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A Foundation for Safety Training Effectiveness

Executive Summary

Safety training is widely considered to be a vital component of any Environment, Health and Safety (EHS) program, playing an important role in preventing work-related injuries (Burke et al., 2006; Waehrer & Miller, 2009), hazard mitigation (Namian, Albert, Zuluaga, & Behm, 2016) and fostering a strong safety culture (Tam & Fung, 2012). Often integrated as a leading indicator of safety performance, organizations employ various metrics to gauge the extent of their training efforts, such as training hours, number of safety talks and training sessions, participation rates or dollars spent (Campbell Institute, 2015). However, many organizations lack a systematic approach to evaluate the effectiveness of these training programs and their impact on safety attitudes, behavioral changes and overall safety culture.

To address this gap, this report summarizes the results of a collaborative research project with the Training Effectiveness Workgroup of the Campbell Institute. The specific aims of this project were to:

1. Review the key considerations involved in developing an effective safety training program, including conducting needs assessments, setting clear training objectives, and exploring the effectiveness and practical applications of different training modalities.
2. Explore the use of evaluation models for measuring training effectiveness, with a particular focus on the Kirkpatrick Training Effectiveness Model.
3. Present insights from the Campbell Institute Training Effectiveness Workgroup on the systems and best practices member organizations use to evaluate training effectiveness, including the introduction of a pretest-posttest design to measure impacts on knowledge and skill acquisition.

These research aims were addressed via a multi-method approach incorporating group discussions, interviews with representatives from National Safety Council member organizations and a literature review of academic and industry articles. Additionally, the Campbell Institute formed a Training Effectiveness Workgroup, which provided a platform for members to exchange insights and best practices. To gain a comprehensive understanding of organization-specific methodologies, metrics and techniques used to evaluate the effectiveness of safety training initiatives, one-on-one interviews were also conducted. Finally, a literature review was completed to evaluate common evaluation training principles and considerations and to offer a foundation for formalizing a safety training effectiveness program for EHS professionals.

Key Findings:

- Safety training is widely recognized as a vital component of any EHS program, contributing to injury prevention, hazard mitigation and the development of a strong safety culture. However, many organizations lack a systematic approach to measuring training effectiveness.

- The measurement of training effectiveness is critical for the evaluation and continuous improvement of EHS training programs, regardless of the type of training modality (classroom-based, online or e-learning, virtual reality, mentorship programs, blended learning, etc.).

- The Kirkpatrick Training Effectiveness Model is amongst the most widely studied model of training effectiveness and remains popular due to its simplicity, relative ease and comprehensive evaluation criteria. Broken down into four levels (reaction, learning, behavior and results), the model served as the framework for the best practices shared by the Training Effectiveness Workgroup.

- The Training Effectiveness Workgroup developed a quasi-experimental, pretest-posttest design to measure safety training effectiveness. The model contains several levels for measuring effectiveness, including perceptions of self, supervisors or colleagues, third-party observations and data analysis.

Introduction and Background

Effective safety training is an essential component of any EHS management system, as it provides workers with the necessary education and skills needed to do their work safely and to avoid creating potential hazards that could place themselves or others at risk (OSHA, 2021). EHS training typically consists of instruction on hazard recognition and control, safe work practices, proper use of personal protective equipment (PPE) and emergency response procedures (NIOSH, 2010). Currently, over 100 standards set by the Occupational Safety and Health Administration (OSHA) contain requirements for training (see OSHA, 2015).

Implementing a comprehensive EHS training program can carry numerous advantages for both organizations and their employees. Several studies and narrative reviews have highlighted the positive relationship between training and safety outcomes, including knowledge acquisition (Robson et al., 2012), adoption of safe work behaviors and practices (Burke et al., 2006; Robson et al., 2012), hazard recognition (Jeelani et al., 2017; Namian et al., 2016) and improvements in safety culture (Marquardt, Albert, Zuluaga, & Behm, 2020; Wu, Liu, & Lu, 2007). Effective training programs may also

contribute to a reduction in workplace incidents and injuries (Aliabadi, Soltanzadeh, & Ghiyasi, 2020; Senouci, Jedinia, & Eldin, 2021; Waehrer & Miller, 2009). For example, a study of 2,358 organizations revealed that those who implemented sound safety training programs experienced a 24% reduction in injuries compared to those that did not (Waehrer & Miller, 2009).

Implementing an effective safety training program can also help organizations avoid the financial costs associated with workplace injuries, including workers' compensation costs and new claim indemnity costs (Shaw et al., 2006), and avoid other financial strains associated with operational delays, process slowdowns, and hiring and onboarding new workers. In 2021, the total cost of workplace injuries was an estimated $167 billion, or about $42,000 per medically consulted injury (Injury Facts, 2023). This figure accounts for wage and productivity losses ($47.4 billion), medical expenses ($36.6 billion) and administrative expenses ($57.5 billion).


A Foundation for Evaluating Safety Training Effectiveness

When determining the possible return on investment (ROI), organizations should consider the direct and indirect costs of workplace incidents, such as medical expenses, damage to equipment or property, lost productivity or business interruptions (National Safety Council, 2013). While the ROI on safety training will vary by organization size, industry and training modality, overall, it is estimated that organizations implementing an effective health and safety program, including training, can expect reductions of 20% or more in their injury and illness rates, and a return of $4-$6 for every $1 invested (ASSP, 2020).

However, despite the potential benefits associated with safety training, unique challenges exist that need to be addressed in EHS training programs (Krauss, Casey, & Chen, 2018). For example, because safety training programs are often mandated by employers, regulators or other stakeholders, workers may experience a reduced sense of choice and self-determination when engaging in the training (Smith, 2018). Motivation may be further hindered by bureaucratization, often resulting in multiple and sometimes redundant or irrelevant trainings (Smith, 2018). This can frustrate workers and call into question the credibility of management and the training program overall (Blair & Seo, 2007). Additionally, there are often scenarios presented in EHS training that are applicable only in emergency situations. Consequently, this often limits the opportunity for trainees to apply this knowledge, resulting in decreased retention over time (Krauss, Casey, & Chen, 2018).

Given these challenges, the importance of evaluating the effectiveness of training interventions cannot be overstated. Business owners are increasingly seeking assurance that training programs are meeting their stated goals of mitigating injury and illness and that they provide a return on investment (NIOSH, 2010). Furthermore, poorly delivered or ineffective training programs can potentially diminish these returns or negate the potential safety benefits (Albert & Routh, 2021). Other potential impacts of inadequate training may also include an increased risk of fatal workplace injuries, negative safety outcomes, reduced productivity (Burke et al., 2006) or poor worker attitudes toward safety practices (Namian et al., 2016). By implementing robust training evaluation processes and leveraging best practices, employers can continuously evaluate, update and improve EHS training programs, and further the goal of creating safer and more productive workplaces.

Characteristics of a Sound Training Program

According to OSHA (2021), a general review of training best practices identified four characteristics that sound training programs have in common:

- **Accurate:** Training materials should be prepared by qualified individuals, updated as needed and facilitated by experienced trainers employing appropriate techniques and training methods
- **Credible:** Facilitators should have an EHS background or be a subject matter expert (SME) on the topic and have experience training adults or working with the target population
- **Clear:** Training materials should be clear and understandable – training developers should ensure that readability and language choices match the intended audience and adjust for factors such as language proficiencies and literacy levels
- **Practical:** Training programs should present information, ideas and skills participants see as directly useful in their working lives for optimal transfer of learning

With these conditions in mind, there are several considerations employers should make during the planning and development of their safety training programs. These considerations will be addressed in three sections throughout this report: training development, delivery and effectiveness.

Training Development

In the context of health and safety, development is the first foundational step of establishing an effective and impactful safety training program. This section will delve into the key elements of training development, beginning with a thorough needs assessment to identify the specific safety knowledge and skills gaps within an organization. Next, setting clear and measurable learning objectives will help to ensure the training process aligns with wider organizational goals and needs. Finally, training development should consider the specific needs of the target audience, allowing for the customization of training content, delivery methods and approaches to maximize the effectiveness and potential benefits of the health and safety training program overall.

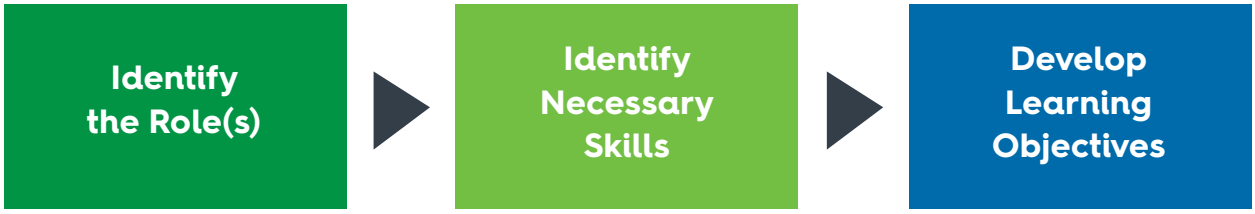
Needs Assessment

One of the first steps toward developing a training program is to identify the gaps in existing health and safety knowledge. A needs assessment refers to the systematic process of collecting and analyzing data to better understand existing knowledge gaps and skill deficiencies within the workforce, specifically as they apply to safety hazards, standards, regulations and goals (see Cekada, 2011).

During this process, employers should also consider the level of risk involved in certain job functions or operational conditions. This ensures the training program not only addresses knowledge gaps but also provides targeted guidance to mitigate specific risks. In addition to considering other potential solutions such as task elimination or engineering controls, when safety concerns arise from factors related to employee performance rather than the environment itself, training emerges as one of the most effective solutions (National Safety Council, 2019).

The Campbell Institute Training Effectiveness Workgroup reemphasized the utility of a needs assessment. According to Campbell Institute member company Dow Inc. (Dow), their approach to training development is a structured and deliberate process involving three key criteria (see Figure 1).

Figure 1. **Dow's Needs Assessment Criteria**



Dow has a well-defined process for assessing the knowledge and skills required for specific roles or responsibilities, especially those with higher risk levels. They start by systematically examining the necessary competencies needed to complete tasks safely and efficiently. This information may come from several different sources, including standard operating procedures (SOPs), hazard analyses, performance standards or a review of the literature and best practices (Cekada, 2011). These sources help provide a comprehensive understanding of the specific safety requirements for the pre-identified role or tasks.

With the required competencies identified in step one, the next step is to compare these requirements to employees' current level of competency, where any gaps may indicate a training need. Employers can utilize a range of methods to evaluate the current competency levels of their employees. This may include work observations, formal or informal interviews, reviewing incident reports, or conducting skill and knowledge tests (Cekada, 2011). These assessments provide valuable insights into the existing skills gaps and areas requiring improvement and can help employers determine the appropriate level of training needed (e.g., organization-wide safety training versus individually assigned refresher courses). Finally, using this information as a foundation for the training program, learning objectives are curated to upskill the employees based on their relevant responsibilities and potential safety risks.

Learning Objectives

After determining the training needs, specific learning objectives should be identified. A learning objective refers to what a worker can do, explain or demonstrate at the end of a training period (Smith, 2018). These objectives should indicate the desired skills or behaviors to be learned from the training using specific, action-oriented language (National Safety Council, 2019). Bloom's Taxonomy is a widely applied framework for developing effective and measurable objectives (Adams, 2015; Armstrong, 2010), and consists of six major categories: knowledge, comprehension, application, analysis, synthesis and evaluation.

1. Knowledge: At the foundational level of Bloom's Taxonomy, knowledge-based objectives aim to provide trainees with basic principles and concepts, such as facts, methodologies or specific processes (Adams, 2015). These objectives lay the groundwork for a solid understanding of safety concepts. For example, a knowledge-based objective could involve familiarizing trainees with the proper usage of personal protective equipment (PPE) and explaining its significance in preventing workplace hazards.

2. Comprehension: The comprehension level focuses on ensuring that trainees understand the underlying principles and concepts of safety practices. These objectives go beyond simple knowledge acquisition and require trainees to demonstrate their understanding of principles in a broader context (Wilson, 2020). For example, trainees may be asked to describe the potential hazards associated with a specific task or articulate effective strategies to mitigate those risks.

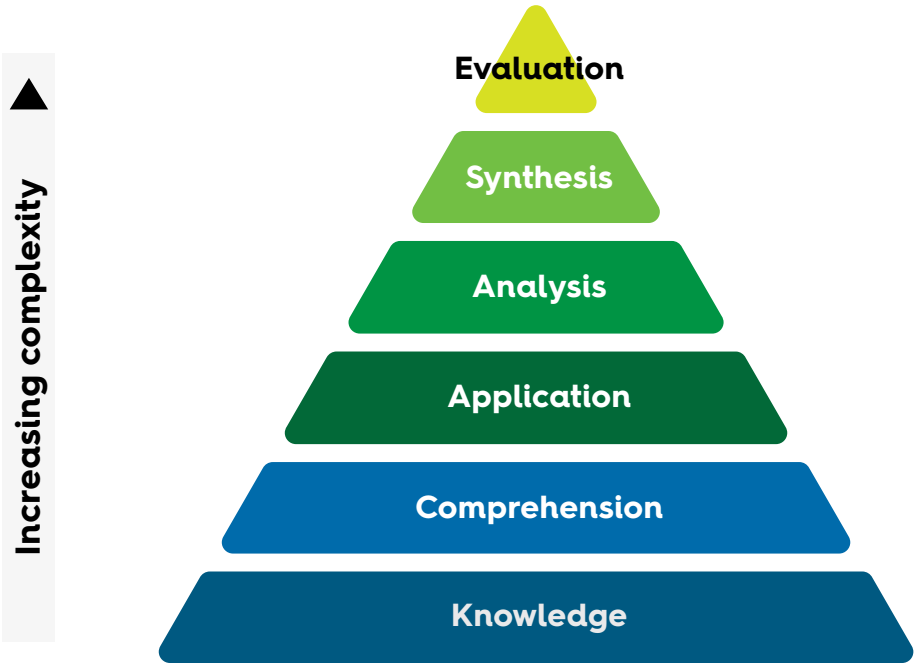
3. Application: The application level of Bloom's Taxonomy is more practical and hands-on compared to the previous levels, where objectives at this stage require trainees to apply their knowledge and comprehension to real-world scenarios or simulations (Wilson, 2020). For example, through simulations or practical exercises, trainees might be asked to demonstrate the correct usage of safety equipment, apply emergency response procedures or implement safety protocols in simulated workplace situations. These objectives help bridge the gap between theoretical knowledge and practical application in the workplace.

4. Analysis: Moving further up the taxonomy, the analysis level focuses on the application of critical thinking skills to the knowledge acquired (Adams, 2015). Objectives at this level prompt trainees to analyze safety protocols, identify potential vulnerabilities and assess the root causes of incidents. By developing these analytical skills, trainees gain a deeper understanding of safety processes and can contribute to their continuous improvement.

5. Synthesis: The synthesis level of Bloom's Taxonomy involves the creation of new strategies and procedures (Adams, 2015). In the context of safety training, the synthesis might include the development of innovative safety strategies, procedures or materials based on acquired knowledge and skills. Examples include designing comprehensive safety plans, creating new training modules or formulating new protocols.

6. Evaluation: The highest level of Bloom's Taxonomy is evaluation, which requires trainees to critically evaluate existing safety programs, assess their effectiveness and propose improvements. Through these objectives, trainees develop the ability to make informed judgments, analyze the impact of safety initiatives and recommend changes to enhance the overall safety culture within an organization.

By addressing knowledge acquisition, comprehension, application, analysis, synthesis and evaluation, training programs become more comprehensive and promote critical thinking, practical application and continuous improvement in safety practices.



Audience Considerations

Understanding the target audience of the training is the next step toward developing an effective program (OSHA, 2021; Smith, 2018). Along with the information attained from the needs assessment, training facilitators should consider other factors, such as the average tenure of the participants, worker demographics, the types of training they have received in the past and whether any new workers are in attendance. For example, younger workers or new employees may require additional instruction on basic hazard recognition and safety precautions due to a lack of real-world experience (OSHA, 2021).

In general, training materials should be written to ensure the readability and language choices match the intended audience, taking into consideration language barriers or low literacy levels (OSHA, 2021). For example, language barriers encountered by migrant workers have been linked to difficulties in understanding EHS information and communicating warnings about potentially hazardous work conditions (Tutt, Pink, Dainty, & Gibb, 2013).

Footnote: An alternate version of the taxonomy adjusts the language and order of the taxonomy categories. In the alternate version, the levels are remember, understand, apply, analyze, evaluate and create (Anderson & Krathwohl, 2001).

Therefore, it is strongly recommended that those who have limited English proficiency should have translated training materials and benefit from instructors who can communicate in their primary language or leverage interpreters during the training. Offering different language dialects and translated materials can help foster the effective communication and understanding of key safety concepts and also facilitates a more inclusive and accessible learning environment for all employees (De Jesus-Rivas, Conlon, and Burns, 2016). OSHA (2021) further recommends that organizations employ similar approaches for contingent workers, day laborers and temporary workers to ensure training content is communicated with minimum language interference.

Learning Styles

Learning styles broadly refer to how learners gather, organize, interpret and store information for future use (Chick, 2010). Proponents argue that instruction is most effective when the methods and strategies employed match those of the learner's preferences (Pashler, McDaniel, Rohrer, & Bjork, 2008; Rogowsky, Calhoun, & Tallal, 2015). Dow emphasizes this importance by customizing training approaches rather than adopting a "one-size fits all" approach. In certain cases, retraining may be necessary to ensure compliance with regulations. However, when it comes to non-regulatory situations, systematically addressing individual needs or localized situations can be achieved through a thorough needs assessment process.

The VARK (visual, aural, read/write, kinesthetic) questionnaire, originally developed by Fleming and Mills (1992), is amongst the most widely recognized learning style model which characterizes individuals into four main learning preferences: visual, aural, read/write and kinesthetic (see Chick, 2010). Notably, research has shown that learning styles may be fluid depending on the information being taught (Pashler et al., 2008). It is recommended that training is developed to meet all four learning styles (OSHA, 2021).

Figure 3. **VARK Training Styles (Fleming & Mills, 1992)**

Training Delivery

Training delivery plays a crucial role in the success of any training program. It serves as the vehicle through which knowledge, skills and competencies are effectively transferred from trainers or facilitators to participants. A well-executed training delivery ensures participants not only grasp the concepts being taught but also have the opportunity to apply and practice what they have learned. Methods of EHS training can range from passive, information-based techniques (e.g., lectures) to computer-based, programmed instruction (e.g., learning management systems) and performance-based techniques (e.g., hands-on learning or simulations) (Burke, et al., 2006). According to a meta-analytic study conducted by Burke et al. (2006), the most engaging methods of safety training tend to be most effective in promoting knowledge and skill acquisition.

Table 1. **Training Modalities by Learner Engagement**
(Adapted from Burke et al., 2006 & Robson et al., 2012)

Engagement Level	Description	Examples
Low	Training that uses oral, written or multi-media presentations, but requires little or no active participation by the learner.	• Lectures • Videos • Training manuals • Online slideshows
Medium	Training with a stronger degree of interactivity, often with a strong emphasis on discussion and feedback.	• Discussion-based lectures • Quizzes or workbooks • Programmed instruction
High	The trainee has a more active role in the learning process, engaging in cognitive and behavioral interaction with the material, and opportunities to ask questions.	• Table-top exercises • Simulated exercises • Behavioral modeling • On-the-job training

Mentorship programs have also been identified as a comprehensive approach to supplement traditional classroom training (Cuervo, Fitch, Stein, & Baron, 2023). Mentorships provide a structured relationship between experienced EHS professionals and individuals seeking to develop their knowledge or skills in the field. While research on how mentorship impacts training is limited, emerging evidence indicates that mentorships may contribute to the successful transfer of EHS knowledge (Cuervo et al., 2023), build leadership abilities (Lester et al., 2011) and apply knowledge to problem-oriented work situations (Bjursell & Sadbom, 2018).

Virtual and Augmented Reality for Training

Significant technological advances have further changed the training landscape. The use of virtual reality (VR) and augmented reality (AR) is increasingly being employed as a tool to deliver safety training as part of the broader EHS landscape (Work to Zero, 2019). Virtual reality devices are designed to immerse the user into an entirely computer-generated environment, while still allowing the individual to navigate the environment as if they were physically there (Verdantix, 2019). In comparison, augmented reality, also known as mixed reality, is an interactive experience in which sensory information (i.e., sound, video and graphics) are overlaid or augmented into the virtual environment (Wang et al., 2018).

Research into immersive virtual reality training has indicated several potential benefits, including soft-skills acquisition (Eckert & Mower, 2020), increased learner engagement (Buttussi & Chittaro, 2018) and reduced cognitive load (Sun, Wu, & Cai, 2019). In comparing VR safety training to conventional training methods, VR training was more effective in maintaining learner attention and concentration and proved to be more effective over time (Sacks, Perlman, & Barak, 2013). Furthermore, a systematic review of virtual reality in safety training provides evidence that this modality actively engages learners, ultimately leading to better learning outcomes (Kanade & Duffy, 2022).

However, like other training modalities, these emerging tactics also have their drawbacks. The biggest barriers to the adoption of AR or VR for safety training are the high costs and cheaper alternatives on the market (Work to Zero, 2021). Further, limited access to head-mounted displays, language barriers and a lack of validated evaluation techniques have also been identified as potential barriers (Kanade & Duffy, 2022). Therefore, different training modalities should be adapted with specific learning objectives and organizational limitations in mind, including budgetary considerations, IT capabilities and time constraints.

Ultimately, the *Training Effectiveness Workgroup* concluded that evaluating training effectiveness depends heavily on available and appropriately focused resources. For example, Campbell Institute members, Dow and W.W. Grainger (Grainger) are investigating virtual reality for their training needs. Alternatively, Nutrien is interested in augmented reality and how it can add value to its safety program and allow trainers to observe trainees live – a vital behavioral observation. Dow also indicated that lower-risk work is most often trained via e-learnings or instructor-led courses, while higher-risk work may entail much more detailed and hands-on training.

Blended Learning

Blended learning, also known as hybrid learning, is an innovative approach to learning which combines face-to-face or traditional classroom approaches with e-learning and online activities (Rao, 2019). Blended learning is rooted in the idea that learning is a continuous process, rather than a one-time event (Rao, 2019). In the context of EHS training, a blended learning approach may be applied in a number of different ways. It may combine one or more face-to-face components, such as in-person workshops, on-the-job training, mentorship programs or group activities, with online components such as e-learning modules, video demonstrations, online forums or discussion groups, or the use of VR/AR training methods.

Generally, the primary advantage of blended learning is that it combines the benefits of more traditional approaches to learning while also leveraging the potential benefits of technology (Hewett, Becker, & Bish, 2018). In general, more research is needed to adequately understand the effectiveness of blended learning, especially in the context of workplace training. However, preliminary evidence has shown that blended learning may produce stronger learning outcomes compared to purely online or classroom methods (Bernard et al., 2014; Means et al., 2010, 2013). A study by Maloney et al. (2015) also found that blended learning was more cost-effective compared to traditional face-to-face models, reducing the delivery of training within a medical program by 24% overall.

Blended learning may also be an efficient means of providing EHS training to employees. According to Greene and Marcham (2019), while online safety courses may be more efficient, consistent and cost-effective compared to face-to-face training, conventional training can also provide the hands-on experience often needed to demonstrate that an employee can perform the job safely. It is important to note that online or blended approaches are not appropriate for some training scenarios (Greene & Marcham, 2019), such as hands-on technical skills training or where in-person experience is necessary to properly identify and control for workplace hazards.

As with all approaches to learning, blended learning also has limitations and barriers to its adoption. First and foremost, because a comprehensive framework on blended learning is lacking, researchers and practitioners are still struggling with the implementation of blended learning (Moskal, Dziuban, & Hartman, 2013). Additionally, a vast majority of research on the topic focuses on learning in academic environments, thus, more research is needed to evaluate the effectiveness of blended learning approaches on workplace training. Other barriers or limitations include a lack of sufficient technology and support (Buchanan, Sainter, & Saunders, 2013), IT literacy (Rao, 2019) and a general lack of sufficient infrastructure (Porter & Graham, 2016). Additionally, as previously mentioned, blended learning may not be appropriate in some safety scenarios, particularly those which require learners to demonstrate competency and knowledge transfer (Greene & Marcham, 2019).

Delivery Style

In the context of training and education, delivery "mode" and delivery "style" refer to different aspects of how information is presented to learners. If, as mentioned above, delivery mode refers to the medium or platform through which materials are presented to learners, then the style relates more to the manner or approach used by an instructor to convey content. Examples might include details about the instructor themselves – their delivery, style or pace (Smith, 2018). According to OSHA (2021), training facilitators should have an EHS background or be a subject matter expert in the field. They should also have experience training adults, experience working with the population or practical experience in the field.

Learning exchanges can occur in three main ways: participant-to-participant, participant-to-facilitator and facilitator-to-participant (OSHA, 2021). Ideally, learning activities will include opportunities for employees to demonstrate the skills and knowledge they have learned in the training (NSC, 2019). Other considerations for delivery style might include the use of visual aids, hands-on activities, PowerPoint slides, etc. A common tactic is for trainers to use a combination of the four learning styles (VARK) to ensure different learning styles are met and increase the overall engagement of the training (Smith, 2018).

Microlearning versus Extended Learning

Notably, the technique of "microlearning" has emerged as a potential supplement to longer, more comprehensive training programs. Microlearning is a training technique that breaks down lessons into shorter, more focused courses designed to meet specific knowledge outcomes (Emerson & Berge, 2018). These modules are typically delivered via various formats and devices, including tablets, computers, laptops and mobile phones (Shail, 2019). By breaking down information, such as health and safety concepts, into smaller modules, microlearning enables learners to focus on one piece of information at a time, iteratively guiding them toward a larger goal.

Compared to traditional "extended learning" techniques, microlearning offers several key benefits. For example, research indicates the average human attention span is decreasing (see Leong et al., 2020), with one study finding a reduction from 12 seconds to 8 seconds from 2000 to 2013 (Gausby, 2015). Microlearning modules are designed to be short, often under 15 minutes, and enable learners to self-pace their training, ultimately reducing the mental fatigue associated with traditional learning approaches (Shail, 2019). Microlearning has also been associated with better retention of concepts (Mohammed., Wakil, and Nawroly, 2018; Shail, 2019), increased learner engagement (De Gagne et al., 2019) and heightened confidence in performing work-based activities (De Gagne et al., 2019; Hesse et al., 2019).

Microlearning may also serve as a more flexible, cost-effective alternative to traditional training methods. Businesses are increasingly focusing on the emerging concept of microlearning to support the fast-paced, multi-task oriented and digitally savvy learners in the workforce (Madden and Govende, 2020). These types of modules offer increased flexibility, allowing workers to control when they take their training, with the ultimate goal of reducing the lost time and productivity typically involved in long-form safety training (Schulz, 2022). Microlearning has also been associated with heightened levels of learner satisfaction and acceptance (Ai-Dung & Woei, 2022) Additionally, compared to the cost of traditional classroom or custom e-learning modules, microlearning may also reduce the costs necessary to quickly train or refresh safety concepts in the workplace (Beste, 2021).

However, downsides to microlearning techniques also exist. Given the shorter length of the training, microlearning modules are limited in the depth of information available. Thus, these techniques are not a substitute for comprehensive training on more advanced or complex topics (Ai-Dung & Woei, 2022). Furthermore, because concepts are broken down into smaller modules, there is the potential for these experiences to become fragmented or disorganized for learners. Technology inequalities may also make microlearning modules less accessible for some learners (Gagne et al., 2019).

Generally, more research is needed to better understand the benefits and limitations of microlearning (Ai-Dung & Woei, 2022), especially in the realm of health and safety. However, preliminary evidence shows microlearning can be useful for facilitating extended training techniques by providing students with a flexible, less time-consuming option for quickly learning or refreshing concepts. As an example, member organization, The Chemours Company, uses microlearning as "refreshers" for employees, allowing them to quickly refresh their understanding of concepts without sacrificing the necessary context of extended learning techniques.

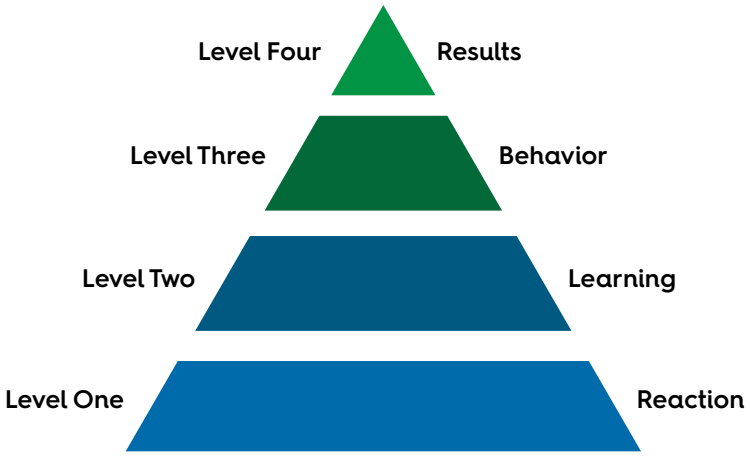
Training Effectiveness

As previously discussed, while training can have numerous benefits on safety outcomes, poorly delivered or ineffective training programs can potentially negate these benefits (Albert & Routh, 2021). Other negative outcomes might include an increased risk of workplace injuries (Burke et al., 2006), unfavorable worker attitudes toward safety practices (Namian et al., 2016) or reduced worker productivity (Burke et al., 2006). Regardless of the type of delivery modality, delivery style or schedule, evaluating the effectiveness of training interventions and making any necessary changes or updates is critical to building a strong overall EHS program. Notably, while most members of the Training Effectiveness Workgroup have metrics in place to gauge effectiveness, many lack a full and formal training effectiveness program. To address this gap, the group benchmarked common evaluation principles and language and worked together to develop a foundation for formalizing a safety training effectiveness program.

The Kirkpatrick Training Effectiveness Model

Originally developed by Donald L. Kirkpatrick in the late 1950s, the Kirkpatrick Model is a long-standing and widely utilized standard for evaluating the effectiveness of training (see Reio, Rocco, Smith, & Chang, 2017). The model is comprised of four levels of effectiveness: reaction, learning, behavior and results. Traditionally, the Kirkpatrick Model is shown as a pyramid to illustrate the hierarchical nature of training effectiveness, where each level builds upon the previous one. Moving up the pyramid, the complexity and impact of the assessment increase, while the availability of the data decreases. At the higher levels, measuring outcomes becomes more challenging and complex compared to the more accessible data available at the lower levels.

Figure 4. **The Kirkpatrick Model** (Kirkpatrick and Kirkpatrick, 2021)



While the Kirkpatrick Model has been studied extensively since its development in the 1950's, more research is needed to determine whether a more modern model of training effectiveness is needed to evaluate current training modalities. Other existing models which can provide alternative perspectives or applications for employers include:

Phillip's ROI Model (Phillips, 2005): This model considers many of the same elements as the Kirkpatrick Model, including reaction, learning, application and implementation, and impact. However, it emphasizes the measurement of financial outcomes and the return on investment (ROI). This model can be useful for organizations seeking to assign a monetary value to the results of training. However, a full ROI analysis can also add additional cost and complexity to the process.

Kaufman's Model of Learning Evaluation (Kaufman, Keller, & Watkins, 1995): This model also adapted many of the same elements as Kirkpatrick's model into five key levels of evaluation: input, process, micro-level, macro-level and mega-level. Kaufman's model emphasizes the alignment of training objectives with organizational goals and more broadly examines the impacts of training. However, implementing this model may require a more comprehensive and systematic approach to assessment, which could be challenging for organizations with limited resources or time constraints.

Brinkerhoff's Success Case Model (Brinkerhoff 2005): This model differs from others in that it assesses the effectiveness of training programs by deliberately identifying and analyzing success. By focusing on cases where a training program or intervention was particularly successful, it enables organizations to extract best practices, replicate successful training modules and enhance overall training effectiveness. However, this model may not capture the overall effectiveness of a training program or provide comprehensive data on the broader impact.

While these models provide alternative perspectives on training evaluation, the Kirkpatrick Training Effectiveness Model served as the foundation for evaluating safety training effectiveness within the Training Effectiveness Workgroup and throughout this report for many reasons. Firstly, the model has been extensively studied since its initial development and has been applied and evaluated across multiple industries (Nawaz, Ahmad, & Khushnood, 2023). Additionally, the popularity of the model has been partially attributed to its simplicity, the measurement of a limited number of variables and the ease of evaluation criteria (Heydari, Taghva, Amini, & Delavari, 2019). The model remains a comprehensive and practical model for measuring training effectiveness. Furthermore, according to a 2023 meta-analytic study of 41 studies on the Kirkpatrick Model, evidence shows a positive association between all four levels of the model, with the authors concluding the Kirkpatrick Model is a useful tool for experienced trainers, decision-makers and training administrators, providing additional support for the adoption of this model (Nawaz, Ahmad, & Khushnood).

Level One: Reaction
The first level of the Kirkpatrick Model is reaction, which refers to the degree to which participants found the training favorable, engaging and relevant to their jobs (Kirkpatrick & Kirkpatrick, 2021). As previously mentioned, the most engaging methods of safety training tend to be the most effective in promoting knowledge and skill acquisition (Burke et al., 2006). The Training Effectiveness Workgroup discussed four key methods their organizations use to collect trainee reaction data – survey questionnaires, open dialogue (e.g., one-on-one conversations or roundtable discussions), instructor feedback forms and e-learning feedback. Surveys and open dialogue were the most common approaches utilized by Campbell Institute members.

Regardless of the method employed, organizations should ensure the data being collected measures the feedback objectively from participants. Oftentimes, this also entails separating content evaluations from instructor evaluations to differentiate between potential issues arising from the content versus the delivery. For example, at the time of this report, Campbell Institute member AECOM was in the process of drafting a safety training effectiveness survey designed to assess the enjoyability of the training, its perceived relevance to the job and overall training satisfaction. Additional examples of Level One questions identified by the workgroup include:

- ***I felt the content of the training was relevant to my work***
- ***I was satisfied with the content of the training***
- ***I feel more knowledgeable about my job because of this training***
- ***I feel I have more skills because of this training***
- ***I feel I will work more effectively because of this training***
- ***I enjoyed this training***
- ***I was engaged with the training***
- ***The facilities were appropriate for this training***
- ***The method of delivery was appropriate for this training***
- ***I understand the risk of exposure resulting in injury or illness I can face in my work***

Level Two: Learning
The second level of the Kirkpatrick Model measures the degree to which participants acquired the intended knowledge, skills, attitude, confidence and commitment based on the intended learning objectives (Kirkpatrick & Kirkpatrick, 2021). Through various evaluation methods, such as post-training assessments, quizzes, roleplaying and simulations, organizations can measure the extent to which employees have absorbed the training content and whether they have developed the desired competencies related to safety practices.

For example, Grainger uses periodic knowledge checks as workers progress through the training, which ensures information is being acquired at different intervals. To address potential issues arising from their learning management system (LMS), AECOM also tracks the number of IT help requests following training assignments. Using the number of reports as a baseline, they can better understand and address potential training barriers arising from quality or technical issues.

Additionally, Level Two evaluations may involve observations, feedback from trainers or supervisors, and self-assessments by participants to gauge their understanding and application of safety principles in real-world scenarios. Management should also consider having brief, ongoing discussions with employees about the application of the training to their work. Grainger went on to elaborate that safety observations and floor walks are another way they evaluate the efficacy of their training program. Dow reiterated the importance of making sure these measurements rely on objective measurements, rather than subjective participant feedback, such as the use of demonstrative skills assessments.

Level Three: Behavior
The third level of the Kirkpatrick Model measures the degree to which participants can apply what they have learned in the workplace (Kirkpatrick & Kirkpatrick, 2021). This evaluation involves observing employees' behavior, collecting feedback from supervisors or colleagues, and conducting interviews or surveys to assess their adherence to safe practices and the integration of training outcomes into their daily routines. Depending on the objectives of the training, observations may take place immediately or after a designated time to address how well the worker retained the training.

The *Training Effectiveness Workgroup* emphasized the importance of reinforcing safety training via coaching, mentoring and correction. Mentorship programs have been identified as a comprehensive approach to supplement traditional classroom training (Cuervo, Fitch, Stein, & Baron, 2023), and more effectively apply knowledge to problem-oriented work situations (Bjursell & Sadbom, 2018). Most members of the workgroup indicated they use some form of coaching and correction, including engaging in follow-up conversations with their safety coaches, measuring safety observations and conducting floor walks with employees. These actions allow EHS managers to better understand how training knowledge is being applied in the workplace.

Level Four: Results
Finally, the last level of the Kirkpatrick Model refers to the broader impact of training outcomes on organizational goals and objectives (Kirkpatrick & Kirkpatrick, 2021). At this stage, organizations aim to measure the long-term effects of key performance indicators (KPIs) related to safety. This may include reductions in incident rates, decreased injuries resulting from days away from work, increased compliance or increased employee engagement. These objectives often involve comparing pretest and posttest data, conducting surveys or interviews, and evaluating key safety metrics. For example, AECOM opts to track training as a KPI and measures it against lagging metrics such as total recordable injury rates (TRIR) and lost workday case rates.

A Pre and Post Process for Measuring Training Effectiveness
The *Training Effectiveness Workgroup* worked together to develop a quasi-experimental pretest-posttest design to measure safety training effectiveness. The pretest model contains three steps for training evaluation: self-perceptions, other perceptions of self and observations of both. The posttest model contains the same elements, with an additional fourth step, which entails evaluating the training based on the above recommendations.

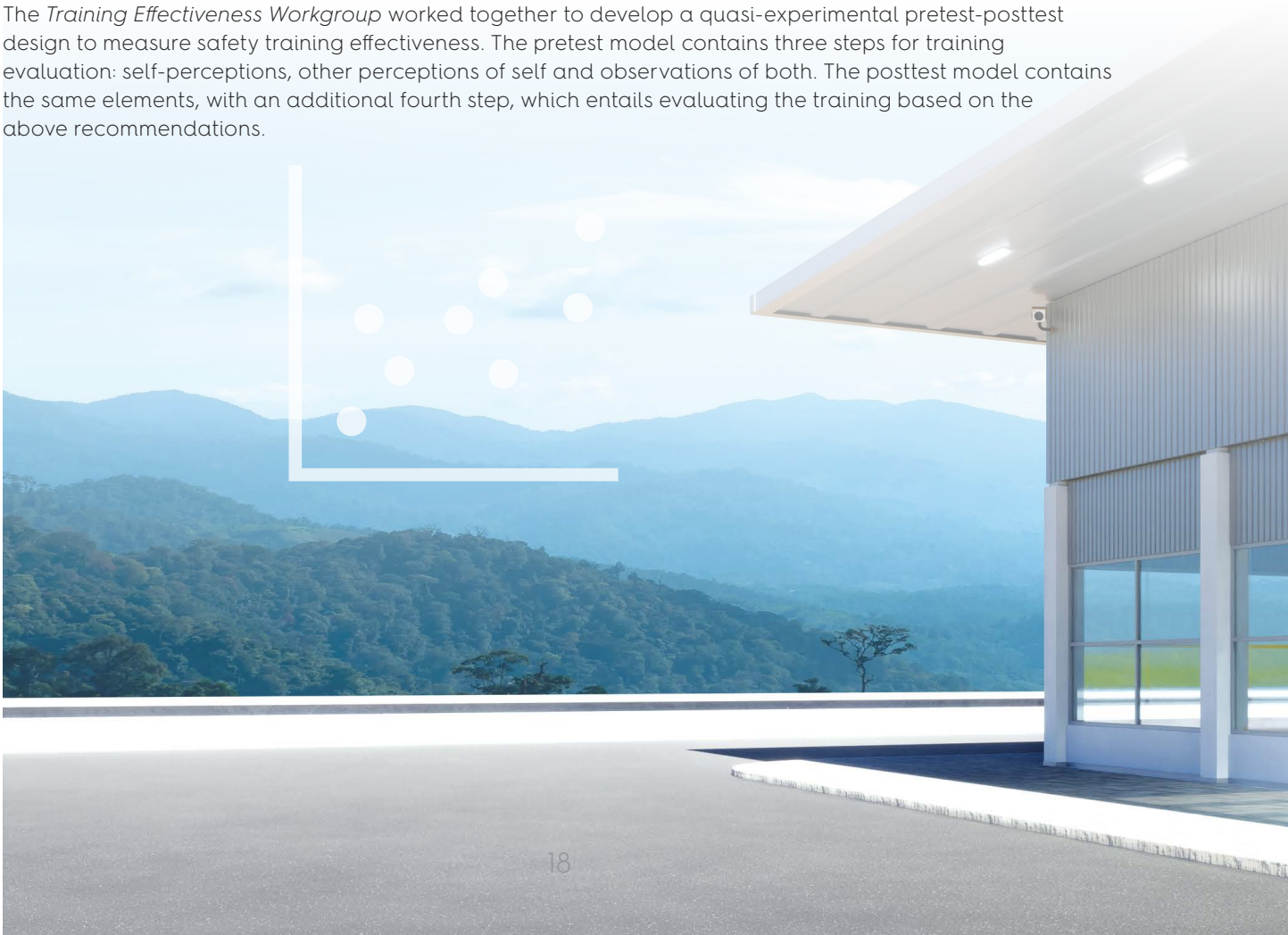


Table 2. **Pretest-Posttest Process for Training Effectiveness**

Phase One: Pre-Training Evaluation

Step One	Step Two	Step Three
Employee perceptions about their knowledge before the training	Supervisor or colleague perceptions about the employee's knowledge and skills	Third-party observations

Phase Two: Post-Training Evaluation

Step One	Step Two	Step Three	Step Four
Employee perceptions about learnings, knowledge gained and skill(s) acquired from the training	Supervisor or colleague perceptions about the employee's knowledge and skills	Third-party observations	Data analysis and measuring training effectiveness

Step one has employees complete an assessment of their job-relevant knowledge, competencies and skills. Again, this step should occur both before and after training to measure the perceived changes resulting from the training. By self-assessing their capabilities, employees can provide insights into their understanding of their roles, responsibilities and the specific skills required to perform their job effectively. This step encourages employees to reflect on their strengths, weaknesses and areas for improvement, fostering self-awareness and ownership of their professional development.

During step two, the evaluation model incorporates the perspectives of the employee's supervisor or colleagues. This step entails soliciting feedback from those who directly observe the employee's job performance or interact with them regularly. By gathering input from these individuals, training facilitators can gain an external viewpoint on the employee's perceived competencies. This step also helps capture a more comprehensive picture of the employee's performance, taking into account their interactions, contributions and impact on team dynamics.

In this case, step two acts as a "check" for step one, where significant differences may indicate perceptual misalignments that can have implications on overall workplace safety. Addressing these misalignments is important for maintaining a safe work environment, as it necessitates open and constructive communication between employees and their supervisors to bridge the gaps in perception, align expectations and foster a culture of safety. Regular feedback sessions, coaching and training can help employees gain a realistic understanding of their competencies while providing supervisors with insights to provide appropriate guidance and support.

In step three, the evaluation process introduces a third-party observer to assess the employee individually and in their interactions with others. This impartial observer closely observes the employee's work activities, teamwork and overall performance. By providing a neutral perspective, the third-party observer can provide an unbiased assessment of the employee's job-relevant knowledge, competencies and skills. This step aims to eliminate any potential biases or preconceived notions that may arise from internal relationships or hierarchical dynamics within the organization.

It is important to note the use of observations can provide valuable insights into a worker's work activities and interactions, but they should not be the sole approach to measurement. Measurement of training effectiveness should consider multiple data sources where possible, including objective performance metrics, worker self-assessments, management feedback and post-training assessments.

While steps one, two and three should be applied before and after safety training, the posttest phase has the additional stage of measuring training effectiveness. In this step, training facilitators should analyze the data collected from the prior stages and use this information to improve the training program. They can examine feedback, observations and self-perceptions to identify areas of strength and areas for improvement in the training content, delivery methods or overall effectiveness.

These data can also be connected back to organizational goals and KPIs relevant to safety training, such as incident rates, injuries, compliance or employee engagement in safety activities. By aligning the training data with these objectives and metrics, training facilitators can assess the impact of the training on broader safety goals and make informed decisions on how to enhance the program further.

Importantly, employers must recognize that correlating training efforts to safety incidents may lead to an incomplete understanding of the underlying root causes contributing to workplace incidents. While safety incidents are undoubtedly a critical factor in addressing potential training gaps, they should not be the sole basis for evaluating the effectiveness or need for a training program. For example, an extensive review of existing leading indicators found that workplace safety is a complex and multifaceted area (Campbell Institute, 2015). While training can be a strong directional indicator of an organization's overall safety culture, other leading indicators should also be collected to more holistically understand workplace safety.

Research from the Campbell Institute (2015) identified over twenty leading indicators and associated metrics that can be used to facilitate information collected from training. Examples of these leading indicators include the use of risk assessments, risk profiling, collection of preventative and corrective actions, safety perception surveys, compliance and management of change processes (Campbell Institute, 2015).

Conclusions

In conclusion, the findings of this collaborative research project highlight the importance of evaluating the effectiveness of safety training programs within organizations. Safety training is widely recognized as a vital component of any EHS program, contributing to injury prevention, hazard mitigation and the development of a strong safety culture. While organizations often employ various metrics to measure their training efforts, many lack a systematic approach to assess the impact on safety attitudes, behavioral changes and overall safety culture.

This report consolidated insights from the Campbell Institute *Training Effectiveness Workgroup*, interviews with member organizations and a systematic literature review to offer a framework for training evaluation, including the use of Kirkpatrick's Training Effectiveness model and the development of a novel pretest-posttest evaluation model. By implementing robust evaluation processes and adopting the best practices outlined in this report, employers can strengthen their commitment to safety, improve their EHS training programs and ultimately provide workers with the skills and knowledge necessary to do their work safely.

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