining organisation as it did not communicate changes efficiently and effectively. To counter this problem, it appears the Managing Director made the online program as generic as possible thus reducing the need for changes. This has serious implications for the effectiveness of the online program as access to accurate and current training programs is vital for workers in the mining industry as it helps to ensure safe work practices are communicated and maintained in a potentially dangerous environment (Newton, et al., 2002). Further by making the content as broad (rather than site specific) as possible, this may have contributed to participants having issues with the amount of information to learn and the high degree of repetition and irrelevant material contained in the online program.

The survey findings suggest that although participants generally felt that a sufficient amount of detail was provided in the training modules, a proportion of participants also believed there was an excessive amount of unnecessary information to learn. There was a statistically significant relationship (p<0.05) between job responsibility and excessive amount of information to learn suggesting that 38% of labourers/TA operators felt there was too much information to learn whereas 42% of professionals were uncertain and 58% did not think so. Also, 64% of novice workers (0 to < 1 year) felt the program contained unnecessary information. The survey findings also indicate that, overall 41% of participants believed there was unnecessary repetition of learning
activities in the program. Interestingly, 40% of participants with 10+ years of mining experience did not think so. Moreover, the open-ended responses in the survey indicate that the top three elements of the online program which participants believe needed improvement were 1) the amount of irrelevant information, 2) the repetition of information and 3) the amount of reading. In relation to the survey findings, the novice (0 to < 1 year) participants may have felt there was a lot of unnecessary repetition of information as it appears a substantial proportion of the training material in the online program would have duplicated the information contained in the Generic Induction (see glossary). The more experienced participants may have avoided a degree of repetition by going straight to the assessments in the online program.

The interview findings support the survey results as a number of workers commented on the large amount of detail in some learning modules, the repetitive nature of the material and the inclusion of what they considered irrelevant information. The issue of repetition, especially for experienced workers, also includes having to complete more than one site induction in a day. In effect this would mean completing the same (or very similar) online training program up to five times in one day. Comments were made by participants that they were answering the same question numerous times and that a large proportion of the information to be learned had already been covered in the Generic Induction. Adding to participants’ frustration was the perception that the online induction program contained information that was not relevant to their job roles. This seems to not only stem back to the inclusion of a large amount of information from the Generic Induction but also the belief that there was not enough focus on site specific and job relevant content. Similarly, research by Douglas and Oosthuizen (2010) found that mine workers believed that Generic Induction information was duplicated in site specific inductions and were thus superfluous. Principles of adult learning suggest that mature learners need to know that what they are required to learn is necessary to cope with their existing situation (Knowles, 1980; Knowles, et al., 2005). This was not always the case in this study where participants appeared to ignore information they believed was not relevant to their job role and therefore not important. Further, the redundancy principle (section 3.7) suggests that providing information that is not essential inhibits rather than promotes learning (Chandler & Sweller, 1991; Sweller, et al., 1998). Some designers assume that presenting the same information in different forms will at best be helpful to learners and at worst do no harm (Sweller, 2005b).
However this is dependent on the learner’s level of expertise, as what is deemed redundant information by experienced learners may be necessary for the novice learner (Sweller, et al., 1998) and needs to be carefully considered. Moreover, according to the expertise reversal effect, experienced workers could suffer from working memory overload if they were unable to ignore additional, redundant information (Kalyuga, et al., 2003).

The survey findings indicate that overall (62%), participants were not completely satisfied with the amount of interaction offered whilst completing the online induction program. Unexpectedly, it was the younger and less experienced participants who felt a need for more interaction. One half (50%) of participants aged 18-24 years old and 43% of participants with 0 to < 1 year of mining experience felt there was not enough opportunities for interaction compared to one quarter (25%) of participants aged 40+ and 10% of workers with 10 plus years of experience. The younger participants may be conditioned to a more interactive computer experience through game playing and this may have impacted on their perceptions. However it is more likely that as 70% of the mining workforce (SkillsInfo, 2011) is comprised of tradespeople and semi or unskilled labourers who have traditionally learned their roles or tasks in a ‘hands on’ environment (Smith, 2001); the content centred approach of the online program may have lacked the context and interaction these workers are used to. A central tenet of social constructivism (section 3.2.3) is that learning is achieved through social interaction, especially dialogue with other learners (Vygotsky, 1978). Hence many of the participants, especially the younger and less experienced workers, may have felt the need to experience a community of practice, and learn through participation in shared work practices and the guidance by knowledgeable mentors (Billett, 1998). Conversely, the finding for the older more experienced participants in the survey may have been influenced by a number of factors, including the desire to finish as quickly as possible and therefore get back to work, hence focusing on the assessments rather than the training content, would increase efficiency. Also a belief that they already know the important mine rules and regulations on mine sites (Laurence, 2005) and therefore did not need to confer with others, may have contributed to their views on the amount of interaction provided by the online program.

However the interview findings indicate that a perceived lack of interaction in the
online program was not limited to the younger and less experienced participants. A range of workers with differing ages, years of mining experience and job roles, also raised the issue of interaction. This included a need to ask questions, clarify information, receive feedback and interact with their peers. There was also a desire to find out the real issues and/or situation at the mining sites and tap into the knowledge of experienced workers. Two of the managers also commented that the older generation tended to prefer more interaction as they were able to discuss the situation at the mine site and find out the bigger picture from the experienced miners which helped them to assimilate and understand the required information. This is not surprising as traditionally safety training has been behaviourally based (Paul & Maiti, 2007) which usually involved workers interacting with more experienced miners in a classroom environment and receiving feedback on-the-job (Cullen, 2008; Somerville, 2005).

Even though the participants attended a training facility, they were seated at separate booths and were required to complete the program individually. Adults not only learn as individuals but also through discussion, solving problems, meeting goals and learning experiences with others that are authentic and guided (Billett, 1998; 2001; Lave & Wenger, 1991). Observing and modelling respected and experienced colleagues (Bandura, 1976; Cullen & Fein, 2005) and receiving guidance and support from a mentor to solve problems and carry out tasks in authentic situations (Brown, et al., 1989; Collins, et al., 1989) has been a familiar and often valuable approach to learning in the mining industry. Research has also shown that appropriate interaction is important for promoting learning in an online environment (Bernard, et al., 2009; Garrison & Cleveland-Innes, 2005; Park & Wentling, 2007). However it appears the only interaction provided in the online induction program was between the learner and static content, unfortunately, as Janicki and Liegle (2001) suggest, online learning programs which are based on classroom lessons tend to be passive transmitters of information. Thus frequent and engaging interaction with course content, such as working on authentic problems, watching videos, interacting with multimedia and reading interesting and useful information would be important to increase participant satisfaction and subsequent learning (Bernard, et al., 2009; Swan, 2001) The challenge is how to incorporate these important elements (such as feedback, authentic problem solving and modelling) in an online site safety induction program in such a way that it supports and enhances socio-cultural learning and transfer without compromising the
efficiency of the program. This is important as efficiency is valued by participants and satisfies the business goals of mining organisations as it meets legislative requirements and is more cost-effective.

The survey also included questions relating to the instructional design strategies used in the online induction program to ascertain what techniques were being used (such as knowledge construction, scaffolding and authentic problem solving activities) and how participants perceived their usefulness. On the whole participants were satisfied with the instructional techniques, particularly knowledge construction as overall 71% believed the lessons built on existing knowledge. The survey findings indicate that overall (66%), participants were satisfied with the variety of learning activities, especially the younger and older participants, however 30% of participants aged 25-39 were uncertain and 18% did not think so. Likewise, the 25-39 year olds were less satisfied with the usefulness of the examples given to support understanding with 23% of 25-39 year olds uncertain and 15% feeling the examples were not helpful. The survey findings also suggest that the professionals were less positive regarding the instructional support, as 36% were uncertain and 18% did not believe that hints and examples were provided if they did not understand the information. The interview findings revealed that the only activities (apart from the multimedia) participants engaged in were the assessment tasks and the main scaffolding (hints and examples) provided in the online program was to take participants to the pertinent information when a question was answered incorrectly.

In regards to building knowledge, participants were able to choose the job/task which was applicable to their situation and the training material was supposed to relate to the job/task. The findings from the interviews suggest that a number of workers, especially in the 25-39 year old demographic, did not feel the design of the online program met the requirements of experienced workers as it was repetitive and not tailored to the site or their job roles. Further, the typical participant the program was designed for was a fifty year old, illiterate dump truck driver yet approximately three quarters of the survey participants and 15 of the 19 interviewees were under 50. This should be carefully considered by the Managing Director when designing training as the typical participant may no longer fit the above stereotype, and younger participants tend to be more computer savvy and expect more interactive, relevant and engaging learning. As W13 (a 27 year old electrician) commented “I’m never going to drive a dump truck in my
life, so why do I need to know how to dump over a low wall?” If it is important that workers need to learn information not related to their job roles, this must be explicitly stated and justified to learners. Adult learners need to know why they are required to learn something so they can make an informed decision regarding the benefits and possible consequences of not learning the information (Cercone, 2008; Knowles, 1980; Knowles, et al., 2005). Further, M12 felt that one induction training program would not help build knowledge and that learning should be ongoing and layered to ensure understanding. Hence the manner in which some of the information was being presented or the techniques used to develop some of the modules and/or activities may have been adding to the cognitive load of some participants (section 3.5). Understanding learning theories and instructional design strategies are important as it not only explains why certain decisions and approaches to learning are made but also helps guide how to do it well (Hager, 1999).

Participants’ perceptions were divided regarding how difficult the learning activities were in the online program. The more experienced participants (one half (50%) of respondents with both 5-9 and over 10 years of mining experience) did not think the activities were too simple compared to 21% of novices (0 to < 1 year). The survey findings also indicate that overall (66%) participants believed that authentic problem solving activities helped them to learn. The most positive (79%) were the least experienced (0 to < 1 year) compared to 54% of participants with 5-9 years of mining experience. This was very interesting, as the Managing Director stated clearly in his interview there was no real-life scenarios or problem-based learning activities contained in the online program. The reasons given were the cost, time, and ongoing effort required to develop and maintain such a program. The interview findings indicate that a number of workers (mainly experienced participants) noticed the absence of real-life scenarios; they wanted authentic, problem-based learning activities incorporated in the online induction program. Although interaction is important, especially to the younger and less experienced participants, real-life scenarios are valued by the more experienced workers. As mentioned previously, if content interaction is only being provided then the quality, variety and authenticity of the learning activities becomes crucial. Learning activities which are delivered in a variety of ways such as narratives and examples (Hutchins & Hutchinson, 2008) and are relevant and authentic will not only help learner motivation and engagement but also support a deep approach to learning (Herrington, et
al., 2006) and improve safety performance in the workplace (Burke, Sarpy, et al., 2006). Authentic learning activities do not have to be complicated or use highly technical functions, such as simulations, to be effective. The inclusion of stories and case studies into the learning activities can generate meaningful experiences for participants, especially in the mining industry as they are an effective means of conveying complex information in a way that is understandable and memorable (Cullen & Fein, 2005).

The survey findings indicate that generally, participants believe the assessments used in the online induction program were appropriate as they checked their level of understanding, however, some found the tests too difficult. Almost one third (30%) of more experienced workers (10+ years of mining experience) thought the tests were too hard compared to 14% of both novices (0 to < 1 year) and participants with 5-9 years of experience. Further, 30% of the older participants (aged 40+) felt the tests were too hard compared to 14% of the younger (aged 18-24) participants and 12% of the 25-39 year olds. Hence the older, more experienced workers appear to have some level of difficulty with the assessments. This may be due to a number of factors including lower levels of literacy and unfamiliarity with online learning, but could also be a result of bypassing the training material and going straight to the assessments, thus not having the opportunity to digest the relevant information. Interestingly, the interview findings suggest that the assessment questions were easy and the process straightforward. Six interviewees believed this resulted in abuse of the system as it was easy to cheat. Only one interviewee inferred the assessments were difficult and he was a mature worker with less than a year of mining experience and had literacy issues.

The design of the online program appears to focus participants on what was considered important information (Ritchie & Hoffman, 1997) and reinforce correct understanding (Driscoll & Carliner, 2005). Criterion-referenced assessments were used to determine if participants had achieved the competency level required. As Dick (1991) states the aim of the systems approach is to ensure the maximum number of learners achieve the required competencies in the most efficient way possible. The participants were required to complete the online program’s assessments with a stipulated 100% pass rate (by the Training Company) however understanding of the information contained in the program by all participants does not appear to be the primary goal. Some participants pointed out, and the MD concurred, you did not necessarily have to read and understand
the information to pass the assessment. This supports Wilkins’ (2011) concern that workers completing online induction programs can take shortcuts such as cheating on assessments if they are not monitored effectively. Further, mandated safety training, including this online site safety induction program, often relies on basic assessment techniques such as true-false and multiple-choice test to assess low level understanding (Burke, Sarpy, et al., 2006). However as the training program also involves more complex and non-routine situations such as the identification and control of hazards in the workplace, more effective measures such as scenarios and simulations would be needed to ensure learning has occurred (Machles, 2003). This is a concern which needs to be addressed. If there is not a suitable method to prevent workers from guessing the answers, then a function to monitor and support those participants could be a solution. The technology is available to record how many times participants attempt assessment questions and the outcomes. If the participant shows a pattern of guessing then some intervention, possibly in the form of learning support, is required. The Training Company relies on the mine sites to identify and reinforce learning with participants who do not demonstrate understanding when they get to work, however as M12 stated and the Managing Director concurred, this does not always happen. This is unfortunate and highlights the importance of Torlach’s (1998) recommendation in his report on a fatality in the mining industry, that workers’ knowledge be checked to ensure they understand the information communicated in an induction.

7.4.2 Learner
The survey findings indicate that overall (81%), participants were motivated to start the online program however not all were engaged as 17% of the unskilled (labourers/TA operators) workers did not think the content was interesting and over one third (34%) of tradespeople, one quarter (25%) of professionals and 12% of labourers/TA operators were uncertain. In the interviews, the words boring, monotonous and uninteresting were frequently used by seven of the participants, all with 3 or more years of mining experience and all mentioned completing a number of site inductions prior to the current program. M11 probably summed it up when he mentioned the typical response of experienced workers when they had to complete an induction was “oh shit we’ve got to do that again”. Nevertheless, participants knew they had to complete the online induction program if they wished to work on a mine site, thus they were definitely motivated to complete the program even if they were not highly engaged.
The interview findings suggest that the lack of engagement was influenced by participants’ perspectives of the level of customisation in the program. The Managing Director believed he delivered a customised and therefore meaningful program as participants could choose the site, department and task relevant to their role on the mine site. However, participants believed that a significant proportion of the information was generic, repetitive and irrelevant. Experienced workers felt they should be recognised for their prior learning (RPL) and not have to complete the full induction each time. This is supported by the Queensland Coal Mining Safety and Health Regulation (2001) which states that workers should be recognised for their prior learning and current competencies when establishing their training needs. Although participants could bypass the content and go straight to the assessments, it appears they still had to click through a number of pages to reach the assessment tasks and answer the same questions as all the other participants. If they were being inducted into multiple sites they were required to complete the process a number of times, including the same questions.

While participants saw the benefits of RPL as much of the content for each site induction was similar to inductions they had previously completed, particularly the generic material. The major obstacles for not offering RPL include: the unique hazards / safety controls and specific requirements associated with each site; the changing nature of mine sites which requires processes and procedures to be constantly reviewed, updated and communicated to reflect those changes; and ultimately the need to ensure compliance and hence minimise the risk of prosecution if an accident occurred. Hence the varying safety controls across mine sites make it extremely difficult to recognise prior learning across different mine site inductions. Additionally, the suggestion was made that novices to the industry should complete a more intensive induction with more interaction and guidance compared to experienced workers who should just be required to complete an assessment. Experienced workers, including supervisors and managers, did not feel the online program was suitable for novices as they could not only go straight to the assessments without reading any of the information but also there was limited support and follow up provided during the training and on site to ensure understanding. The Managing Director also mentioned it was difficult to make the program interesting and relevant to all workers, especially as there was such a wide range of abilities and computer skills. Hence, the online program seems to struggle to effectively account for individual differences such as prior knowledge and ability as it appears to be a *catch net* to ensure everyone, including the “lowest common
denominator”, can complete the induction and thereby complying with legislative requirements. This ‘one size fits all’ approach to designing online training programs does not appear effective in skilling workers to meet the requirements of their job roles and the organisations’ goals of health and safety.

The high degree of learner control was a significant feature of the online program. The survey findings indicate that perceptions varied regarding participants’ ability to decide the order they completed the modules. The more experienced workers were the most positive regarding their ability to decide their pathway through the online program. Seventy percent of participants with 10+ years of experience were satisfied with the amount of learner control, compared to 57% of participants with both 5-9 years and 0 to < 1 year and 31% of participants with 1-4 years of experience. Conversely participants with 1-4 years were the least satisfied with 37% disagreeing they had control over the lesson order followed closely by 36% of the participants with 5-9 years of mining experience. Further, over one third (35%) of 25-39 year olds did not believe they had sufficient control compared to 28% of younger participants (18-24 year olds) and 10% of older workers (aged 40+). Possible explanations for the above finding were discovered in the interview findings. For some participants the online program offered convenience, flexibility and autonomy whilst completing the induction. Hence, learner control was an important aspect of the online program as participants felt they could choose the order of the lessons, what content they wished to focus on, and the time they spent learning the material, thus tailoring the training to their own needs (Granger & Levine, 2010; Orvis, et al., 2009). However six of the interviewees who raised concerns about the lack of customisation were either 25-39 years old and/or had 5-9 years of mining experience. They did not think the experienced workers needed to complete the induction program (especially in its current format), and it therefore appears the degree of learner control was not the important issue, but having to complete ‘unnecessary’ inductions multiple times was. As adult learning theory suggests learners need to be intrinsically motivated to learn and training programs which are not engaging and relevant do not build confidence and enthusiasm. Also adult learners bring a vast reservoir of prior experiences which they can draw upon and prefer to learn via more practical methods rather than more passive means. Hence training programs should not only build on previous knowledge and experience of learners but should be more interactive and relate learners’ experiences to the concepts being learned (Knowles,
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1980; Knowles, et al., 2005). The online induction will continue to be viewed as a “necessary evil” for some participants if they do not think they are going to learn anything new and/or they believe they already know the information and therefore do not need to waste time perusing the training material. Research into safety training has shown that if programs are not viewed as a priority and do not meet the goals of participants and account for the varying levels of knowledge and experience of individuals, workers may continue to attend but not invest the effort required to learn the information and subsequently improve safety performance in the workplace (Burke, Holman, et al., 2006; Burke, Sarpy, et al., 2006; Peters, et al., 2010).

The survey findings indicate that 86% of participants with 0 to < 1 year of experience did not feel the information was difficult to understand compared to 40% of participants with 10 plus years of mining experience. Novice workers may have been more positive regarding their abilities to understand the content for a number of reasons including; more current knowledge of the subject matter obtained from the Generic Induction, taking the time to peruse all the information in at least the initial site induction or they may not have had the ability to effectively evaluate their own learning. As the research suggests trainees are often poor judges of their own learning (Sitzmann, et al., 2009). The interview findings extend the survey results as they indicate that both novice and more experienced workers may have had difficulty understanding some of the material in the online program. One young interviewee with no mining experience had trouble with the way the training content was worded; this could be an issue with terminology and/or lacking the background knowledge to put the information in context. Comments were also made by a couple of the supervisors suggesting that older, more experienced workers were having problems understanding information and applying their knowledge appropriately. The interview findings also suggest that some participants were unable to remember important information at the completion of the online induction program. Four participants (all barring one were aged 39 or over) admitted they would not remember certain information. This issue with retention was supported by all the management and supervisory staff, with more concern for novice workers. M11 believed that too much content and not enough time for reflection has resulted in poor information retention. According to Kushnir (2009) if there is a perception of large amounts of unnecessary or irrelevant material, learners can experience feelings of information overload.
Further, the interview findings also indicate that participants used a variety of techniques such as reading, skimming and skipping to peruse the information contained in the online program. Ten interviewees skimmed through the training program trying to identify important information before attempting the assessment questions while six participants opted to ‘skip’ the content and go straight to the assessments. The skimming and skipping methods chosen by some participants, particularly novices, may not have been the most suitable approach. Learning in the workplace involves learning new concepts and ideas and achieving goals through problem solving and transfer of learning (Billett, 1998). However some participants appeared to operate in an automatic fashion thus increasing their chances of missing important routine information (Perkins, et al., 1993). This surface approach to learning involved participants focusing on what they considered was important and/or relevant to their situation and completing the induction as quickly as possible (Biggs, 1991b; 1993).

The inability of some participants to understand and/or remember important information may be due to a variety of reasons including: poor computer skills and/or anxiety learning online, lacking the cognitive/metacognitive skills necessary for independent learning or difficulty processing large amounts of information. As discussed previously the older more experienced workers could have more computer anxiety and therefore increased difficulty learning in an online environment. They are conditioned to and in a lot of cases prefer the face to face environment of a classroom (Newton, et al., 2002). Also having more control over their learning can be daunting, especially as they are required to motivate themselves and navigate their way around an online program whereas traditionally an instructor would have taken this responsibility (Long, et al., 2007). Moreover, M5 stated “you are not always dealing with the highest educated people and that’s not being nasty that’s a fact”. According to research by Colquitt and colleagues (2000) an individual’s cognitive ability is a strong predictor of learning success. Learners with lower cognitive ability not only absorb and retain less information but are also less capable of diagnosing and learning from errors compared to learners with higher cognitive ability (Sitzmann, et al., 2009). Further, allowing a high level of control to participants with poorer cognitive and/or metacognitive skills can lead to less time being spent on complex training materials resulting in participants not learning the required information (Granger & Levine, 2010). Experienced participants who have extensive prior knowledge, and elect to use a surface strategy
may function effectively in routine situations however this may not be the case when they encounter complex, ill-defined work situations. As S3 notes “a miserable old bugger was telling a rigger how to do his job and got it wrong which could have ended in a fatality”. Novices who use a surface approach but do not possess the same depth of propositional knowledge and breadth of procedural knowledge as experienced workers may find it difficult to apply their learning to routine situations, let alone complex tasks at the mine sites do not always reflect what was learned in the induction.

For some participants the design of the online site safety induction program, which to many appeared to include a plethora of unnecessary and repetitive information, may place too much extraneous cognitive load on their working memory resulting in learning and transfer deficiencies (see section 3.7). Research also suggests that as working memory declines with age resulting in reduced working memory capacity and subsequent slower processing ability especially with complex tasks (Paas, et al., 2005; Wallen & Mulloy, 2006), older learners can be more susceptible to distraction and can therefore find it difficult to ignore irrelevant information (DeStefano & LeFevre, 2007; Schulz & Robnagel, 2010). Hence cognitive load theory (CLT) and strategies to increase concentration such as displaying less information on the screen (Rivera-Nivar & Pomales-Garcia, 2010) need to be considered. Although too much learning material can also occur in classroom situations leading to poor retention (Zhang, 2005; Zhang & Nunamaker, 2003), participants have the opportunity to ask questions and seek clarification from instructors and/or their peers.

The survey findings indicate that overall (74%), participants would recommend the program to others, particularly 93% of workers with 0 to < 1 year of mining experience. However age and years mining experience had an interesting influence on perceptions regarding whether participants felt the program met their needs. The most positive were the younger and older participants as all (100%) of the 18-24 year olds and 85% of the 40+ age group believed the program met their needs compared to 57% of 25-39 year olds. Further, one quarter (25%) of the 25-39 year olds were uncertain and 17% disagreed. In regards to mining experience it was the less experienced who were most positive regarding the program meeting their needs as 93% of participants with 0 to < 1 year were satisfied compared to 60% of more experienced workers (10+ years). The positive response of the younger and less experienced participants may be related to the
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younger participants’ familiarity with computers and the less experienced being more motivated to complete the online induction program. Also their recent completion of the Generic Induction would possibly have helped familiarise newer entrants to the mining industry with the training content and the simple, linear structure of the program seemed appropriate to those with limited computer skills and/or content knowledge. Whereas the older participants who were possibly less computer literate may have relied on the structure provided to mitigate their lack of computer skills, and as the program was considered, on the whole, user-friendly this may have helped to overcome some participants’ anxiety and increase satisfaction. The mature and experienced workers may not have felt the program met their needs as they may have preferred face-to-face training and/or as they already believed they knew the information in the online induction and had completed many site inductions before it was not really relevant for them. According to a number of researchers (Brown, 2005; Orvis, et al., 2009; Sitzmann, et al., 2008) participants who have a positive emotional experience and are satisfied with the learning process and outcomes of an online program are more likely to learn. However as the next section will attest, liking the program does not necessarily equate to learning (Kirkpatrick, 1979).

7.4.3 Effectiveness

To examine participants’ perceptions of the effectiveness of the online induction program in the survey, participants were asked if they had learned from the program or not, whether they could apply their learning in the workplace and if the program was a good way to learn safety. Although the survey findings suggest that, overall (86%), participants believed they learned from the program, it was the novices and younger participants who were the most positive. All (100%) of the 18-24 year olds and 93% of participants with 0 to < 1 year of mining experience believed the program helped facilitate learning. In regards to general effectiveness, the survey findings indicate that, overall, 69% of participants did not believe that the online induction program was a good way to learn safety. Three quarters (75%) of participants with 5-9 years of mining experience did not think it was a good way to learn safety, closely followed by the remaining groups (64% - 69%). The most positive response was 29% of the 0 to < 1 year of mining experience group who believed it was a good way to learn safety. It appears youth and inexperience may contribute to a more positive perception of learning from the online site safety program. The interview findings help to expand on the
survey results. All 19 interviewees believed they learned the necessary information and/or already knew the material pertinent to their job roles. Twelve participants thought the program was effective, either to a greater extent as 5 participants with 0-4 years of mining experience (and one aged under 25) thought it helped their learning or to a lesser extent as 7 more experienced workers (5+ years of mining experience) viewed it mainly as a useful revision aid. Seven participants (all were experienced workers and/or aged 25-39 years old) did not believe the program was effective in facilitating the learning of safety information. The experienced workers felt there was nothing new in the content, therefore they did not learn anything. There was a belief that not much effort or thought was required to complete the induction and that workers were relying on memory rather than trying to understand the information.

Again, the younger participants may be confident in their computer skills (Salajan, et al., 2010) and therefore felt a more positive emotional response regarding the process of completing the program online resulting in the belief that learning had been successful (Orvis, et al., 2009; Sitzmann, et al., 2008). Also, younger and/or less experienced participants may not have been able to accurately assess their level of understanding (Sitzmann, et al., 2009) which may have led to an over estimation of their achievements. The interview findings provide an insight as to why some of the more experienced and/or mature workers believed they failed to learn or felt the program did not facilitate learning. These participants thought there was nothing new to learn and they did not believe the online program was an effective way to learn safety. Four of these participants preferred the interaction and guidance offered by face-to-face training, two participants were supervisors who had commented on the lack of understanding of the information when workers returned to site. This highlights the focus on conveying factual information rather than developing higher order skills such as procedural and metacognitive abilities (see section 3.4.1). To encourage learners to develop critical thinking and problem solving skills, learners need to work on authentic problems, be guided on effective strategies to use and be appropriately assessed on their progress (Munby, et al., 2003).

Laurence (2005) noted that many accidents in the mining industry were a result of workers not following rules and regulations. However, as mentioned previously, the difficulty was convincing experienced workers they needed to learn this information as
they believed they already had a good knowledge and understanding of the rules and regulations. Similarly, learners who had worked longer in the construction industry were less influenced by training (Bahn & Barratt-Pugh, 2012b; Wilkins, 2011). Wilkins (2011) suggested that workers’ unwillingness or inability to see the applicability of theoretical information provided during training in a practical workplace situation, resulted in a number of workers not grasping the relevance of some material. Moreover, according to Rumsey (2003) competency-based training does not promote the learning of higher order skills and the techniques to transfer learning to new situations. Nor does this approach to training allow learners the time to digest and reflect on their learning and thus promote understanding of why the information is important and how to apply this knowledge in a variety of situations (Gonczi, 2000). The literature stresses the dangerous, changing and dynamic nature of the mining industry (Galvin, 2006; Gyekye, 2006) and emphasises the need for workers to develop the knowledge and skills required to successfully perform in a complex environments (Kowalski-Trakofler, et al., 2004; Mine Safety Technology and Training Commission, 2006). Moreover, research has shown that well designed programs can enhance the metacognitive skills of learners, including novices and ineffective learners (Gott, 1995; Munby, et al., 2003).

Interestingly, the survey findings indicate that, on the whole, participants believed they applied their learning in the workplace and/or were confident they could apply their learning in the workplace. The professionals were the most confident with 92% believing they applied their learning. Unsurprisingly, 93% of workers with 0 to < 1 year of experience were the most confident in their ability to apply their learning to the workplace compared to 56% of participants with 10+ years of mining experience. Further, one third (33%) of experienced participants (10+ years) were unsure. The interview findings provide an interesting insight into participants’ perspectives of their ability to transfer learning to the workplace. All 14 workers (excluding supervisors and managers) believed they had or could transfer their learning to the workplace and most were able to give an example, especially tasks they considered important and/or relevant to their job roles. This perspective contrasts strongly with the interview findings gathered from the managers and supervisors.

According to the managers and supervisors very little transfer of learning was occurring, and if it did it was only when there was a clear similarity between the
learning content and the task performed on the mine site. This is an example of specific, near-transfer (section 3.4.3) where the task has a clear similarity with the learning material and involves routine tasks that are performed in a consistent manner (Noe, 1999; Royer, 1979). Some mine sites were constantly changing or amending SOPs without informing the Training Company to enable the induction program to be updated to reflect the new processes and procedures, resulting in difficulties, especially for novices, in transferring their learning effectively to the workplace. Further mine workers, including non-school qualified, older and more experienced workers, are used to face-to-face training (Cullen, 2008; Newton, et al., 2002) and prefer to learn on-the-job and by listening and watching more experienced miners (Somerville, 2005). Hence, Bandura’s (1976) social cognitive theory (section 3.2.2), which suggests people learn through observation and modelling the behaviours of others is a key principle which needs to be considered when designing training for workers in the mining industry.

Interaction with peers and an instructor, and examining real-life scenarios also helps mine workers to identify and understand the real situation at a mine site not how it is supposed to be according to a training program. Apart from individual differences (such as age, cognitive ability, experience) the absence of interaction, guidance and authentic, problem-based activities may be having an impact on developing workers’ ability to solve problems and apply learning to new situations. The general impression received from the supervisors and managers was that workers were having difficulty identifying hazards, demonstrating critical thinking skills and adapting to new situations. This was an issue with both new and experienced workers. Explanations given for the apparent lack of problem solving skills include; novices not appreciating the importance of safety training and therefore not applying themselves to learning the information, older workers not willing to change their behaviours as they believe they already know how to perform a task, and ultimately the belief that ‘hands-on’ learning with the guidance of an expert is more effective.

As the mining industry needs workers who can solve problems and assess risks in high-pressured environments, there is a need for workers to develop problem solving skills to solve ill-defined or non-routine problems (Burke, Holman, et al., 2006). For effective far-transfer to occur (see section 3.4.3) workers need to understand the concepts underlying the problem, abstract the relevant principles and apply that knowledge to the
new situation (Stevenson, 1994). Although near-transfer is more likely to occur, far-transfer is possible if learners can see the similarities in the original learning domain and the situation in which the knowledge needs to be applied. Also learners need to see the relevance and therefore believe it is worth expending the effort to learn (Billett, 1996a). Learning experiences that are authentic and guided are an effective method for novices to gain the tacit knowledge of experienced workers so they can develop the procedural knowledge necessary to perform their roles (Billett, 2001). As Clark (1999) states, de-contextualized training can result in a high level of transfer failure.

Regulated training does not need to be a passive, de-contextualised, pedagogically limiting experience. Knowles’ (1980; 2005) principles of adult learning supports real-life, problem solving activities which are based upon learners experiences would help adults recognise the importance of learning the required information and help them relate the theory being learned to their past experiences. Further, problem solving activities which are narrative-based can be an effective means of promoting hazard awareness and critical thinking thus helping to reduce accidents and injuries (Cole, 1997). This is crucial in the mining industry as there appears to be not only an issue with workers learning and retaining the information contained in the online site safety induction program but also transferring that knowledge to the workplace, especially in non-routine situations. Moreover workers’ perspectives regarding the relevance and value of the training they receive can also have a dramatic impact on quality and frequency of worker involvement in the training (Colquitt, et al., 2000; DePasquale & Geller, 1999). Hence providing relevant and engaging materials that directly conveys the dangerous conditions, and the possibility of serious injury or death, may convince workers of the value of safety training and consequently increase learning outcomes and performance (Wilkins, 2011).

The interview findings also suggest that safety training was not valued by all workers. S3 expressed the view that some of the older, more experienced workers were ignoring safety rules and regulations. S1 echoed this sentiment as he believed that many experienced workers paid “lip service” to safety, and this influenced novices to the industry as they wanted to be accepted. Further M11 thought that some of the younger workers did not value safety training as they viewed themselves as competitive and believed they were invincible. An observation supported by W14 who commented on
the disregard some young males had for the speed limits at the mine sites, resulting in
dangerous behaviour to improve their production quotas. According to M11 only those
who had experienced or seen a serious accident really appreciated the dangers of
working on a mine site. This perception was supported by two worker interviewees,
who had witnessed accidents and consequently had more respect for the importance of
safety training.

The male dominated, competitive and high risk taking culture of the mining industry
(Billett & Somerville, 2004; Somerville, 2005) impacts on how the values of the
industry are expressed by individuals (Billett, 2001). Individuals are strongly
influenced by what they perceive to be the expected, or expedient, safe work practices
of the workplace. Hence where there is a perception by workers that production is more
important than safety, then the value placed on safety initiatives such as training
diminishes, and violations of processes and procedures are more likely to occur
(Reason, 1998). Further, workers are influenced by the social context that surrounds
them (such as shared norms and values) which consists of both formal practices and
informal learning from watching and imitating others (section 3.4.4). Informal learning
can have a profound and negative impact on tacit knowledge leading to
misinterpretation of information and incorrect decision making (Marsick & Watkins,
2001; Watkins & Marsick, 1992). It is also worth noting that the two most common
motivating factors in high risk industries are fear of injury and fear for one’s livelihood
(Wilkins, 2011). These constitute the two most basic levels of motivation described in
Maslow’s (1943) hierarchy of psychological and safety needs. As the importance of
safety training was heightened for participants who had witnessed the devastating
consequences of an accident, introducing aspects of transformational learning (see
section 3.3.2) could be beneficial in helping workers reflect upon their own attitudes to
safety and understanding the consequences of not learning and/or obeying safety rules
and regulations. Hence providing workers with the opportunity to review a serious
incident or accident that may have occurred on a mine site, analyse the information
pertaining to what happened and why it occurred, and participate in (or observe) a
discussion assessing the evidence (Mezirow, 2000) may help challenge some
participants’ current perspectives on safety training and encourage a willingness to
learn.
7.5 Conclusion

This chapter has discussed the quantitative and qualitative findings for workers in the mining industry who had completed an online site safety induction program. The interview findings have extended the survey outcomes to provide an in-depth characterisation of the phenomenon pertinent to this study. The key findings which have emerged in the areas of program support, program delivery and program design are summarised below.

In the area of program support, the findings suggest that sufficient technical assistance is provided to workers, as the minor issues that arose appeared to be resolved quickly by the Training Company staff. However some participants, particularly those with a combination of three or more of the following elements; poor literacy, limited computer skills, unfamiliar with online learning, aged 45 plus and/or over 10 years of mining experience, may benefit with more guidance from an instructor who is knowledgeable in the subject matter and the realities of working on a mine site. This would give workers the opportunity to ask questions and clarify information they did not understand.

In the domain of program delivery, the technology including program functionality appears appropriate for most workers with limited computer skills. However, identifying workers who have limited computer skills and/or are anxious about learning online and offering a greater level of support before they begin the program may help reduce the amount of apprehension and/or frustration experienced by these participants. A substantial proportion of participants appeared to be satisfied with the efficiency of the program, especially as they can complete a site safety induction program within 3 to 4 hours. Further, the multimedia, interface and usability elements of the online program seem, in general, suitable for most participants however more visuals, less text on screen and hierarchical hypertexts and maps to aid navigation may be helpful, particularly for the older and/or less computer literate workers.

In the area of program design there appears to be a number of areas for concern including a ‘one size fits all approach’, the level of learner control for some participants, the inclusion of incorrect, repetitive and irrelevant information, minimal opportunities for interaction and the absence of authentic problem solving activities. This may have impacted on some workers’ ability to understand and effectively transfer learning to the
workplace. It was alarming to discover that the supervisors and managers did not believe workers, both novices and experienced operators, could effectively transfer their online learning to the workplace, particularly in non-routine situations. Further, it is concerning that the majority of participants did not believe the online site safety program was a suitable way to learn safety. This suggests that substantial changes are required, specifically in the design of the program, to improve its learning and instructional effectiveness. These changes should include authentic, problem solving activities which are delivered in a variety of ways such as narratives and case studies to promote engagement and subsequent learning, particularly of complex information; the elimination of redundant information and ensuring that any additional explanations are not impacting negatively on experienced learners. This may help increase information retention and reduce feelings of cognitive overload. Further, separate programs for novices and experienced learners, and focus on job relevant and site specific information, as this may ensure true customisation of the program and increase participants’ motivation to learn.

The following concluding chapter of the thesis will further synthesise and discuss the key findings that have emerged in light of the central and specific research questions that guide this study.
8. **CONCLUSION**

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**8.1 Introduction**

Online site safety induction programs are becoming more popular in the mining industry as they are cost effective and convenient for mining companies. Workers do not need to be flown to remote mining sites and then be absent from work for up to a week to complete a traditional face-to-face safety induction program. The time and location of online training is more flexible, providing more convenience for both the worker and the company. However the quality, particularly the instructional effectiveness, of online site safety inductions varies from organisation to organisation. As the mining industry is dynamic, dangerous and constantly changing, mine workers need to understand and apply many complex operating and safety procedures (Kowalski-Trakofler, et al., 2004; Mine Safety Technology and Training Commission, 2006). Unfortunately, many training approaches are proprietary (Wirth & Sigurdsson, 2008) and few processes are in place to evaluate training programs (Mining Industry Skills Centre, 2007). Hence understanding the perspectives of mine workers completing an online site safety induction program will be of great assistance to mining companies and providers of training to ensure participants receive quality training. The potential exists for providing more efficient and effective training for workers if adult learning theories and design principles drive the design of the training programs, and learning outcomes are the primary focus rather than legislative compliance.

The aim of this study was to examine mine workers’ perspectives relating to the learning and design effectiveness of an online site safety induction program in the Australian mining industry. Chapter Two provided the background information needed to understand the mining industry and the emergence of online learning as an
instructional method. Chapter Three examined the appropriate learning and instructional design theories to provide a framework and help interpret the perspectives of participants regarding their experiences with an online site safety induction program. The case study research strategy (outlined in Chapter Four) chosen to examine workers’ perspectives of an online induction program provided both breadth and depth of understanding as the data was collected using two methods; a survey and face-to-face interviews. Chapter Seven discussed the findings of both the survey and interview phases of the study and placed them in the context of literature. This chapter summarises the purpose and importance of the research and the main research outcomes in terms of their overall significance in relation to the research questions. It also highlights some specific issues that emerged from the study, and suggests recommendations for practice. This chapter provides a set of guiding principles that will inform future policies and practices in the area of study, namely online learning for workers in the mining industry. Finally this chapter outlines the contribution to knowledge, limitations inherent in the study and suggests areas for further research.

An analysis of the context of the study, the mining industry, revealed a dearth of literature pertaining to competency based safety training and in particular no evidence of empirical studies examining workers’ perspectives of online site safety induction programs was discovered. An extensive review of the literature revealed a wide-range of learning theories and instructional design strategies with differing priorities and influences associated with learning, and the importance of incorporating learning and design principles in the development of effective online training programs in the workplace. From this literature review and context analysis, it was evident that there was a need for research to inform the gaps about the effectiveness of an online training program in the mining industry. The case study research approach was valuable in providing workers’ perspectives about factors influencing the effectiveness of an online site safety induction program. This study described and analysed the elements impacting on the perceived effectiveness of an online safety program (such as program support, program delivery and program design) in an industry that is potentially dangerous and often regards safety training approaches and processes as exclusive. The study has also provided a better understanding of workers’ experiences of an online site safety induction program, including what they valued and the obstacles or barriers to learning they encountered.
The research questions which shaped the study are presented in Table 7.1 and will be addressed below.

<table>
<thead>
<tr>
<th>Table 8.1 Research questions</th>
<th>Subsidiary Questions</th>
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</thead>
<tbody>
<tr>
<td><strong>Major Research Questions</strong></td>
<td><strong>Subsidiary Questions</strong></td>
</tr>
<tr>
<td>1. What are the perspectives of mine workers on the effectiveness of online site safety inductions in the Australian mining industry?</td>
<td>i) What are the perceived levels of satisfaction towards online learning among mine workers and managers?</td>
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<tr>
<td></td>
<td>ii) What factors do learners perceive may hinder their learning via computer based systems?</td>
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<tr>
<td></td>
<td>iii) What are the perceived levels of effectiveness of knowledge acquired via online training programs among mine workers and managers?</td>
</tr>
<tr>
<td>2. What instructional design strategies assist adult learners in the mining industry to engage with online OH&amp;S induction training?</td>
<td>iv) What instructional design strategies used in the online induction program do learners feel aided their learning?</td>
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</table>

**8.2 Main Outcomes and Recommendations**

The study achieved its aims which were to investigate participants’ perspectives of the learning and instructional design effectiveness of an online site safety induction program.

**8.2.1 RQ1: Perceived Effectiveness of the Online Program**

In regards to the first question, ‘What are the perspectives of mine workers on the effectiveness of online safety programs?’, the findings indicate that the online site safety induction program maybe efficient but not always effective with regards to learning. In general, participants were satisfied with the technology and delivery aspects of the online program. All participants had access to a computer, and the program functionality was reliable and appropriate to all levels of computer skills. Few encountered problems with the technology and when it did occur, participants were generally satisfied with the timeliness and actions taken to resolve any issues. This is a positive outcome and it is important that the Training Company monitors and maintains this level of technical support. A large proportion of workers felt the self-paced nature of the program was efficient and as it allowed participants to complete the training at their own pace with few distractions and interruptions by others. However the interviews revealed some participants experienced anxiety when completing the online program, possibly due to a combination of factors including lack of computer skills, lower levels of literacy and not knowing what to expect as they were unfamiliar with
learning online. Hence identifying these workers prior to the program and offering more support in the form of a short computer orientation and/or introductory program; including basic computer skills, why they are using a computer to learn, how the program is structured and what to expect before they start the induction, may help alleviate some concerns. Helping participants after they have become anxious or frustrated is more difficult, especially if workers have a low sense of self-efficacy to learn via this medium.

Participants were generally positive regarding the multimedia, the interface and usability elements of the program with the majority indicating they were comfortable using the program. However some participants, particularly younger workers, felt there was too much text, and a proportion of older, longer serving workers had difficulty finding important information. Recommendations for improvement would be to increase the amount of visuals compared to text and ensure the navigational prompts are more structured and include simple hierarchical maps. Further, identifying and reducing possible instances of the modality effect (too many elements being processed in visual or verbal working memory) will help ensure participants do not experience cognitive overload.

The findings also reveal that participants encountered a number of barriers or issues whilst completing the online program which may have impacted on their learning. A lack of guidance, interaction and feedback were major barriers for some participants, especially workers who may not be familiar or comfortable with self-directed learning. Non-professional workers (tradespeople, semi-skilled workers and unskilled labourers) tend to prefer a socio-cultural environment where the trainer provides guidance and feedback and colleagues the necessary tacit as well as explicit knowledge (Smith, 2001; Smith, 2003) to understand the real situation at a mine site. Providing a trainer may seem the obvious recommendation, however this may not be the most popular solution for a number of reasons. Mining companies may not favour an increase in costs with a corresponding reduction in levels of efficiency with no guarantees that improved learning will result, especially if some workers revert back to being passive learners who expect to be spoon fed. A solution would be to identify participants requiring more urgent learning support (such as workers with a combination of three or more of the following issues; poor literacy, lack of computer skills, unfamiliar with online
learning, aged 45+ and/or 10+ years of mining experience) prior to attending training, allowing companies to put into place appropriate processes to ensure workers receive a higher level of support. This could include; attending the proposed introductory/orientation program, monitoring their progress, allowing only one site induction a day, assessing their knowledge on site and providing ongoing training. Moreover, a variety of facilities both simple and sophisticated can be incorporated into the design of the program to provide learning support. For example a site which workers can refer to if they need a definition of a word or an explanation of a concept (similar to a FAQ’s facility), to more advanced help in the form of feedback, (an explanation of why their answer was incorrect rather than just referring them back to the pertinent information). However, providing an experienced facilitator who understands the content, culture and mine site environment may still be the best option for some mining organisations. More support is necessary, how it is provided will depend on the amount of time, money and resources companies are willing to invest.

Providing current and accurate information is vital, especially in such dangerous working environments. Unfortunately, this was a major issue for some mine sites as the information in the training program did not always reflect practices in the workplace. Processes and procedures are constantly changing at sites and a method of cross referencing information such as job tasks and standard operating procedures (SOPs) at the mines with the content in the online induction is vital to ensure that all the information is consistent, accurate, current and relevant. At present, this would require a significant improvement to the existing system of identifying and communicating any changes occurring at mining sites to the Training Company by some mining companies. A recommendation which may help with this problem would be the appointment of a dedicated representative at the mine site to liaise with the Training Company to ensure any changes in policy and procedures are communicated swiftly.

Other factors which were identified as potential barriers to workers’ learning were mainly related to the design aspects of the program and will thus be addressed when answering the second research question.

Although the overwhelming perception by workers was very positive regarding their acquisition of knowledge and application of learning to the workplace, observations by managers and supervisors paints a negative picture. Further, the survey findings
Conclusion

indicate that the majority of participants did not think the online program was a suitable way to learn safety. Compliance, rather than learning appears to be the primary focus of the program. Participants were required to pass all the tests, thus satisfying regulatory requirements, however it was acknowledged by the Managing Director of the Training Company and participants that guessing was not uncommon amongst workers, and it does not appear to be monitored or controlled. The nature, amount and perceived relevance of the content (especially for participants completing more than one induction) prompted many workers to ‘run on automatic or switch off’. This concern was not actively addressed by the Training Company as it was presumed that workers’ knowledge and understanding of the information would be assessed on site. However this did not always occur. Hence workers, both novice and experienced, could complete the online induction program without having to learn the information (in the worst case scenario workers could go straight to the assessments and guess until they achieved the correct answer) and were allowed to work on site without demonstrating understanding. This situation needs to be addressed as the purpose of a site safety induction is to familiarise workers with the processes, procedures and hazards of a particular site prior to working at that mine site. Improved instructional and evaluation techniques are required to optimise learning (discussed later), however it is also recommended that the induction process should include some form of follow-up training to ensure workers can understand and apply the information effectively in the workplace. As stated by a manager, the “sheep dip” approach to training does not support the construction of knowledge especially as all workers complete the same induction, have limited, if any, opportunity to digest and reflect on their learning and there is little or no follow-up or further training.

In this online induction program it appears participants were only encouraged to use lower level processes such as memorisation, so it is unreasonable to expect them to demonstrate higher order processes, such as analysing complex problems and developing solutions (Biggs, 1991a; McAlpine & Clements, 2001). The rudimentary assessment tasks such as true/false, yes/no, drag and drop, and multiple choice, are suitable for simple, straightforward tasks which have well-defined behavioural outcomes (Hoffmann, 1999). This was appreciated by a variety of participants such as novices to the industry, those new to online learning and experienced workers who valued efficiency as it was easy and very predictable. However, as discussed, the
mining industry requires workers to be able to identify potential hazards and use analytical and decision making skills to proactively prevent accidents and injuries (Burke, Holman, et al., 2006). Workers need to develop the procedural and metacognitive skills necessary to enhance transfer of knowledge to the workplace, especially in complex or non-routine situations. The online induction program should include activities which are contextualised and varied to enhance recognition and generalisation of knowledge to new contexts (Eraut, 2004; Stevenson, 2002), integrate theory with practical knowledge and experience (Peters, et al., 2010) and provide continuous quality feedback on performance (Loos & Diether, 2001). The diverse backgrounds of workers in the mining industry including age, level of prior knowledge, cognitive ability, computer skills and familiarity with online learning needs to be considered when developing an online site safety induction program. Focusing on the technical aspects and participants with lower levels of cognitive ability has led to a gap in providing quality instruction for all workers. Hence it is recommended that designers of safety training programs have a sound understanding of learning theories and associated instructional design principles to ensure the instructional techniques implemented are effective in promoting learning and transfer of knowledge to the workplace for all participants (Williams, 2002). Efficiency and productivity is important, and must be considered, but it should not be at the expense of learning and safety.

8.2.2 RQ2: Perceived Effectiveness of the Instructional Design Strategies

In answer to the second research question, ‘What instructional design strategies assist adult learners in the mining industry to engage with online OH&S induction training?’, the findings suggest that workers were generally satisfied with the self-paced nature of the program as it was considered quick and easy to complete, however the design strategies used in the online induction program were limited in their effectiveness for engaging workers to learn safety. As discussed, the Managing Director revealed that no adult learning theories were consciously adopted to underpin the instructional design strategies used in the development of the program: its design was based on his wide experiences as a trainer. Further, the program was aimed at the “lowest common denominator”. Hence the audience, the type of material (a lot of processes and procedures) and the competency based approach influenced the design of the program.
On the surface the systems based approach, (which involves sequencing, chunking, and simplifying the content, creating a linear path for participants to follow, and culminating in a basic assessment) appears suitable, particularly for novices and older workers with limited computer skills. These design strategies were highlighted by some participants as aiding their learning. Participants also liked the multimedia elements and the high degree of learner control. The systems approach increased the efficiency of the program for the majority of participants and was manageable for novices and workers with low levels of computer skills.

However, for some, this very feature was frustrating as it was perceived as too prescriptive and simple. Participants did have the ability to control their learning, as they could decide what content to focus on and for how long, thus improving efficiency (which most participants valued) and in theory, tailoring the learning to their needs. However, allowing all learners a high degree of control was a double edged sword as it may have been effective for some, but was not helpful to learning for others. For example, novices could, and did, skim through the training materials. Likewise, longer serving workers, who felt there was nothing new to learn and/or the training material was not relevant to their job role and therefore not important, often ignored the content. Not surprisingly, some participants had difficulty understanding and/or retaining important information. Using a surface approach, especially by lower-ability learners with complex training material, may have resulted in some participants not only missing and/or not paying the necessary attention to important content but also absorbing and retaining less information (Sitzmann, 2009). Participants valued the power to control their learning as it not only increased efficiency, especially for those completing multiple inductions, but also helped circumvent the overwhelming amounts of repetitious and irrelevant training material contained in the program. Hence control became a means of avoiding content rather than providing the capacity to identify and focus on important information. The degree of learner control should be carefully considered. If certain recommendations to the online program are implemented (see below) which eliminate repetitious and perceived irrelevant information and is customised to participants’ level of experience, then less learner control, such as going straight to the assessments, should be allowed to novices and workers who are identified as requiring more support in the learning process.

As mentioned briefly, a significant issue raised by participants in the interviews was a
high degree of repetitious information included in the online program, especially for workers completing more than one induction. Also causing frustration was the perception of large amounts of irrelevant or unnecessary material. Experienced workers in particular believed that too much generic safety information was included in the program and not enough job relevant and/or site specific material. This issue also resulted in some participants having a feeling of information overload. The Managing Director’s decision to make the training program as generic as possible to help minimise cost and reduce the need for changes appears to be a false economy when it comes to learning. Workers are requesting more job relevant and site specific content in the online induction as this is the information that is perceived as most useful for working on a mine site. This is even more imperative for workers completing more than one site safety induction program, as the large quantities of repetitive and perceived unnecessary content is not only impacting negatively on motivation and engagement but also their ability to identify and focus on important information and subsequently apply their knowledge in the workplace. Hence, a recommendation would be to not only map the competencies of the Generic Induction against the content contained in the site safety induction to identify any areas of overlap but also ensure that workers receive the information relevant to their job role and not unrelated tasks. Depending on legislation and safety concerns, any unnecessary information in the online site safety induction program, such as duplicated processes and procedures, and unrelated job roles/tasks, could be removed and more site specific content included. Another recommendation would be to limit the amount of site safety inductions workers can complete on one day. Even with the elimination of repetitious and unnecessary information, participants may continue to miss critical content in the belief there is nothing new to learn and/or efficiency is more important than learning.

Experienced workers believed they should be recognised for their prior learning and this is supported in the Queensland Coal Mining Safety and Health Regulations (2001) which states that workers’ current competencies and prior knowledge should be considered when developing training. Further, novices would benefit from an induction program which suits their needs for more interaction and guided learning. Designers of training in industry should adopt different instructional approaches depending on the background of the learner and the type of performance required. Knowing the learning theory behind different instructional strategies gives the developer more power to
deploy these methods more effectively (Clark, 1999). For example, using design principles from cognitive load theory would ensure experienced workers would not suffer cognitive overload due to the expertise reversal effect by removing information that is considered redundant whereas this information may be necessary for novices and thus retained. According to Kalyuga and colleagues (2003) the most important implication to consider regarding the expertise effect is that instructional methods should be customised to the level of experience of the intended learners. Also incorporating aspects from other learning theories, particularly Knowles’ (1980; 2005) principles of adult learning, but also aspects of constructivism, and workplace learning theories (including, Bandura’s (1976) social cognitive theory and cognitive learning in the workplace) would be helpful, as the findings revealed that participants would like the program to be more interactive, guided, and include real-life scenarios. To be truly customised, online programs need to offer more than high learner control and 24/7 access, but should also account for contextual variables such as the learning needs of individuals and the characteristics of the learning environment (Servage, 2005). Hence the recommendation for separate programs for experienced and novice workers to ensure that the online program is suited to participants’ differing levels of knowledge, job responsibility, and abilities. It is important that all participants meet the competency standards of the Australian mining industry however it must also be purposely designed to meet the needs of experienced and novice learners (Newton, et al., 2002).

The suggestion by experienced workers was to just complete an assessment. However, as mentioned previously, the findings indicate that not only are novices having difficulty understanding and transferring their knowledge to the workplace but longer serving workers are also making mistakes and not always demonstrating knowledge of routine tasks let alone new and/or complex situations. For experienced workers a recommendation would be to develop a shorter, more targeted online training program which engages the learner by using more interactive and interesting activities and appropriate assessments (such as scenarios) to construct and test knowledge acquisition. Suggested activities include; working on authentic scenarios or case studies which mirror the complexity of real-life problem-solving situations so learners can apply their knowledge effectively in the real world (Collins, et al., 1989). These activities do not need to be highly technical or expensive such as simulations, but should effectively convey complex information. Stories are also an integral part of mining culture. They
not only provide important information about the workplace, and instruct new comers into the culture and values of the mining industry (Cullen, 2003), but also connect learners to the experiences of others without having to go through the experience themselves (Bruner, 2005; Jonassen & Hernandez-Serrano, 2002). Listening to narratives about deaths, disasters and near misses by expert and highly regarded mine workers (Cullen, 2003) may also help in transformational learning by challenging existing belief systems and culturally expected behaviours in favour of new ones (Cranton, 2002). Other elements which would help improve the online program would be observing and listening to role models, and incorporating learning from errors and situations which don’t go to plan to help prevent routinization (Burke, Holman, et al., 2006; Burke & Sarpy, 2003). These changes will not only support a deeper approach to learning but will also help workers to develop the metacognitive skills such as self-monitoring, necessary to promote far transfer of learning to the workplace. Moreover, research has shown that well designed training programs can enhance the metacognitive skills of novice and ineffective learners (Gott, 1995; Munby, et al., 2003). For novices, the recommendation would be to retain the structure of the systems based approach as workers new to the industry were comfortable with the simple, linear design. There was little demand on short-term memory as the information was organised into small pieces (Driscoll, 2000) and the instructional goals were clear and consistent (Ritchie & Hoffman, 1997). However, similar to more experienced workers, the online program should also incorporate authentic activities including real-life scenarios, problem-solving and case study activities. This also applies to the assessments. Instead of providing basic test items, where participants can easily guess the answer, workers should be required to problem solve and reflect on their learning; such as being able to identify authentic hazards in the workplace and provide viable and safe solutions.

The online site safety induction program should be dynamic, customised to the learner’s level of prior knowledge and where possible be flexible to learners’ preferences for experiencing the content. Designing the online program to include characteristics of the appropriate learning theories, such as principles of adult learning, ensures that the instructional event is sequenced in such a way that learners do not experience cognitive overload, that they have opportunities for engaging in authentic activities, that the content is professionally relevant and that motivational elements exist (such as stories and case studies) to focus learner attention.
8.3 Guiding Principles

The following set of guiding principles, have emerged from the study, and will provide valuable information for the development of online learning programs in industries similar to mining and in particular those that have the following characteristics; mandatory safety induction training, a high percentage of non-professional employees (such as tradespeople, semi-skilled workers and unskilled labourers), a high proportion of males, and workers with limited computers skills and/or unfamiliar with learning online. The guiding principles have also led to the development of a succinct framework for online site safety induction programs which can be utilised by all parties involved in developing and/or delivering such programs. The guiding principles and framework have been informed by adult learning theories, particularly the principles of adult learning as well as workplace learning theories.

The guiding principles developed include standard interface design principles which are relevant to most online learning programs and principles which are pertinent to the mining industry. Adult learning theory, particularly principles of adult learning have helped shape the guiding principles and practical suggestions which are presented in the following tables. They are grouped into three areas; the learner, the learning program and the implementation. Table 8.2 outlines the guiding principles and practical suggestions which would contribute to successful learning outcomes for learners.

<table>
<thead>
<tr>
<th>Guiding Principles</th>
<th>Practical Suggestions</th>
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</thead>
<tbody>
<tr>
<td>1. The learner has a basic level of computer competency before commencing the online program.</td>
<td>A short introductory computer course should be completed by learners who have limited computer skills prior to undertaking training.</td>
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<tr>
<td>2. The learner has a clear understanding of what to expect in an online learning program.</td>
<td>Learners need to know what is involved in an online induction program, including the program’s purpose, what information will be covered, how long it may take and how it is structured.</td>
</tr>
<tr>
<td>3. The learner is capable of successfully completing the program independently.</td>
<td>Learners who have a combination of three or more of the following: limited computer skills, low level of literacy, unfamiliar with online learning, 45+ years of age and/or 10+ years of mining experience should be identified and, where necessary, provided extra learning support.</td>
</tr>
<tr>
<td>4. The learner is actively engaged.</td>
<td>Activities which are practical, interactive and relevant will help motivate learners. Where possible, learning outcomes should relate to real-life experiences and integrate theory with practical knowledge.</td>
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</tbody>
</table>
5. The learner experiences authentic problem-based learning as well as knowledge-based learning. 

Practical Suggestions: Authentic problem-based learning involves higher order thinking skills such as analytical and decision making skills, while knowledge-based learning involves recall and comprehension.

6. The learner has opportunities to observe and listen to more experienced and respected practitioners.

Practical Suggestions: Learning experiences which support mentoring and modelling are effective for gaining tacit knowledge and understanding the relevance and importance of theoretical information.

7. The learner experiences guidance in the form of quality feedback on performance.

Practical Suggestions: Feedback to learners must be informative and ongoing to provide guidance on learning performance.

Table 8.3 presents the guiding principles and practical suggestions which contribute to the successful development of a learning program.

### Table 8.3 Guiding principles and practical suggestions (for the learning program)

<table>
<thead>
<tr>
<th>Guiding Principles</th>
<th>Practical Suggestions</th>
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<tr>
<td>1. The learning program has a higher proportion of visual and audio media compared to text-based information.</td>
<td>Selection of media depends on the nature of the content, learning goals, functionality of the technology and the learning styles of individuals. Where there is a high proportion of males and older workers, the inclusion of more visual media and audio narration is warranted.</td>
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<tr>
<td>2. The learning program is easy to navigate</td>
<td>The navigational aides should be simple, consistent, clearly identified and use visual clues and hierarchical maps to help reduce disorientation for novices.</td>
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<tr>
<td>3. The learning program provides the appropriate level of learner-control</td>
<td>Online learning designs must consider the context and characteristics of the learners when determining the degree of flexibility and self-direction provided to learners.</td>
</tr>
<tr>
<td>4. The learning program is customised to suit both novice and experienced learners.</td>
<td>Online learning designs must consider the level of experience and prior knowledge of learners and use appropriate instructional strategies and technologies to facilitate learning.</td>
</tr>
<tr>
<td>5. The learning program should actively support transformative learning.</td>
<td>Online learning designs must engender changes in perceptions and behaviours to ensure safe work practices. Stories, especially delivered by respected mentors may increase acceptance and subsequent transformation of existing frames of reference.</td>
</tr>
<tr>
<td>6. The designer understands and can effectively apply relevant learning theories and instructional design principles to the learning program.</td>
<td>The instructional approaches adopted should vary depending on learner characteristics, the specific context, the type of performance required and the nature of the content.</td>
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</table>
Table 8.4 presents the guiding principles and practical suggestions which support the implementation of the program.

<table>
<thead>
<tr>
<th>Guiding Principles</th>
<th>Practical Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The appropriate technical requirements are established and maintained</td>
<td>The technology, including functionality of the program, must be reliable and appropriate to learners with diverse levels of computer skills and knowledge.</td>
</tr>
<tr>
<td>2. Quality technical support is provided</td>
<td>Technical support is available to support learners in the use of the technology and to ensure technical issues are quickly identified and resolved.</td>
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### 8.3.1 Implications for Theory

Using existing theories (such as principles of adult learning and workplace learning theories), this thesis generated a framework which would contribute to a better understanding of the factors influencing the development, implementation and evaluation of effective online site safety induction programs in the mining industry. The framework outlines eight key areas which should be considered, in conjunction with the guiding principles, when developing online site safety training programs:

**Marketing and Promotions** – Provide a course fact sheet to participants prior to training which includes a short introductory computer course for some potential participants; limit the amount of induction programs which can be completed on one day by participants, depending on experience, level of computer skills and familiarity with online learning. For example, only one induction to be completed by novices and/or workers with basic computer skills and unaccustomed with online learning, and no more than three inductions for experienced, computer literate workers who are conversant with online learning.

**Training Needs Analysis (TNA)** – Conduct an analysis to discover participants’ work experience (novice to expert). Include an analysis of context, content, job tasks and characteristics of participants (flexibility, self-direction, RCC and RPL); pace, place and time; preferred learning strategies, assessment methods and tools; and participant support services (particularly for industry expert with limited computer skills and online learning experience).

**Instructional Design Model (IDM)** – Include authentic and relevant knowledge (content map with navigation using ID icons/cues and hierarchical maps, customised
content using limited text with important hypertext information, images, audio-video); shape attitudes (authentic problem-solving case studies and scenario planning); and skill development (immediate constructive feedback), learning and assessment activities (online knowledge – true/false, yes/no, drag & drop, multiple choice and **short answers**; attitudes – **case studies and scenarios**; skills – **performance checklists in the workplace**); and providing experienced mentors within the workplace post-program to ensure knowledge/skills and attitudes are practiced safely in the high risk and hostile environment.

**Content** – Limit cognitive load by eliminating irrelevant and repetitive material, and providing just enough contextualised content (compliance, safety and risk) with hypertext for important information.

**Interaction** – Stimulate participant engagement by incorporating a high degree of participant control with various information and communication technologies (reflective discussions from experts regarding their experiences).

**Program Evaluation** – Use a combination of approaches including participant engagement, employee and employer satisfaction surveys, workshops and exit interviews.

**Support Services**– Provide ongoing guidance and learning support via a trainer during completion of the program and follow-up in the field via a mentor. Ensure prompt technological support via office staff and specialised learner support (for literacy issues, personal problems, disabilities) where appropriate.

**Staff** – Professional staff such as an experienced trainer/assessor for the online safety induction program. Administrative staff to ensure a point of contact, prompt responses to participants’ non-training related requests.

The development of this framework addresses the dearth of available substantive frameworks identified in the literature pertaining to the online learning of safety by adults in hazardous workplaces. The framework is firmly grounded in the mine workers perspectives and so it is relevant to that context.
8.3.2 Implications for Practice

Primarily, this study highlights the need to understand learning theories and instructional design principles when developing online learning programs. Further, the study revealed the need for the mining organisations and program designers to liaise closely with each other to not only ensure accurate and current training material but also to determine if the learning outcomes were being transferred to the workplace. The design of the online program needs to provide the necessary support strategies for workers’ reading and computer levels of literacy. However, the program’s focus on efficiency and the less able learners created a learning environment which did not align with the majority of learners’ needs and experiences. The mining regulation supports training which is tailored to workers’ prior knowledge and competencies. An understanding and provision of customised training will assist in developing effective learning opportunities for both novice and experienced workers.

A focus on legislative compliance also impacted on the effectiveness of the online program. Providing only knowledge-based learning and relying on basic, summative assessments may have covered the minimal standard identified by the regulation, but failed to achieve the learning necessary for successful application of knowledge in the workplace. Balancing the training priorities outlined in the regulation with the diversity of learners’ needs and experience is essential for providing effective training. Workers were motivated to complete the online induction program so they could work at the mine sites, although few were engaged and/or challenged to learn. Online programs need to be dynamic and relevant to engage a diverse workforce. Including activities which are authentic, and mirror real-life problem-solving situations will not only engage workers but also encourage the development of higher order thinking skills such as analysis and decision making necessary for transfer of learning in a dangerous and complex environment. Conversely, it may also decrease efficiency as more thought and effort would be required from workers. The pressure to finish quickly, whether it be internally and/or externally driven, would need to be addressed as workers are strongly influenced by what they perceive to be the expected, or expedient, safe work practices of the mine site. According to Reason (1998), if workers perceive production is more important than safety, then the value placed on safety measures such as training diminishes.
The findings revealed areas for improvement in the development of the online site safety program which were the direct responsibility of the mine sites (as they had outsourced their site safety induction training), and several recommendations for ways of addressing these issues have been suggested. In summary, the major needs are identified as follows:

- Communicating promptly any changes in policies and procedures at the mine site to the designers of training to ensure the accuracy and currency of information.

- Requiring more site specific and job relevant content to be included in the training material.

- Identifying and providing appropriate learning support for workers who have difficulty with independent/self-paced learning.

- Limiting the amount of inductions workers can complete in one day to minimise boredom and fatigue.

- Providing ongoing training and assessment post induction to ensure understanding and application of knowledge in the workplace.

It is acknowledged that the participating mining organisations will need to make their own determinations of what is considered important and desirable, and how it will be implemented, based on legislation and their own business and safety agendas.

### 8.4 Contributions to Knowledge

The aim of this study was to interpret the perspectives of participants and communicate their views on the effectiveness of an online site safety induction program. Participants’ perspectives were valuable in identifying the gaps which impacted on understanding and transfer of learning to the workplace. In achieving this aim, the study has generated a number of guiding principles and a model which will assist in the development, implementation and evaluation of online learning programs in the mining, and similar, industries.

One of the most crucial findings of this study revealed the importance of understanding
learning theories and instructional design principles and applying them appropriately to an online learning environment. An absence of this knowledge can result in online learning programs which are limited in learning and teaching effectiveness. On the surface, the systems approach to design appeared suitable due to the context, nature of the content and learning objectives, however as the findings indicated it was not always effective as participants were not successfully applying their learning to the workplace. As Noone (1993) states if learners are not able to perform their jobs successfully, the instructional design is inadequate. Thus knowing the theory behind the different instructional strategies gives the designer more power to deploy different methods more effectively (Clark, 1999). For example, Knowles’ andragogical model outlines characteristics of adult learners which should be considered when designing instruction. An examination of participants’ experiences of the online program highlighted the absence or minimal regard for all six of Knowles’ assumptions. Nor were the concepts or elements of workplace and transformational learning used to inform and guide instructional decisions. The mining industry has a strong oral tradition where stories are the preferred method to convey important information and influence behaviour change. This needs to be incorporated in online training courses. Also, mine workers tend to be more practical and are used to learning in more hands on situations with the guidance of a mentor. Hence the need for less theoretical information or knowledge-based learning, particularly with older and longer serving members who believe they know the information and/or have trouble understanding theoretical concepts. Providing workers with the opportunity to observe and listen to respected role models will not only convey why certain information is relevant and important but also provide a safe and more familiar context to learn.

Satisfaction with the online learning experience and subsequent successful learning outcomes can be associated with a number of factors including learner support, interaction, control, technology and course design (Burke & Huchins, 2007; Granger & Levine, 2010; Gunawardena, et al., 2010; Puzziferro, 2008). The online site safety program focused on two elements, technology and learner control. The lack of learner support, meaningful interaction and appropriate course design may have not only impacted on learning but also contributed to participants’ belief that the online site safety induction was not a good way to learn safety. Moreover, the need to understand the target audience and customise training to suit workers with varying levels of
experience and ability was highlighted. The high proportion of participants who exercised a high degree of learner-control to avoid material which was considered repetitive, generic and unnecessary suggests that important information was being missed and/or not understood and the quality of design/instruction was lacking. Providing a ‘one size fits all’ program which was aimed at the ‘lowest common denominator’ not only negatively impacted on the development of higher order thinking skills necessary in the mining industry but also contributed to the surface approach to learning utilised by most workers. Including educational learning experiences that incorporate more engaging and interactive elements (such as narratives, case studies and real-life scenarios) not only promotes learning but also channels the competitive and practical nature of mine workers. The mine sites should have in place the processes to assess and reinforce learning where necessary, however workers should be expected to have achieved a certain level of knowledge and understanding at the completion of the induction program. Hence the need for both the mining companies, and the designers and providers of online programs (if they are separate organisations) to continually monitor and measure the impacts of training to ensure its effectiveness.

### 8.5 Limitations of the Study

This study added insights into participants’ experiences of an online site safety induction program by using a case study approach. Both breadth and depth of understanding was achieved by way of a survey and interviews. However this research has limitations which must be acknowledged when interpreting the reported results. It is also important to ensure that readers appreciate the boundaries of this study. The focus of this study was on the participants’ perspectives of an online site safety induction program and what factors they believe influenced the effectiveness or not of the program. It is also important to reinforce that no connection is being inferred from individual experiences to organisational effectiveness, efficiency or safety.

Section 4.7 outlined a number of limitations inherent in the study and will be summarised in three categories: research design, research participants, and research outcomes. Firstly it is recognised that the use of self-reporting carries with it limitations in terms of bias and socially acceptable responses. In particular, if an individual’s perceptions do not match their behaviour, this would not be identified as observation of actual behaviour was not performed. This limitation was somewhat mitigated by
interviewing key informants (managers and supervisors) regarding their observations of participants’ behaviours.

The design of using a single case study is also a recognised limitation of the study because results do not allow for comparisons between online site safety programs of different design and delivery approaches. It is also recognised that the sample size in the quantitative phase of this study was not large. The sample size of 83 participants may have diminished the ability to find significant associations and generalizability of the findings is not claimed. A replication on a larger sample with multiple cases is desirable but may be difficult to achieve given the difficulties of recruiting samples due to the reticence of mining organisations to share information relating to safety processes and practices and the remote and geographically scattered population.

The conduct of the study and the research participants themselves also represented a number of limitations. It is firstly acknowledged that with any study, the researcher brings biases and prior experience that may impact upon the research outcomes. The researcher in this case was female and not familiar with the industry, therefore needed to establish a level of credibility with the participants. This brings both benefits and drawbacks. The researcher had little pre-existing knowledge regarding the nature and content of the program and was open to all concepts being discussed however it also meant that some participants may have been less forthcoming to a female and outsider.

It is also acknowledged that within the mining industry the gender mix is biased towards a heavy representation of males. It is therefore noted that generalising to industries with a large female population is not appropriate.

### 8.6 Implications for Further Research

The dearth of literature that focuses on workers’ perspectives of competency based online learning programs (Cheng, et al., 2011), and whether online learning can enhance safety training effectiveness (Burke, Sarpy, et al., 2006; Douglas & Oosthuizen, 2010; Wilkins, 2011) establishes the need for future research. The dynamic and dangerous nature of the mining industry reinforces and intensifies this need, if mining organisations are going to ensure the safety of workers.

This study indicated the need for understanding and utilising a range of instructional
techniques was critical to ensure an effective learning experience for a diverse range of learners. The study also identified the need to take a socio-cultural perspective to identify, examine and incorporate learning theories and instructional principles which are suitable to the audience and learning context, workers in the mining industry. Longitudinal studies measuring perspectives and behaviours before and after online safety training would enable better understanding of what learning and instructional approaches are more effective. Research comparing different online induction programs at different mine sites and/or organisations would also be valuable as few studies have methodically evaluated and compared the various training content and approaches, particularly in the mining industry. As the designer of the online training program had no formal qualifications or understanding of instructional design strategies it would be interesting to examine an online program which was developed by a qualified designer. Further research will also indicate the relevance of the guiding principles in other mining organisation or workplaces with similar training contexts. For example, the vast majority of research on transformative learning has been within formal, educational settings. There is a need to explore other contexts such as workplaces where the learning situation is more open to external influences (Taylor, 2007).

8.7 Concluding Remarks

This study set out to address the identified gaps in the literature and contribute to current knowledge and understanding of participants’ perspectives of the effectiveness of an online site safety induction program in the mining industry. The study’s findings have addressed, to some extent, the paucity of information in the literature about safety training approaches and processes and helped to establish a better understanding of these experiences by identifying factors which were not only valued by participants but also the obstacles and barriers to successful learning. In particular, the findings identified design issues as a key factor influencing the perceived effectiveness of an online induction program.

This study highlights that there are many advantages offered by online learning to meet the needs of stakeholders in large and geographically disperse organisations, however, unless the needs of a diversity of learners are identified and supported, the goal of safety may be compromised. The perspectives of workers were important in establishing areas
of need and subsequent steps companies and designers of online training can take to improve the effectiveness of online safety training programs. Hence, providing a well-researched study and analysis of workers’ perspectives of an online site safety induction program facilitates the development of relevant and useful knowledge for practitioners and researchers.
9. REFERENCES


References

Allen & Unwin.


References


References


References


Strother, J. (2002). An assessment of the effectiveness of e-learning in corporate training programs. *International Review of Research in Open and Distance Learning, 3*(1), 1-17.


References


Appendix A: Mezirow’s Transformational Process

According to Mezirow the transformational process is made up of ten phases:

1. A disorienting dilemma
2. Self-examination with feelings of guilt or shame
3. A critical assessment of epistemic, sociocultural, or psychic assumptions
4. Recognition that one’s disconnect and the process of transformation are shared and that others have negotiated a similar change
5. Exploration of options for new roles, relationships, and actions
6. Planning of a course of action
7. Acquisition of knowledge and skills for implementing one’s plans
8. Provisional trying of new roles
9. Building of competence and self-confidence in new roles and relationships; and
10. A reintegration into one’s life on the basis of conditions dictated by one’s new perspective (Mezirow, 2000; p. 45).
Appendix B: Gagne’s Taxonomy of Learning & Bloom’s Cognitive Taxonomy

Gagne classified his learning outcomes or domains of learning, into five taxonomies. These represent the variety of capabilities or outcomes that are possible as a result of the learning process. Thus when designing instruction, the first step is to conduct a goal analysis to categorise the goal into one of the following domains of learning:

<table>
<thead>
<tr>
<th>Taxonomy</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Information</td>
<td>Declarative knowledge; facts, concepts, principles or procedures</td>
</tr>
<tr>
<td>Intellectual Skills</td>
<td>Procedural knowledge that requires prior learning of simpler component skills:</td>
</tr>
<tr>
<td></td>
<td>- Discrimination</td>
</tr>
<tr>
<td></td>
<td>- Concrete concepts</td>
</tr>
<tr>
<td></td>
<td>- Defined concepts</td>
</tr>
<tr>
<td></td>
<td>- Rule</td>
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<tr>
<td></td>
<td>- Higher order rules; problem solving; more than one rule</td>
</tr>
<tr>
<td>Cognitive Strategies</td>
<td>Unique, effective, creative strategies; seeing problems in new and insightful ways; finding solutions to what others did not see as a problem</td>
</tr>
<tr>
<td>Attitudes</td>
<td>Experiences of success following the choice of a personal action</td>
</tr>
<tr>
<td>Psychomotor Skills</td>
<td>Single fluid motion vs. complex procedures; cognitive skills involved; non trivial psychomotor skills</td>
</tr>
</tbody>
</table>

(Gagne, 1985)

Bloom’s Cognitive Taxonomy

The cognitive domain involves knowledge and the development of intellectual skills. There are six major categories, which are listed in order below, starting from the simplest behaviour to the most complex. The first category must be mastered before the next one can take place.

<table>
<thead>
<tr>
<th>Taxonomy</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Recall of data</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Understand the meaning, translation and interpretation of instructions and problems. State a problem in one’s own words</td>
</tr>
<tr>
<td>Application</td>
<td>Use a concept in a new situation or unprompted use of an abstraction.</td>
</tr>
<tr>
<td>Analysis</td>
<td>Separates material or concepts into component parts so that its organisational structure may be understood. Distinguishes between facts and inferences.</td>
</tr>
<tr>
<td>Synthesis</td>
<td>Builds a structure or pattern form diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Make judgements about the value of ideas or materials</td>
</tr>
</tbody>
</table>

(Bloom et al., 1956)
Appendix C: Introductory Letter

Dear Sir/Madam

Thank you for your interest in participating in this research project. The project is entitled “Enhancing OH&S induction courses with web-based learning systems: Implications for training mining workers” The chief investigator is Rebecca Kidd who will be working in conjunction with Dr. Kathy Lynch and Dr. Anne Roiko.

The aim of the project will be to investigate whether skills and knowledge acquired via online learning are easily transferred to the workplace and have a positive impact on safety performance. The project will also gather valuable information regarding the attitude of mine workers toward learning via a new and highly technological medium and highlight any barriers which might impede their learning. By identifying areas which need improvement or modification, your company will be able to create the optimum learning environment for your employees.

To complete the project we are proposing to use a survey to collect information from a wider population regarding participants’ attitudes towards the effectiveness of online training programs for learning. We will also conduct one hour interviews with mine workers and Site Managers/OH&S Managers who have completed an online induction program to obtain a more in-depth understanding of workers’ attitudes to online learning.

Please be assured that all the information gathered from the survey and interviews will be totally confidential. Names will not be included or used in any publications (such as the thesis and journal articles) resulting from the research. Any quotes used in publications will not reveal any persons’ identity.

We would be very grateful for your participation in the research project and would appreciate your written consent if you wish to proceed. If you have any concerns or further questions regarding the research design or methodology, please contact Rebecca Kidd on 07 5492 3025 or 0400 232 011.

Kind Regard

Rebecca Kidd
Appendix D: Research Project Information Sheet

Research Project Information Sheet

Please note: Participation in this research project is voluntary. There will be no penalty or loss of benefits to the participant if they choose not to partake in the research project. Participants are entitled to withdraw from the study at any stage, again without penalties or loss of benefit and without providing a reason for doing so.

My name is Rebecca Kidd and I am currently working on a PhD research study at The Sunshine Coast University. The aim of this research project is to examine the effectiveness of online learning for induction training. As part of the research I am investigating what participants think about the online component of their induction course.

I would greatly appreciate if you could spare about 15-20 minutes of your time to fill in a questionnaire regarding the online part of your induction training. You may also be asked to participate in an interview at a later date. This will not be compulsory – only if you wish.

You will be asked questions about the Web site that you are using in your induction training. These will cover issues such as the look and feel of the Web site, the quality of the content that is provided, how motivated you were to learn on the Web site, any factors which may have helped or hindered you from learning and how easy or difficult it was to transfer that learning to the workplace. The questionnaire will not ask questions of a personal and intrusive nature. It is not a test – it is your opinion that I am after.

If you wish to take part in the interview you will be asked questions to elaborate on some of the responses you made in the questionnaire and to discover your perceptions about learning online. There are no “right” or “wrong” answers.

The interviews will be tape recorded and you will only be expected to answer questions you are comfortable with and you will be able to discontinue the interview at any stage. If the interview should cause you any great distress, you are welcome to use the counselling services of the Sunshine Coast University free of charge, without going through myself, any of the researchers or your mine management (see below).

It is planned that the information gathered in this study will contribute towards creating more effective and more enjoyable online learning environments for people working in the mining industry.

Please be assured that all the information gathered from the questionnaire and interview will be totally confidential. Your name will not be included or used in any publications resulting from the research. Any quotes used in the publications will remain anonymous and will not reveal your identity. You may view a copy of the interview transcript by contacting myself or the chief investigator and can withdraw any comments or the entire transcript at a later stage. Refusal to participate in the questionnaire and/or interview will not disadvantage you in any way.

Research Team

Principal Researcher:  Associate Professor Kathy Lynch, Teaching and Research Services, University of the Sunshine Coast.

Ph: 07 5456 5506.   Email: kathy.lynch@usc.edu.au

Researcher:  Rebecca Kidd, Faculty of Science, Health and Education, University of the Sunshine Coast.
Please take your time if necessary to consider whether you would like to proceed with this research project. If after having read this information package and upon reflection you wish to proceed, please contact Rebecca Kidd by phone or email.

The researchers and USC would like to thank you for considering this research project.

If you have any complaints about the way this research project is being conducted you can either raise them with the Principal Researcher or, if you prefer an independent person, contact the Chairperson of the Human Research Ethics Committee at the University of the Sunshine Coast: (c/-The Academic Administration Officer, Teaching and Research Services, University of the Sunshine Coast, Maroochydore DC 4558; telephone (07) 5430 4574; facsimile (07) 5459 4727; email humanethics@usc.edu.au)
Appendices

Appendix E: Survey

OH&S Online Induction Mining Survey

My name is Rebecca Kidd and I am currently working on a PhD research study at The Sunshine Coast University. The aim of this research project is to examine the effectiveness of online learning for induction training. As part of the research I am investigating what participants think about the online component of their induction course. I would greatly appreciate if you could spare about 15 minutes of your time to fill in a questionnaire regarding the online part of your induction training. You may also be asked to participate in an interview at a later date. This will not be compulsory – only if you wish.

You will be asked questions about the Web site that you are using in your induction training. These will cover issues such as the look and feel of the Web site, the quality of the content that is provided, how motivated you were to learn on the Web site, any factors which may have helped or hindered you from learning and how easy or difficult it was to transfer that learning to the workplace. The questionnaire will not ask questions of a personal and intrusive nature. It is not a test – it is your opinion that I am after.

This survey aims to find out what you think of the OH&S online induction program you have just completed. There are no ‘right’ or ‘wrong’ answers. Your opinion is what is important.

This is not a test. Your name and responses will not be shown to anyone else.

The survey consists of a number of statements. Read these questions carefully and think about how well the statement describes the online induction program. Most questions ask you to click on a button that best relates to your answer.

You can change your choice at any time by just clicking on another button.

Some questions will use check boxes. These allow you to choose more than one answer for the question.

You may find that some of the questions seem to be repeated in different sections of the questionnaire. This is to assist with the analysis of the questionnaire.

Participation is this study is completely voluntary. You may withdraw from the study at any time, without any consequences. If you have any complaints about the way the research project is being conducted you can raise them with Rebecca Kidd (07 54922561, rgk002@student.usc.edu.au) or, if you prefer an independent person, contact the Chairperson of the Human Research Ethics Committee at the University of the Sunshine Coast: telephone (07) 5459 4574; email humanethics@usc.edu.au.

It is assumed that by completing the questionnaire you have given your free will consent to participate and you are at least 18 years of age.

If you would like to participate, please click ‘Start’. 
OH&S Online Induction Mining Survey

1. What mine site did you do this online OH&S induction for?

2. Sex: Male Female

3. I identify as:

   - Australian
   - Aboriginal
   - Torres Strait Islander
   - Pacific Islander
   - New Zealander
   - Other (please specify)

4. Age:

   - 18-24
   - 25-39
   - 40-54
   - 55-64
   - 65 +

5. I have the following years of mining experience:
   (Select only one)

   - No previous mining experience
   - Less than one year
   - 1 to 4 years
   - 5 to 9 years
   - 10 to 14 years
   - 15 to 20 years
   - More than 20 years

6. What type of mine(s) have you worked in? (Select as many as apply)

   - Open-cut
   - Underground
   - Metaliferous
   - Coal
   - None

7. The highest level of formal education I reached was (Select only one)

   - Primary School
   - Secondary School
Appendices

TAFE
Degree or Higher
None of the above

OH&S Online Induction Mining Survey

8. My main job responsibility at the mine is?:
(Select only one)
- Tradesperson e.g. Electrician, plumber, carpenter, boilermaker, apprentice, fitter
- Labourer
- TA Operator
- Administration
- OH&S Officer
- Trainer
- Manager
- Supervisor
- Surveyor
- Environmental Officer
- Engineer
- Other (please specify)

9. I completed the online induction program:
- Today
- Within the last month
- Between 2 to 3 months ago
- Between 4 to 5 months ago
- More than 6 months ago

10. Before I started the OH&S online induction program, I could use a computer:
- Hardly at all
- Average (for example I can use email, surf the web and play computer games)
- Very well (for example I know how to use applications such as Word Processing and Spreadsheets)

11. I came across technical difficulties while doing the OH&S online induction program:
- Yes
- No
- If yes, please explain
OH&S Online Induction Mining Survey

12. The following questions ask you about how you found the look and feel of the OH&S online induction program. Click the box which most closely matches your agreement with the statement.

Please select the appropriate answer code: 1 = I strongly agree, 2 = I agree, 3 = Uncertain, 4 = I disagree, 5 = I strongly disagree

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>I liked the way the program looked on the screen.</td>
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<tr>
<td>I felt comfortable using the program.</td>
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<td>I could clearly read the writing on each screen.</td>
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<tr>
<td>I thought there was a good mix of writing, sound, pictures and movies.</td>
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<tr>
<td>I liked the order in which the lessons were delivered.</td>
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<td>I thought the links were easy to find.</td>
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<tr>
<td>I did not like the colours used on the pages.</td>
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<tr>
<td>I found the quality of the pictures, cartoons, graphs and videos was high.</td>
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<tr>
<td>I thought there was too much writing on each page.</td>
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</table>
OH&S Online Induction Mining Survey

13. The following questions ask you about how you found completing the OH&S online induction program. Click the box which most closely matches your agreement with the statement.

Please select the appropriate answer code: 1 = I strongly agree, 2 = I agree, 3 = Uncertain, 4 = I disagree, 5 = I strongly disagree

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>I did not know what to expect of the program.</td>
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<tr>
<td>I felt the first page helped me understand how to find my way around the program.</td>
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<tr>
<td>When I had a technical problem using the program it was quickly fixed.</td>
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<tr>
<td>I was given enough time to become familiar with the online induction program.</td>
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<tr>
<td>I was jumping from page to page a lot to find the information I needed.</td>
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<tr>
<td>I could decide the order in which I did each lesson.</td>
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<tr>
<td>I enjoyed the online program.</td>
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<tr>
<td>I needed help from my trainer to find my way around the program.</td>
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<tr>
<td>I thought the program started quickly enough.</td>
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<tr>
<td>Navigating around the program was easy for me.</td>
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<tr>
<td>I did not have enough time to finish the program.</td>
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<tr>
<td>The trainer was not always available to discuss any problems I had with the program.</td>
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<tr>
<td>I found it easy to get started.</td>
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<tr>
<td>There were opportunities for me to share ideas with other people doing the program.</td>
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<tr>
<td>Any instructions I received from the trainer were clear to me.</td>
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<tr>
<td>I was satisfied with how long it took me to finish the program.</td>
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<tr>
<td>I felt the program met my needs.</td>
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</tr>
</tbody>
</table>
OH&S Online Induction Mining Survey

14. The following questions ask you about your learning experiences with the OH&S online induction program. Click the box which most closely matches your agreement with the statement:

Please select the appropriate answer code: 1 = I strongly agree, 2 = I agree, 3 = Uncertain, 4 = I disagree, 5 = I strongly disagree

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>It was clear what I was going to learn for each lesson.</td>
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<tr>
<td>I enjoyed using the computer to learn.</td>
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<td>I felt the lessons were explained with enough detail.</td>
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<tr>
<td>I thought the information in each lesson was interesting.</td>
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<tr>
<td>I thought the lessons had the correct information.</td>
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<tr>
<td>I had trouble understanding some of the lessons.</td>
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<tr>
<td>I thought the tests checked my understanding of all the important things in the lessons.</td>
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<tr>
<td>I felt there was too much information to learn overall.</td>
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<tr>
<td>I thought some of the information was unnecessary for me.</td>
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<tr>
<td>I did not learn much from the program.</td>
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<td>I thought the tests were too hard.</td>
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<tr>
<td>I found the program helped me learn the required information.</td>
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<tr>
<td>I have used what I have learned in the program in my workplace.</td>
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<tr>
<td>I would recommend the program to others.</td>
<td></td>
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</table>
OH&S Online Induction Mining Survey

15. The following questions ask you about the learning activities or exercises you did while working through the OH&S online induction program. Click the box which most closely matches your agreement with the statement:

Please select the appropriate answer code: 1 = I strongly agree, 2 = I agree, 3 = Uncertain, 4 = I disagree, 5 = I strongly disagree

| I found there was plenty of variety with the learning activities. | 1 | 2 | 3 | 4 | 5 |
| I found some exercises helped me build on information I already knew. | 1 | 2 | 3 | 4 | 5 |
| If I didn't know the answer I was given hints and examples. | 1 | 2 | 3 | 4 | 5 |
| I found the learning activities too simple for me. | 1 | 2 | 3 | 4 | 5 |
| Working on real-life examples helped me learn. | 1 | 2 | 3 | 4 | 5 |
| I found the hints and examples helpful to work out answers. | 1 | 2 | 3 | 4 | 5 |
| I thought some of the exercises unnecessary as they often repeated information I already knew. | 1 | 2 | 3 | 4 | 5 |
| I believe I can apply what I have learned in the program to my workplace. | 1 | 2 | 3 | 4 | 5 |

16. Overall I thought the online induction program was a good way to learn about safety in the mines: (Select one option only)

I Strongly agree
I Agree
Uncertain
I disagree
I strongly disagree

17. Please tell me the one best thing about the online induction program:

18. Please tell me what one thing in the online induction program needed improvement?

19. I would be interested in a follow-up interview:

Yes
No

20. Thank you for participating in the survey. It is greatly appreciated. We are looking for participants who are willing to be involved in an interview with the researcher to find out more about your experiences with the online induction program. If you would like to participate in an interview, please contact Rebecca Kidd on the following email address: rkidd@usc.edu.au using the subject line “Research Project”

OR

Please click HERE and leave your contact details.
Appendix F: Schedule

The following documents were produced by the study:

- Interview transcripts
- Coding of interview transcripts
- Identification and organisation of related constructs from coded information
- Table of attributes from coding
- Memos pertaining to interesting observations from interviews
- Profile of participants
- Frequency counts from interviews and qualitative data in survey
- Data summary tables or matrices:
  - Perceived barriers to learning via the online induction program
  - Perceived effectiveness of the online induction program
  - Perceived satisfaction with the online induction program
Appendix G: Consent Form

Consent to Participate in Research - Interview

Enhancing Occupational Health & Safety induction courses with web-based learning systems: Implications for training mining workers.

I understand that:
- Participation in this project is voluntary and I do not have to participate
- I may withdraw from the research project whenever I wish, and do not have to give a reason for doing so
- If I choose to withdraw from the project, the interview data received from me will be destroyed and not used in the project findings
- I will not be penalized or treated less favourably if I do withdraw from the study

I have read the information about this project and I understand its contents. I agree to participate in a 20-30 minute interview which will be tape recorded and transcribed. I am aware that parts of the interview may be used at educational conferences, reports to senior management or published in journal articles, but that these will remain anonymous. I understand the interview data and any information relating to me will be kept strictly confidential by the researcher.

I understand the contents of the Research Project Information Sheet for the research project and this Consent to Participate in Research form. I agree to participate in the Enhancing OH&S induction courses with web-based learning systems project and give my consent freely. I understand that the project will be carried out as described on the Research Project Information sheet, a copy of which I have kept. I also realise that I can withdraw from the project at any time and that I do not have to give any reasons for withdrawing. Any questions I had about this research project and my participation in it have been answered to my satisfaction.

Participant’s Signature: _____________________________________________

Printed Name: ____________________________________________________

Phone/Mobile: ___________________________________________________

Date: _______________
Appendix H: Interview Sheet - Managers

**Interview Protocol – Supervisor/Manager**

Date:  
Name:  
Years mining experience:  
Job role:  
Age:

Was this your first OH&S induction? If not, was this your first online induction?

**How did you find the online induction program?**  
(What did you think about the quality of the multimedia? How comfortable were you using the technology?)

**How satisfied were you with this method of learning?**  
(How was the content?)

**What difficulties, if any, did you encounter?**

**What activities or exercises did the program use? Please explain.**  
(What activities did you find effective and why. What did you think about the assessments and feedback?)

**How effective did you find the online induction program? Please explain.**

**Have you observed your people putting into practice what they learned in the online induction? Please explain**

**Have your workers applied what they have learned to new situations? How?**

**What changes, if any, would you like to see made to the online induction program? Why?**

Thank you for your time. Any questions? All information will remain anonymous. Potential for further interview.
Appendix I: Interview Sheet – Workers

Interview Protocol

Date:
Name:
Years mining experience:
Job role:
Age:

Was this your first OH&S induction? If not, was this your first online induction?

How did you find the online induction program?
(What did you think about the quality of the multimedia? How comfortable were you using the technology?)

How satisfied were you with this method of learning?
(What did you think of the content?)

What, if any, difficulties did you encounter?

How effective did you find learning via the online induction program? Please explain.
(What did you learn? What did you enjoy most about the program? If you didn’t learn why not?)

Can you describe how you would put into practice what you have learned during the program? Give examples
(How easy or difficult would it be to apply learning? What strategies would you use to help apply your learning?)

What activities or exercises did the program use? Please explain.
(What activities did you like and why? What did you think about the assessments?)

What changes, if any, would you like to see made to the online induction program?

Thank you for your time. Any questions? All information will remain anonymous. Potential for further interview
Appendix J: Quantitative Data

Bar charts of gender against all dependent variables
Bar charts of education against all dependent variables
Appendices

Difficulty finding important information

Enjoyed program

Sufficient opportunities for interaction

Excessive amount of information to learn

Existence of unnecessary information

Liked screen appearance
Bar charts of age against all dependent variables
Bar charts of years mining experience against all dependent variables
Appendices

Difficulty finding important information

Enjoyed program

Sufficient opportunities for interaction

Excessive amount of information to learn

Existence of unnecessary information

Liked screen appearance
Appendices
Bar charts of job responsibility against all dependent variables
Bar charts of mining sites against all dependent variables
Appendices

- Trainer instructions were clear
- Some information difficult to understand
- Motivated to start program
- Lesson content was interesting
- Satisfied with time taken to complete program
- Lack of time to complete program
Bar charts of mining companies against all dependent variables