## 2.4. Training and Safety

### 2.4.1. Principles of Adult Learning and Learning Styles



To cite: Press, M., & Disiewich, K. (2017). Principles of adult learning. In Chirkov, V., Anonson, J., Anderson, J., Press, M., Gerrard, A., & Ha, C. (Eds*.). Enhancing cultures of safety and safety engagement in the Saskatchewan mining industry: A collaborative and multidisciplinary inquiry* (pp. 284-290). Saskatoon, SK Canada: International Minerals Innovation Institute.

### 2.4.1. Principles of Adult Learning and Learning Styles

In this chapter, we looked at principles of adult learning and learning styles, and their potential influence on safety training and engagement in the mining industry. Knowles (1970) identified the following principles of adult learning: self-concept (from dependent to self-directed learners); adult learner experience (uses accumulated experience as learning resource); readiness to learn (oriented to developmental tasks of social roles); orientation to learning (shifts from one-subject centeredness to problem-centeredness); and motivation to learn (internal processes). According to Knowles, Elwood, Holton, and Swanson (2015), andragogy is "a core set of adult learning principles. The six principles of andragogy are (1) the learner's need to know, (2) self-concept of the learner, (30) prior experience of the learner, (4) readiness to learn, (5) orientation to learning, and (6) motivation to learn." (p. 4-5).

Learning styles represent individual differences in learning and are based on experiential learning theory. Experiential learning theory is a process of relearning, resolving conflicts, adaptation to the world, synergistic transactions between person and environment, and a creation of knowledge through the transformation of experience (Kolb & Kolb, 2005). Kolb (1985) developed the learning styles inventory (LSI) which is a tool to identify an individual's orientation to learning as an accommodator, a diverger, a converger, or an assimilator.

The questions that guided our scoping review were: What influence do principles of adult learning have on safety training and safety engagement of employees? What impact do learning styles have on safety training/education?

**Method**

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

Search #1: Principles of adult learning,

1. Miners (miners or workers or employees or "shift workers" or "blue collar workers") and
2. Principles of adult learning ("principles of adult learning" or "principles of adult education" or "adult learning" or "adult education" or "adult learner" or "adult learning theory" or andragogy)
3. Safety engagement ("safety engagement" or "risk taking behavior" or "risk taking behaviour" or "safety" or "safety behavior" or "safety behaviour" or "high risk behavior" or "high risk behaviour" or "safety rule violation" or "accident proneness" or "risk perception" or "perception of safety" or "safety devices" or "workplace safety" or "work safety" or "risk tolerance").

Search #2: Learning Styles

1. Miners (miners or workers or "shift workers" or "blue collar workers" or employees)
2. Learning styles ("learning styles" or "learning theory" or learning or "kinesthetic learning" or "tactile learning" or "reading-writing preference learners" or "visual learners" or "auditory learning"
3. Safety education ("safety education" or safety or "safety training" or "OHS training" or "occupational training")

Search #3: Learning Styles

1. Miners (miners or workers or employees or "blue collar workers" or "shift workers")
2. Learning styles ("learning styles" or accommodator or converger or diverger or assimilator or

visual or auditory or tactile or activist or reflector or theorist or pragmatist or concrete or abstract or active or reflective or reflection or kinesthetic or "reading-writing" or avoidant or participative or competitive or collaborative or dependent or independent or cognition or affective or cognitive or "social learning theory")

3. Learner (learner or learning or "adult learner" or "adult education" or "learning methods" or "learning theory")
4. Safety engagement ("safety engagement" or "risk taking behavior" or "risk taking behaviour" or "safety behavior" or "safety behaviour" or safety or "equipment safety" or "high risk behavior" or "high risk behaviour" or "risk taking behavior" or "risk taking behaviour" or "safety rule violation" or "accident proneness" or "accident prone" or "risk perception" or "attitude to risk" or "perception of safety" or "safety devices" or "protective equipment" or "workplace safety" or "work safety" or "risk tolerance")

A grey literature search was conducted for learning styles:

1. Miners or mining and
2. Principles of adult learning ("principles of adult learning" or "principles of adult education" or "adult learning" or "adult education" or "adult learner" or "adult learning theory" or "learning principles") and
3. Safety engagement ("safety engagement" or "safety behavior" or "safety behaviour" or "workplace safety" or "work safety")

The following limiters were included in the grey literature search: review the first four pages of Google Scholar only; include only articles from Canada, USA, and Australia; include only research articles or reports; all concept terms must be in the report or on the website page; and must be written in the last five years.

**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. The broad inclusion and exclusion criteria allowed us to explore the literature in this area more completely, see Table 1.

*Table 1. Principles of Adult Learning and Learning Styles*

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

**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 results were being collated. The team had final approval of the included articles. Those articles 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: Principles of Adult Learning PICO Summary of All Included Articles. Table 2 (a & b) is an overview of the scope of the review and articles identified.

*Table 2a. Principles of Adult Learning number of results by database*

| Databases selected | Articles selected for further review | Articles Selected for Review | Final article selection from article summaries |
|---|---|---|---|
| Engineering Village | 3 | 76 | 3 |
| Nursing and Allied Health | 0 | | |
| ABI Inform Complete | 11 | | |
| Web of Science | 4 | | |
| Scopus | 3 | | |
| Embase | 0 | | |
| CINAHL | 2 | | |
| ERIC | 2 | | |
| Medline | 9 | | |
| Academic Search Complete | 14 | | |
| PsychInfo | 2 | | |
| CBCA Education and CBCA Business | 8 | | |
| Grey Literature Search | 18 | | |

*Table 2b. Learning Styles number of results by database*

| Databases selected | Articles selected for further review | Articles Selected for Review | Final article selection from article summaries |
|---|---|---|---|
| ABI Inform Complete, CBCA Business, CBCA Education, Sociological Abstracts | 17 | 123 | 2 |
| Web of Science | 24 | | |
| CINAHL | 16 | | |
| Academic Search Complete and SocIndex | 46 | | |
| PsycInfo | 2 | | |
| Eric | 4 | | |
| Proquest dissertations and theses | 14 | | |
| Cochrane | 0 | | |

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

*Table 3. Principles of Adult Learning and Learning Styles number of articles by publication, country, and population*

| Type of Publications | Country of Researchers | Populations Studied |
|---|---|---|
| Two quantitative studies:<br>• One comparative case study and action research design<br>• One descriptive design<br>One qualitative study:<br>• Mixed methods<br>Other:<br>• One literature review<br>• One description of a training program | USA<br>Australia | • Mines<br>• Working engineers<br>• Undergraduates, post-graduates, and e-educators |

The grey literature search did not result in any papers to be included.

**Description of Identified Factors**. There were very few results found related to this topic in the two searches conducted. Three categories were identified from the literature: learning styles preferences, learning principles, and frameworks for safety training.

***Learning styles preferences***. In a quantitative descriptive study of 291 working engineers, Baukal and Ausburn (2015) found the preferred learning style was significantly different from the general population suggesting there may be occupational patterns that should be taken into account when providing training and education. In a mixed methods study of undergraduates, post-graduates, and e-educators, Willems (2011) found learning styles change over time and each cohort had homogenous learning styles. She cautioned learning styles were only one aspect of learner diversity and scaffolding of tasks is necessary for the development of skills.

***Learning principles***. One study reported on learning principles. In a study of six mine sites across four American states, Pena (2014) found using experiential learning theory provided opportunities for miners to simulate and practice a task while getting feedback from trainers thus improving their ability to understand the training. He also stated the use of SLAM (stop, look, analyze, and manage) as a training procedure worked because it included active learning. In this study, Pena found miners wanted more hands on training. He also found there was a false sense of security in the mining community which may be a hindrance to utilizing the correct lock out, tag out (LOTO) procedures.

***Frameworks for safety training***. Two articles reported on frameworks for safety training. Calandra and Harmon (2012) reported on the development of a safety learning program, and they found the following: clients need flexibility in choice of educational products, expert knowledge needs to be broken into manageable pieces for learning, and synthesize subject matter experts' knowledge into general principles. The authors blended different theories and approaches to instructional design to meet the needs of the learners and to provide the necessary education in a short period of time. Albert and Hallowel (2013) developed a framework for integrating andragogical principles for adult learners into safety training. This five step process included: orientation to andragogy and development of inquiry climate, development of a safety performance model, appraisal of safety competence and development of learning objectives, identification and implementation of learning strategies and resources, and measurement and assessment of learning. They suggested this framework can be used to stimulated

employees to proactively participate in development of safety objectives and safety training programs.

**Discussion**

Pena (2014) found training programs that included active learning and experiential learning principles worked better. In the two training frameworks presented, active learning was not a component. Calandra and Harmon (2012) included flexibility of choice of educational products, and Albert and Hallowel (2013) included adult learning principles in the development of their training framework.

There were only two studies related to learning styles. There may be predominant learning styles within professions (Baukal & Ausburn, 2015), therefore it may be useful to understand the predominant learning styles prior to developing an educational program. As well, learning styles may change over time and with education (Willems, 2011), so older learners may have developed new learning styles.

**Gaps in the Literature**. Very few articles related to safety training and adult learning principles were identified using these search criteria. As well, there is very little information in the literature regarding learning styles and safety training. More research is required into the inclusion of adult learning principles in safety training. Grey literature was not assessed in this review. There may be more examples of training programs in a grey literature review.

**Recommendations**. Of the articles reviewed, all authors considered the learners' needs. They suggested using experiential learning theory in designing programs (Pena, 2014), flexibility of choice in educational products (Calandra & Harmon, 2012), and inclusion of learner in developing learning goals (Albert & Hallowel, 2013). Including the learner in the learning process may have implications for improving their safety engagement. Thus, recommendations for industry based on the current scoping review include:

- Offer flexibility in types of training programs in order to engage all types of learners.
- Include the learner in the development of the training program.
- Understand the principles of adult learning and consider these principles when developing safety training programs.
- There may be some advantage to determining the predominant learning style of a workplace prior to developing safety training programs, however this is not supported in the literature.

## References

Albert, A., & Hallowel, M. R. (2013). Revamping occupational safety and health training: Integrating andragogical principles for the adult learner. Australasian Journal of Construction Economics and Building, 13(3), 128-140. doi: 10.5130/ajceb.v13i3.3178.

Baukal, C. E., & Ausburn, L. J. (2016). Relationship of prior knowledge and working engineers' learning preferences: implications for designing effective instruction. European Journal of Engineering Education, 1-21.

Calandra, B., & Harmon, S. W. (2012). A unique design for high-impact safety and awareness training. Educational Media International, 49(2), 97-108. doi: 10.1080/09523987.2012.683960.

Knowles, M.S. (1970). The modern practice of adult education: Andragogy versus pedagogy. New York, NY: Association Press.

Knowles, M. S., Holton, E. F., & Swanson, R. A. (2015). Introduction to adult learning. The adult learner: The definitive classic in adult education and human resource development (pp. 3-7). New York, NY: Routledge.

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. Academy of Management Learning & Education, 4(2), 193-212.

Kolb D. (2004). Learning styles inventory. In A. Lowy and P. Hood (Eds.), Using 2 x 2 thinking to solve business problems and make better decisions (pp. 267-268). San Francisco, CA: Jossey-Bass

Pena, G. (2014). Training and retraining of miners using adult learning theories. *ProQuest Dissertations and Theses DPA Capella University.*

Willems, J. (2011). Using learning styles data to inform e-learning design: A study comparing undergraduates, postgraduates and e-educators. Australasian Journal of Educational Technology, 27(6), 863-880. doi: 10.14742/ajet.917.