Online Site Safety Induction Training: Implications for Mines

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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, there were 18 fatalities recorded for 2008–09, a substantial increase from the previous year of 4 fatalities. As a result of this increase the Mining Industry recorded the third highest fatality rate in Australia. According to Australian 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. 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 for eLearning 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. Without effective instructional design, courses delivered online may negatively impact learners’ understanding and performance. This paper focuses on mine workers' level of perceived satisfaction with an online site safety induction program. The research approach used an interpretivist theoretical framework with mixed methods used to collect and analyse data. In this paper only the quantitative information will be reported and will focus on participants perceptions regarding any barriers to learning via the online induction program. Preliminary analysis of the data indicates that the main barriers were lack of computer skills and access to trainer support and that learner competency and motivation could impact significantly on participants willingness and/or ability to learn. 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.

Keywords: perceptions, online learning, safety inductions, mining industry.

1. Introduction

The Australian Mining Industry incorporates the exploration and mining of minerals (including coal) and the associated minerals processing industry (Minerals Council of Australia, 2008-2009). Overall, mining has contributed over $500 billion directly to Australia’s wealth during the past 20 years and in 2008 accounted for approximately 8% of Australia’s gross domestic product (Australian Bureau of Statistics, 2009/2010). 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 and many mining sites are situated in remote and sparsely populated areas of regional Australia (Australian Bureau of Statistics, 2009/2010).

As miners work in confined, physically demanding and dangerous environments which are constantly changing (Gyekye, 2008), the mining industry is typically regarded as hazardous (Galvin, 2006; Gunninham, 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. In Australia 18 deaths were recorded in 2008-09 by the Australian mining industry. This is 14 more than the 4 recorded by the industry in 2007-2008. On average 12 deaths have occurred per year during the past decade. During 2008-2009 the highest number of fatalities (8) was recorded by the open cut metalliferous sector followed by the underground coal and underground metalliferous sectors. The fatalities were caused by various factors including: vehicles, falling from height, maintenance related, crushing and being hit by falling objects (Minerals Council of Australia, 2008-2009).

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 (Grayson, et al., 2005; Kowalski-Trakofler, et al., 2004). In Queensland, the Mining and Quarrying 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, 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 it does not specify duration or mode of delivery. Although safety inductions are mandatory in high risk industries such as mining, there is little evidence that research has been conducted on the content and effectiveness of safety induction training programs.

2. Online learning in the mining industry

Online learning, eLearning and web-based training are words that 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; Zheng & Nunamaker, 2003). A report by the Australian Flexible Learning Framework (2006) declares that the most common uses for eLearning were induction and regulatory training such as occupational health and safety. Compliance is a key driver for developers of web-based training as the Internet provides a highly cost-effective way to deliver information pertaining to regulatory requirements (Tyrell, 2005).

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 skill the work force (Driscoill, 1998; Zhang & Nunamaker, 2003). The desire to produce workers who can solve problems in sophisticated and complex environments (Grayson, et al., 2005; Kowalski-Trakofler, et al., 2004) has created a need in many organisations to continually update employee 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, Hase, & Ellis, 2002).

Unfortunately, the quality of instruction for web-based training programs varies greatly among organisations. A manual placed online followed by three multiple-choice questions, is not an interactive learning experience and does not constitute effective course design (Oliver, 1999). In the mining industry there is the added difficulty of lower levels of literacy compared to the general work population. This could have a substantial impact on how online learning programs are designed as the level of text and language used would need to be carefully considered (Newton, et al., 2002).

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 applying learning in the workplace and subsequent dissatisfaction with online learning by workers.

3. Potential barriers to online learning

Introducing an online learning program into the workplace must 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. If the workers 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 (Song, Singleton, Hill, & Koh, 2004) and transfer what learning to the workplace (Park, 2007). In the mining industry the level of computer literacy varies considerably and therefore support is required for those who are not as confident with the technology. 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 medium in the mining industry (Newton, et al., 2002).
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 often equated to old school memories of boredom and irrelevant exercises (Gamme & 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., 1986). 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 program requires 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). Feelings of isolation and/or lack of a sense of community were also barriers to online learning reported in the literature (Mullenger & 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, at a time and place convenient to them, then the desire and interest to use them will decrease. Similarly 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). 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).

4. The study

Appropriate learning theories and instructional design strategies are necessary in order to develop efficient and effective online safety inductions for workers in the mining industry. However, 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 addressing this deficit. The central research questions of this study are:

- How effective are online site safety induction programs in the Australian mining industry?
- How effective are the instructional design strategies used in web-based induction programs in the Australian mining industry?

The study design

This study positioned itself in an interpretivist framework as the goal of the investigation was to ascertain the perspectives of mine workers on the effectiveness of an online induction program. A single case study approach was subsequently taken as this study examined participants’ experiences of learning in their natural environment, the mine site.

A case study approach can accommodate a variety of research designs (both positivist and interpretivist) and methods for data collection and analysis. This research used mixed methods to collect and analyse data. Quantitative data was collected from participants regarding their satisfaction with and attitude towards the effectiveness of a specific web-based training program for learning. The data was collected using a survey designed upon a five point Likert scale. Interviews were used to collect qualitative data concerning participants’ perspectives of learning via the online induction program.
The key research questions, with subsequent subsidiary questions, that shaped both the survey and the interviews are presented in Table 1 however only the quantitative findings from subsidiary question 1(b) are reported in this paper.

Table 1: Key research questions

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<thead>
<tr>
<th>Major Research Questions</th>
<th>Subsidiary Questions</th>
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<tr>
<td>1. How effective are online site safety induction programs in the Australian mining industry?</td>
<td>a) What are the perceived levels of satisfaction towards web-based learning among mine workers and managers?</td>
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<td>b) What factors do learners perceive may hinder their learning via computer based systems?</td>
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<td></td>
<td>c) What are the perceived levels of effectiveness of knowledge acquired via web-based training programs among mine workers and managers?</td>
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<td>2. How effective are the instructional design strategies used in web-based induction programs in the Australian mining industry?</td>
<td>d) What were the instructional design strategies used in the web-based induction program?</td>
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<td></td>
<td>e) What instructional design strategies used in the web-based induction program do learners feel aided their learning?</td>
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Participants

Miners working in the open-cut coal mines of the Bowen region of Queensland who had completed the same online site safety induction program were invited to participate in the study.

Instrument Design and Analysis

As the aim was to collect data from a random sample of a given population over a short space of time, approximately two months, a cross-sectional survey design was implemented. As no suitable attitudinal scale had been constructed for adult workers learning about safety in the mining industry via a web-based system, a survey was developed for this study. To help formulate the questions for the survey, themes relating to the major focus of this study were identified and constructs were established using the literature, especially in relation to adult learning and web-based systems. Instruments which had been used to measure participant satisfaction with web-based learning programs were also examined for suitable constructs. Question items were then formulated and examined to ensure they related to the constructs identified in the themes and were able to help answer the research questions. As the main purpose of the survey was to measure the attitudes of participants towards the web-based induction program, the majority of questions were in a Likert scale format. A variety of questions were asked in this research to find out participant 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. This allowed the participants to choose from a range of alternative fixed responses such as 'strongly agree', 'agree', 'neutral position', 'disagree' and 'strongly disagree'. Due to the type of data collected, which was measured on nominal and ordinal scales, descriptive statistics and non-parametric statistical approaches were appropriate (Pallant, 2001). In this study, descriptive statistics were used to give a profile of the respondents and the chi-square test to examine the relationship between independent and dependent variables.

5. Findings and discussion

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 looking at distinct profiles, it was discovered that some participant profiles were confounding the data so a decision was made to remove 8 profiles. These profiles included 2 primary educated participants (who also nominated Pacific Islander and Aboriginal for their nationality) and the 8 higher degree participants (including 2 male participants who also nominated other for their nationality, and 3 females). Due to insufficient numbers, 83 participants, it was not possible to conduct formal statistical testing however within the constraints of the data it was possible to look for interesting patterns.

Demographic Profile

Using the demographic data a profile of the average mine employee working in open cut coal mines in the Bowen Basin region can be obtained. The majority of participants were male (89%), and 95% of participants (all percentage will be rounded to the nearest whole number as the data is referring to people) identified as Australian. Secondary school education was nominated by 55% of all participants as their highest level of education followed by TAFE at 44%. More than half (61%) of the
participants were aged between 25-39, with 20% of participants in each of the age brackets 18-24 and 23% in the age bracket 40-54. It is interesting to note that there is a relatively young workforce employed in the mines with almost three-quarters (72%) of the population under the age of 40. In relation to years of mining experience, 45% of the population had only 1-4 years of mining experience and more than half (57%) of the participants were employed as tradespeople at the mines. A tradesperson was defined as 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.

Perceived Barriers to Learning

To examine participants’ perceptions of the barriers or problems they encountered whilst completing the web-based induction program included, but was not limited to; instructor support, learner competency, computer skills and learner motivation. The survey results for the above constructs are reported below.

Instructor 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. Figure 1 shows that gender had some influence on how participants perceived the degree of trainer support provided. Males were the most satisfied with the amount of support, with 74% believing they had sufficient access to a trainer when they required help. In contrast, one-third of females (33%) were uncertain and 22% felt they did not receive the required support from a trainer. Participants’ views on how clearly they understood any instructions they received from a trainer were on the whole positive. Although the results were not statistically significant it was interesting to see as presented in Figure 2 that one-third (33%) of participants at mine site B did not think the trainer’s instructions were clear, 43% of participants from mine site 1 were uncertain as opposed to 100% of participants from C, E and F mine sites who believed they received clear instructions.

In this case study, the results indicate that female workers tend to require more instructor support when completing the online safety induction program. Trainers in this instance were usually administrators of the program and therefore had little knowledge about or understanding of the information contained in the online site safety program. To improve learning outcomes it would be beneficial to have a trainer or mentor who could not only help with computer issues but could also answer their questions regarding the content. Further, although participants were generally satisfied with the clarity of instruction from trainers, participants working at particular mine sites reported some level of difficulty understanding the trainer’s instructions. It is therefore important to establish participants’ familiarity with learning via this medium and their level of computer knowledge before commencing the program.

Learner Competency

Participants’ perceptions of their ability to comprehend the information included in the online induction program, was another potential barrier which was investigated. It was interesting to note as presented in Figure 3 that the less experienced miners were more positive regarding their ability to understand
the information than some of the most experienced miners. All (100%) of the participants with no mining experience and three quarters (75%) of participants with less than a year of mining experience did not believe they had difficulty understanding the information in the online induction program. Conversely, 40% of participants with over ten years mining experience felt that some information was difficult to understand.

![Bar chart showing distribution of years of mining experience among participants.]

Figure 3: Understanding information

These results are interesting, the fact that the more experienced workers tended to have more difficulty may be due to a number of factors, including their preference for or familiarity with instructor led training. Traditionally inductions have been conducted face-to-face with the instructor in control and imparting the information to the students. Any information that was not understood could easily be clarified by asking the instructor. Further, more experienced workers are used to interacting and talking to colleagues during training to find out what is expected at the mine site and to share their own knowledge. The lack of interaction in the online program may be demotivating for these participants and thus they do not put in the effort required. Therefore due to the absence of an instructor and the familiar classroom environment more experienced workers may find the online safety program difficult to understand.

Computer Skills

Participants were asked about their perceived level of computer skills before they started the web-based induction program. The following results were not statistically significant, however very revealing. When education is cross tabulated with computer competency ($\chi^2=12.4, p=0.02$ however 33.3% of cells had an expected count less than 5 making the p-values unreliable) the results show that 57% of participants with a TAFE qualification believed they could use various applications (i.e. spreadsheets) on a computer very well as opposed to 61% of secondary school educated participants who nominated average competency (i.e. could use email, surf the web). Further, 17% of secondary educated participants indicated that they had hardly used a computer at all before starting the web-based induction program (Figure 4).

These results indicate that computer literacy can vary greatly among participants, and this can have an impact on their attitude towards and ability to successfully complete an online induction program. As participants, who nominated secondary school as their highest level of education, self reported a lower level of computer competency it would be beneficial to gather this information to help identify those who need more support.

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, with Figure 5 showing that 61% of males and 57% of females were motivated to start the program. However one third (33%) of females were not so sure. Interestingly, participants were more ambivalent regarding the lesson content. Figure 6 shows that 34% of tradespeople and 25% of professionals were uncertain about whether the lesson content was interesting and 17% of labourer/Trade Assistant operators disagreed.

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Figure 4: Computer competency

To work on a mine site it is compulsory that all workers complete a site safety induction program. Therefore it is not surprising that the majority of participants were motivated to start the online induction program. The reason why some females expressed uncertainty would need further investigation. However it is the unskilled workers, Labourers/TA operators, who expressed more dissatisfaction with the lesson content. Typically, unskilled workers do not have formal qualifications and would not have participated in further education. Consequently these participants may not know how to take responsibility for their own learning and may lose motivation if they cannot read or immediately understand the information and cannot rely on a trainer to give them support and direction. It is therefore important that the content and activities in the online learning program are pitched appropriately to participants’ levels of education, work experience, computer competency and familiarity with learning online.

Figure 5: Motivation to start

Figure 6: Interesting content

6. Conclusion

For mining organisations traditional approaches to learning, which assume that everyone learns in the same way and has the same capabilities, do not always cater to the needs of adult learners and the environment in which they work. 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) This research has highlighted a number of barriers or problems which participants perceived they encountered when completing an online site safety induction program. These barriers included a lack of trainer support, difficulty understanding information, low level of interest in the content and poor computer skills. By identifying areas which need improvement or modification, the mining companies in the case study will be able to create the optimum learning environment for their employees. The results of the study will also give mining companies a clear indication as to whether the tools and training they are providing their employees are equipping them 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.
References