

TEACHING MINERS: BREAKING THE BARRIERS TO LEARNING

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ABSTRACT

Miners, like many skilled blue-collar workers, are not traditional learners. They have not always been successful in classroom-type settings, preferring to learn on the job in a hands-on environment. U.S. law requires that miners have a minimum of 8 hours of safety training annually, plus 40 hours for underground miners and 24 hours for surface miners when they enter the industry. However, miners rarely view this training time positively. In fact, it has been called “safety jail” by many, who regard it as a time to get a little extra sleep.

While mining has become far safer in the past 100 years, it is still a dangerous occupation. The Office for Mine Safety and Health Research, a part of the National Institute for Occupational Safety and Health (NIOSH), has funded a project for the past 4 years to address this challenge. The purpose of the research was to find a way to develop *effective* safety training for these people.

Miners are born story tellers. They share “near miss” stories, stories about master miners they have known, and stories about how things used to be. These stories not only pass along information about what will happen if a miner fails to respect the mining environment, they also instruct listeners in the culture of mining and the values that it embraces. Stories, it seems, are a way to get safety messages across to miners, especially inexperienced ones, and using older, wiser miners in these stories is an obvious choice. This paper will discuss how a series of training videos was developed, how “master miners” and story lines were chosen, and how the resulting videos have been received in the mining industry.

INTRODUCTION

The Spokane Research Laboratory (SRL), a part of the National Institute for Occupational Safety and Health (NIOSH), began conducting regional stakeholder meetings in the mining industry when it joined NIOSH in 1997. Participants at these meetings were selected for their expertise and experience in different sectors of mining. They were asked to identify problems for researchers to consider in their work so that the research being done would meet the needs of the industry.

One of the issues identified repeatedly over the years was the need for high-quality, effective training materials that could be used both in training new miners and in annual safety training. Safety professionals were concerned that as the older, more experienced miners began to retire and leave the industry, the traditional method used to train new hires—pairing them with expert miners—would no longer be possible. In addition, more women were entering the field, as well as workers for whom English was a second language. Clearly, training miners was becoming more complex as the demographics of the industry changed. Trainers believed the situation was critical, and in 1998, a project was funded at SRL to develop and evaluate effective safety training for the mining industry.

In 1998, the NIOSH Pittsburgh Research Laboratory was producing excellent training materials for coal miners, including many that used stories to teach. Because of limited resources and a desire not to duplicate this work, SRL made the decision to focus on training for noncoal miners, with an emphasis on mining

situations in the western United States. While it is true that there are many similarities between coal mining and metal/nonmetal mining, these two broad segments of the mining industry have very different occupational cultures. Most of the materials discussed in this paper are applicable to both, but they were specifically designed for use in hard-rock or aggregate mining operations.

APPROACH

Miners are not traditional learners. Their work environment is dangerous and very physical, requiring them to maintain a constant state of awareness about possible dangers and the ability to react quickly to changes in work conditions. They learn their trade in a master-apprentice relationship, and most of what they learn is on-the-job training. As adult learners, they fit the pattern defined by Knowles (Knowles et al., 1998), in that they—

- Need to know why they need to learn something,
- Need training to be self-directed,
- Need their training to relate to prior experience,
- Must be ready to learn, and
- Must be motivated to learn.

Wlodowski (1985) further suggests that adults are motivated to learn if they believe they will be successful, if they think they have a choice in whether to learn or not, if they believe they are learning something valuable, and if they are enjoying the experience. The key to meeting these needs for mine safety training, it seemed, was to look closely at the mining culture for clues as to how to make learning fun, interesting, and relevant. While it is true that U.S. miners are required to spend time in training classes, this does not guarantee that they will pay attention or learn anything. The Mining Act of 1977 mandated that all coal and metal/nonmetal miners receive safety training before beginning work in the mines, as well as annually thereafter. This certainly created a training opportunity, but did little to provide either the materials or the training methods that trainers needed.

The approach used in this project was first to put together a group of industry safety professionals who would act as a technical advisory group. Membership in this group was loose and changed as the topics selected for training development changed. A list of “critical issues” was produced by the group and included such things as handling explosives, installing ground supports, and working around mobile equipment. These issues generally were in areas where training materials were either nonexistent or outdated.

The mining industry in the United States is regulated by the Mine Safety and Health Administration (MSHA), which has kept a very comprehensive database of accident statistics since 1977, when the the 1969 Mine Safety and Health Act was amended to include metal/nonmetal mines as well as coal mines. This database, accessible through the MSHA Website at www.msha.gov, is an invaluable source of information on what kinds of accidents are happening in the mining industry, what miners are doing at the time of the accidents, what kinds of injuries they are sustaining, and numerous other variables. The MSHA Accident/Injury database, which also includes narrative descriptions of the accidents, was “mined” for information on major accident categories at the beginning of each new training project. This information was then compared to the issues identified by the technical advisory group, and the subjects for new training materials were selected based on severity of the problem and detailed data on what exactly was happening to miners because of it. The issues developed by the advisory group and the information in the MSHA database provided the content categories for the training, but the truly critical piece was to design the method by which the topics would be introduced.

If training materials are going to be truly effective, they must not only include accurate content, they must work within the culture of the prospective learners. It was considered crucial to the success of the project to match the training materials to the mining culture in order to improve chances of being effective. Culture is a difficult thing to identify. *Blue-Collar Aristocrats* (LeMasters, 1975) introduces the reader to the world of skilled blue-collar workers in an urban factory setting and allows us to observe them as they socialize in their

favorite bar and discuss their cultural norms and values. Mining has a culture that is uniquely its own but shares many common values with other skilled blue-collar trades. Much has been written about mining culture, including *Roaring Camp: The Social World of the California Gold Rush* (Johnson, 2000), *Saloons in the Old West* (Erdoes, 1979), *Fire In the Hole: The Untold Story of Hard Rock Miners* (Dolph, 1994), and dozens of others. The authors unearth many themes about mining culture, and most reveal miners to be fiercely independent, hard-working, hard-playing, and distrustful of “outsiders.” Finding ways to get these people to participate willingly in their own training was a challenge.

The idea of using narrative, or story-telling, as a teaching technique in this project developed gradually. Research has shown that stories can be very powerful. Slater claims that stories—

have substantial potential to influence behavior. It is difficult to consider 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)

Trying to change another person’s behavior (one of the primary objectives of safety training) without obtaining their buy-in is often viewed as an impossible task. Simmons believes that stories are “the oldest tool of influence in human history” (2001, p. xvii) and that they can provide the trainer an effective way to “connect people to what is important and to help them make sense of their world” (p. 29). In other words, stories provide the learner with that critical “why should I care?” element.

Lave and Wenger (1991) have taken this idea even further by stating that true learning does not take place in isolation, but rather in a social environment with all the interactions that would accompany it. While we may associate story-telling with entertaining children, MacDonald (1993) argues that “The adult’s sense of story is fully developed, the attention span is long, and adults prove eager listeners if you will take the time to seek out...tales we need to hear” (p. 57). It is clear that the current research on adult learning theory supports story-telling as an effective strategy in training miners.

Miners are story-tellers. One need only spend time with them to observe how they interact with each other through story-telling. The stories they share may provide information about “near misses” they have had, about master miners they have worked with, or about someone they knew who made an error in judgment and paid dearly for it. The role of the stories is complex, but Billett (1994) explains it like this: “Developing learners’ conceptual understanding of why things are done a certain way, and what would happen if they were not, is a key role.” Cole has researched the role of story-telling and its relationship to training. He states that “A universal problem in education is the matter of translating socially relevant information into information that is personally relevant” (1997). U.S. laws pertaining to mining (U.S. Code of Federal Regulations, 1977) require that miners be trained in health and safety. This is the social relevance that Cole makes reference to. The challenge is to comply with the law and at the same time provide training that is personally relevant to miners. Simmons (2001) believes that stories are an effective way to reach learners, stating “Teaching stories help us make sense of new skills in meaningful ways. You never teach a skill that doesn’t have a reason why” (p. 18).

Changing the behavior of adults is not a simple task. Cranton (1994) discusses “transformative learning” (the primary objective of safety training) and maintains that true transformative learning occurs through critical self-reflection, when learners revise old assumptions and develop new assumptions, beliefs, and ways of seeing the world that change their behavior (p. 4). Critical self-reflection, however, may be difficult to achieve in an 8-hour safety training class. Stories can provide shortcuts to this type of learning. Parkin (1998) discusses the power of stories and their ability to reach us at different levels. She quotes Neuhauser (1993), a corporate trainer, this way:

Stories allow a person to feel and see the information as well as factually understand it. . . because you ‘hear’ the information factually, visually, and emotionally. It is more likely to be imprinted on your brain in a way that sticks with you longer, with very little effort on your part. (Parkin, 1998)

MacDonald reinforces this theme with a lyrical story of her own. “ ‘I have learned,’ said the Philosopher, ‘that the head does not hear anything until the heart has listened, and that what the heart knows today the head will understand tomorrow.’ ” (1993).

When the first video (*Handling Explosives in Modern Mines*) was released in 1999, feedback from the industry was enthusiastic. It captured the essence of mining, we were told, and didn’t talk down to miners or treat them with disrespect. And as the videos began to come out, a lively competition developed among the mines and miners to see who would be chosen to be in the next one. The surprising dilemma was not reluctance on the part of the industry to participate, but rather to find a way to be fair and to include as many sites and people as possible.



To date, eight videos have been produced by SRL. Two of them, *Hidden Scars* (Cullen, 2001b) and *You Are My Sunshine* (Cullen, 2002a), are documentary-style stories of a fatal accident and a major mining disaster, respectively. The other six provide training on specific areas of mining and use story-telling to assist the learning. These videos include—

- Handling Explosives in Modern Mines (Cullen, 1998)
- Preventing Rock Falls in Underground Mines (Miller, 1999)
- Miner Mike Saves the Day (Cullen, 2000)
- Hazards in Motion (Cullen, 2001a)
- Zen and the Art of Rock Bolting (Cullen, 2002b)
- Aggregate Training for the Safety Impaired (Cullen, 2003)

In each of these videos, older, wiser miners observe younger, inexperienced miners performing unsafe acts and mentor them by either telling them stories about why this is not a good idea, or by introducing them to other expert miners who show them the proper way to do things. Camm and Cullen (2002) discuss the role mentoring, or the master-apprentice relationship, has as the primary method used in the mining industry to train new workers. These videos, particularly *Zen and the Art of Rock Bolting*, use this mentoring technique in order to take advantage of the credibility and legitimacy that the expert miners have earned.

Video was the format chosen for development of training materials because of its ability to capture both people and stories visually. While it could be argued that other media, such as DVD, CD’s, or Web-based training were more flexible, an informal survey of mining industry customers revealed that these media were not widely used, but video was. Mines are located where minerals are found and are often in remote locations. Access to satellite service or high-speed Internet lines is rare for these operations, so it was decided to provide the stories in a format that was immediately useable. The digitally shot footage used to create videos could also be raw material for eventually creating DVD’s, CD’s, and Web-based learning, leaving those options open for the future.



Filming video footage for *Hazards in Motion*

A commercial production studio was contracted to provide the technical expertise and equipment that would assure the footage was the highest quality possible. The project relied heavily on a

collaborative relationship with the mining industry. For the videos to be seen as realistic and credible, it would be necessary for operating mines to provide locations, miners to act in the videos, equipment and other props for the video shoots, and on-site expertise and support. This required an act of faith on the part of the industry, because we are a Federal agency, and many miners and operators openly stated their distrust of “the Feds.”

Scripts were developed at SRL and provided to mine safety professionals to check for accuracy and thoroughness. Once shooting began, the miners involved were given minimal coaching on what to say, but were, rather, given the freedom to tell the stories as they wanted.

When the project first started, we were concerned the miners would be unwilling to participate or cooperate. This certainly was not the case. Mining can be viewed as a fairly closed culture, with limited tolerance of “outsiders.” Information spreads rapidly within this culture, primarily because many of the miners have “tramped,” or moved to work at other mines when the one at which they were employed was either temporarily or permanently shut down. Over the years, many of the older miners have gotten to know each other and stay in touch. Thus, the word spread quickly through the Western mining industry that NIOSH was producing videos and that it was doing a good job. Miners seemed to enjoy seeing their old buddies in the videos, and many contacted us asking what they needed to do to be a “movie star.” The miners used as actors provided suggestions, ideas, stories, and generally whatever assistance they could to make the videos entertaining, factual, and educational. They cooperated fully in the development of the videos, which added greatly to the credibility of the training.

The videos were never released until they had been thoroughly reviewed by the technical advisory team and corrections or additions made. When it was time to release the videos, the world premier for each was generally held in towns near the mines where filming took place and the miners involved were invited as honored guests. Each “actor” was given his own copy of the video, as well as a portrait taken at some point during the shooting. The miners were encouraged to invite friends and family members to the premier and to celebrate a job well done.

RESULTS

The videos have been very well received in the mining industry. NIOSH has distributed over 7000 copies of the eight videos, with new requests coming in daily. Four of the videos have earned national awards. Recognition and sheer demand, however, are not the only indicators of effectiveness, so in 2001 a formal evaluative process was established to gather data on whether these videos really did make a positive difference in training. An independent team of researchers was contracted to gather evaluative data on the first five videos produced and to analyze these data for information that would provide guidance for the research project under which the videos were created (Fein and Isaacson, 2001). For each video, a pre-test and post-test were developed for trainees, as well as a questionnaire for trainers. Telephone interviews, face-to-face interviews, and e-mail feedback were also used to gather data from both the targeted audience (miners) and the end users (trainers).

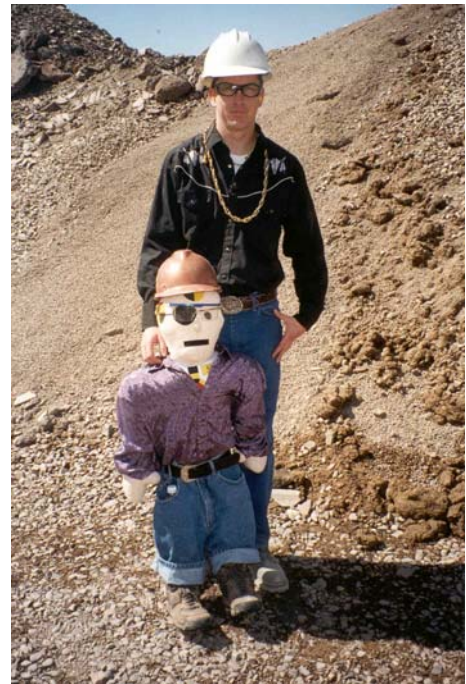
Five major themes emerged from the evaluative study. Safety professionals in the mining industry generally viewed the videos very positively and were eager for more. Specifically, their comments were—

- *Quality.* The videos were judged to be excellent, both with respect to quality of footage and content.
- *Credibility.* The videos are all shot in real mines, using real miners and real situations that the trainees can identify with. It was also mentioned that the videos showed respect to miners and did not talk down to them.
- *Content.* The videos present a lot of information, but do it in a way that miners can relate to and learn from.
- *Effectiveness.* Themes that are presented in the videos are important to both new miners and experienced miners, and because the videos are entertaining to watch, trainees pay attention to the messages in them.

- *Engaging nature.* The videos use stories to make the information personally relevant to trainees. The videos were not viewed as boring, and the humor and pathos in the narratives helped touch the hearts of the trainees.

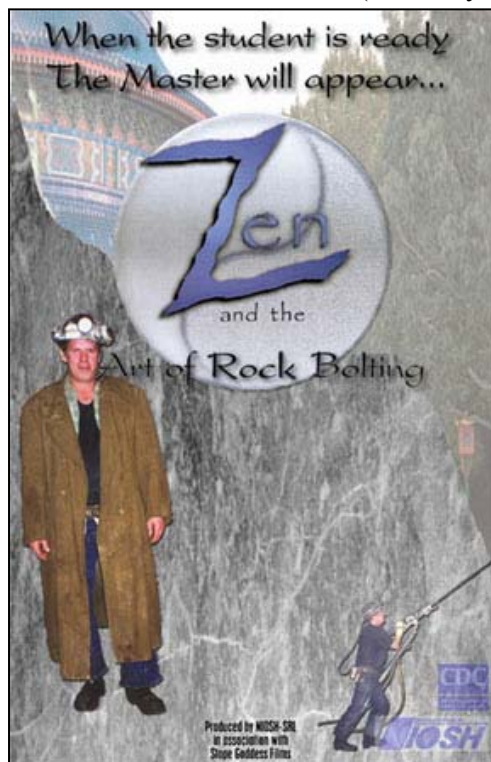
The video *Zen and the Art of Rock Bolting* (Cullen, 2002) was reviewed for effectiveness using evaluation tools quite different from those used to evaluate the first five videos (Fein, 2003). The research team determined that pre- and post-viewing multiple-choice or true-and-false tests were not the best way to gather information from miners. In addition to being relatively easy to guess, they did not honor the past experiences and knowledge of the trainees. Consequently, the evaluation instruments for *Zen* depended on open-ended questions asked both before and after viewing to see if there had been a change in the knowledge base and to answer (1) how effectively did the video capture the wisdom and experience of a master miner? and (2) how effectively did the video provide information to both new and experienced miners?

Results showed that the *Zen* video did, in fact, capture the master miner effectively. Having him explain how to do things made the lesson much more vivid to inexperienced miners, as well as reinforcing prior knowledge in older miners. In answering the question about whether they would like to work with or be trained by master miner Jim Mortensen, an overwhelming majority said “yes,” that he obviously knew what he was doing and conveyed that information well.



Ted and Slick, heroes of *Aggregate Safety for the Safety Impaired*

“Effectiveness” of training materials can be measured in many different ways. It is not rational to ask how many accidents were prevented as a result of having miners watch the videos, because it is impossible to isolate that training from all other variables present in the mining environment. It is probably more appropriate to ask how effective the users (the safety trainers) think the videos are. Their criteria will include such things as willingness of the miners to attend safety training, attitudes about the topics they’ve seen, retention of the stories, etc.



One anecdotal situation deserves to be mentioned. SRL has been asked by numerous mines to replace the training videos after they have been shown. It seems that the miners are stealing them from the training rooms and taking them home to show their families. This, we have been told, has never happened before with other training materials.

CONCLUSIONS

Mining will continue to be a dangerous occupation, particularly as easily won minerals are mined out. At the same time, the mining workforce in the United States is aging. It is critical to the continuity of the industry that new workers be properly trained so that they can successfully work in their careers without disabling injuries. The videos produced at SRL have become valuable tools for safety trainers. Their utilization of story-telling, credible experts, and realistic locations and situations has made them both popular and useful in the industry’s goal to produce needed minerals as safely as possible. By relating the training stories to

real-life situations and people, and by respecting the work experiences of the workers who view them, the NIOSH videos are seen as effective in changing the attitudes and behaviors of an occupational culture that has been considered quite resistant to change.

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