1.5.3. Critical Thinking

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In this chapter, we looked at the relationship of critical thinking to policy-making and the impact on safety engagement. The Foundation for Critical Thinking (2013) defined critical thinking as a process of actively evaluating information from experiences to guide action. In this chapter, critical thinking and reasoning are used interchangeably.

The question that guided our search was: How does critical thinking or reasoning related to policies impact the safety engagement of employees in the mining industry?

Method

A scoping search of the literature was undertaken using the following key words:

1. Miners (miners or mining or "resource extraction" or industry) and
2. Critical thinking ("critical thinking" or "decision making" or reasoning) and
3. Policy-making ("policy making" or policy or policies or checklist or rules or regulations) and
4. Safety engagement ("risk taking behavior/behaviour" or "safety behavior/behaviour" or safety or behaviour/behavior or "high risk behavior/behaviour" or "safety engagement" or "safety rule violation" or "accident proneness" or "risk perception" or "perception of safety" or "safety devices" or "workplace safety" or "risk tolerance" or "industrial accidents" or "occupational safety" or "occupational health")

Search Strategy. The databases searched are listed in the results. From this search, we selected articles based on the inclusion/exclusion criteria. The inclusion and exclusion criteria were kept broad in that we did not specify the types of research methods to be included or excluded in order to capture as many research articles on the topic as possible.   In our search, we collected articles that were pertinent in this topic area. The broad inclusion and exclusion criteria allowed us to explore the literature in this area more completely, see Table 1.

Table 1. Critical Thinking Inclusion/Exclusion Criteria for Article Selection

Inclusion Criteria	Exclusion Criteria
• Articles with key terms in the title or abstract	• Editorials
• Peer reviewed	• Commentaries
• Within 5 years	• Book reviews
• English language articles	

Screening Strategy. The articles were checked for inclusion by two team members. The inclusion process was iterative in that the included/excluded articles were reviewed again for inclusion as the themes were developing. The team had final approval of the included articles. Those not applicable to the scoping review were excluded.

Results

A brief summary of each article including its location, population studied, main issue addressed, comparison group, and primary outcomes is provided in Appendix G. Table 2 is an overview of the scope of the review and articles identified.

Table 2. Critical Thinking Databases and Articles Selected

Database	No of articles found from search	Articles Selected for Review	Final article selection from article summaries
Academic Search Complete	5	62	18
CINAHL	4		
Medline	0		
Nursing and Allied Health	3		
Engineering Village	9		
PsychInfo	9		
CBCA Education	7		
Embase	0		
ABI/Inform Complete	10		
Scopus	9		
Web of Science	6		

Description of Included Articles. Table 3 provides an overview of the types of publications, country of publication, and populations studied.

Table 3. Critical Thinking: Populations, Country of Research, and Type of Study

Type of Publications	Country of Researchers	Populations Studied
Quantitative Studies • Cross sectional surveys (2) • Retrospective analytical study (1) • Secondary analyses of data (2) • Cluster randomized controlled trial (1) Qualitative Studies • Ethnography (2) • Content analysis (2) • Focus groups (1) • Mixed methods (5) • Action research (1) • Interviews (1)	USA (2) UK (2) Australia (2) Sweden (2) Canada Brazil Korea The Netherlands Taiwan Zimbabwe France Denmark Norway Bosnia-Herzegovina Malaysia Hong Kong	General organizations (6) OH&S (1) Nuclear (3) Chemical (1) Air navigation (1) Medical (1) Mines (1) Steel (1) Manufacturing (1) Sports safety (1) Construction (1) Latino day laborers (1)

Description of Identified Factors. In order to make it easier to describe the results of the scoping review, the articles were divided into three categories: individual factors, safety policies and procedures, and safety training.

Individual factors. There were three articles identified that related to individual factors. The articles pertained to age, experience, and risk-taking. One article looked at problem-solving abilities of older workers. Using a randomized control trial, Koolhaas, Brouwer, Broothoff, & Van der Klink (2010) investigated an initiative to promote older workers' personal commitment in sustaining a healthy working life. Measures such as vitality, work ability, productivity, fatigue, job strain, work attitude, self-efficacy and work engagement were identified that could inform strategies to improve safety problem solving capacity of workers and supervisors. One article described how experience is used to make decisions. Hayes (2012) determined that although operational managers generally comply with operating limits

made by industry, they will use experience and risk assessment to make decisions outside of the rules to ensure safety when there is no guidance for hazardous situations. One study reported on risk taking. In a focus group study investigating and describing safety culture and risk taking at a steel manufacturing company, Nordlof, Wiitavaara, Winblad, Wijk, and Westerling (2015) identified the following themes: acceptance of risks related to the job; individual responsibility for safety; production and safety tradeoffs; importance of communication, and internal and external conditions. The authors found the participants had a sociotechnical understanding of safety culture and risk taking.

Safety policies and procedures. Eight studies were identified which pertained to safety policies and procedures. The articles looked at institutional values, policies and procedures, and worker-run programs. Two articles touched on institutional values. In an analysis of work accidents, Helena Palucci Marziale, Rocha, Robazzi, Cardoso dos Santos, and Trovo (2013) were not able to link institutional values to workers' safety behavior. The authors compared two groups of workers: those who had an accident, and those who did not. In a content analysis of documents from foreign owned platinum mines in Zimbabwe, Maunganidze, Ncube, and Sibanda (2013) described the motives for disaster planning were economic and political rather than concern for worker safety. They reported disaster planning is an illusion that risks are controllable and manageable.

Six articles referred to the development of policies and procedures. In a study by Rake and Nja (2009), emergency response personnel were interviewed and observed to determine how decisions were made during an emergency. They found "pro-active strategies" were rarely used and most decisions were influenced by "routines and procedures." Hopkins (2011) analyzed the relevance of prescriptive technical rules in three hazardous events and concluded that rules should be complied t**o** in order to guide end point decisions, force industry good practice and guide the management of catastrophic events. In a secondary analysis of transcript data, Kim, Park, and Kim (2011) found when policies or procedures were in place there was less variance in communication; and in an off-normal situation without a policy or procedure answers depend on the way a question is asked. Therefore, the authors suggested a need for standardization of communication in nuclear power plants. In a mixed methods study, Lin, Chen, and Pan (2013) concluded checklists were better at identifying musculoskeletal discomfort provided it is easily administered. The authors suggested there is a need for a proactive checklist to assist in early identification of discomfort. Ramli, Watada, and Pedrycz (2011) analyzed factors influencing occupational health and safety. They found six variables were important: development of policies and programs, consultation, training, risk control, and maintenance and improvement strategies. Ramli et al. suggested this intelligent data analysis evaluated the influential factors of policy implementation; and these factors should be considered when implementing policies and procedures. In an action research project, Poulos, Donaldson, and McLeod (2012) evaluated a partnership approach to policy development for an injury prevention program. They found the partnerships were seen as positive. They identified the following challenges: time, efficiency, diversity, and commitment; and the following benefits: policy ownership, broad-base, and resource sharing.

Safety training. There were seven articles related to safety training. They discussed benefits of safety training, tactics to improve engagement, and a worker run program. Two articles related to the

benefits of safety training. Williams, Ochsner, Marshall, Kimmel, and Martino (2010) found Hispanic workers who completed a safety training session were more likely to demonstrate personal initiative in seeking PPE or asking about a hazardous situation after the intervention. In a mixed methods study of the construction industry in Hong Kong, Tam and Fung (2012) researched perceptions related to safety culture and effectiveness of mandatory safety training courses. They suggested public resources, induction and ongoing training, and technically accurate procedures taught through interactive methods, as well as mandatory safety courses for project managers.

Four articles pertained to training tactics to improve engagement. The organizations used autonomy supportive tactics, relating incidents to work experiences, story-telling, and problem solving. Burstyn, Jonasi, & Wild (2010) used self-determination theory to investigate inspector tactics to resolve workplace non-compliance with health and safety regulations in Alberta. Although there were geographical differences, experienced inspectors used autonomy supportive tactics (empathetic education approaches) most successfully and at a lower cost. In a qualitative analysis of monthly safety talks in the chemical and nuclear industries, Mbaye and Kouabenan (2013) found participants were more engaged and motivated to participate if the topic was related to their work processes. The authors described experience-based analysis as a management practice used to detect, analyze, and correct factors identified as causes of accidents. Drawing on the findings of three ethnographic studies from hazardous industries, Hayes & Maslen (2015) identified that safety incidents reported as stories build expert safety imagination and are used to assess expert decision-making on a daily basis. Study participants drew from the experiences of others, imagined themselves or family members in the story and used scenario-based learning rather than recollection of rules to make their decisions. Pedersen and Nielsen (2013) tested an approach to safety training combining problem-solving and culture change in the steel manufacturing industry with 14 manufacturing companies. The authors identified five categories to resolve: acceptance of risks, individual responsibility, production versus safety, communication, and risk-taking. They found this approach to be effective at all levels of the organization.

One article described a worker run program. In a mixed methods study evaluating the impact of a hazard mapping program, Anderson, Collins, Devlin, and Renner (2012) found there was high employee engagement. They described a culture shift from management run programs to worker run programs with management support. Anderson et al. reported elimination of hazards, cooperative attitudes, improved communication, and a system-focused culture.

Discussion

In this scoping review, the relationship of critical thinking to policy development and the impact on safety engagement was investigated. The articles described individual factors related to critical thinking and safety policies, procedures, and training programs. Critical thinking and problem-solving ability was looked at from individual factors such as age, experience, and risk-taking. Although there was little literature to support this area, there may be some improvement in problem-solving and critical thinking with age and experience.

There was little information on the influence of institutional values on safety engagement. However, policies and procedures were well supported in the literature. If policies and procedures were

in place, there was better resolution of the incident and better communication. As well, involvement of all levels of the organization in policy development may result in more realistic policies and better adherence to them.   Safety training is a way to ensure all employees understand safety policies, and the more the training is related to everyday work, the more likely employees are to adhere to the safety policies and procedures. As well, safety training using problem-solving approaches may improve critical thinking during a safety incident.

Gaps in the Literature. The research indicated a preference for problem-solving approaches during training, and clear policies and procedures to monitor safety in the workplace. There were 12 qualitative research studies identified and six quantitative articles with only one experimental study. More quantitative research should be conducted to support the results obtained in the qualitative research studies, to provide linkages, and to promote generalization of the results.

Recommendations. Based on the scoping review, the following are recommendations for the mining industry:

•   Clearly outlined policies and procedures may provide better support to employees during a safety incident.

•   Training sessions that include problem solving and critical thinking scenarios may better prepare employees for dealing with safety incidents.

•   Involvement of multiple levels of employees in policy and procedure development may result in policies and procedures that are more comprehensive and appropriate to the situation.

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