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Understanding How Manufacturing Employees Learn About Safety

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UNDERSTANDING HOW MANUFACTURING EMPLOYEES LEARN ABOUT SAFETY

by

Melissa I. Bloch-Meier

A Dissertation Submitted in
Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
in Urban Education

at

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ABSTRACT

UNDERSTANDING HOW MANUFACTURING EMPLOYEES LEARN ABOUT SAFETY

by

Melissa I. Bloch-Meier

The University of Wisconsin-Milwaukee, 2021

Under the Supervision of Professor Simone C. O. Conceição

While millions of workers are injured on the job every year (Bureau of Labor Statistics, 2019), at least some of these injuries can be attributed to failure to use what was learned during safety training (Safety Partners LTD., 2014). By better understanding workers' experiences, organizations may be better able to create more impactful safety training programs that will ultimately keep more workers safe. Therefore, the purpose of this study was to gain an understanding of how manufacturing employees learn about safety. A review of research has shown that empirical studies related to manufacturing employee safety training can be modeled through Daffron and North's (2011) transfer of learning model and Daley and Cervero's (2016) model of learning in continuing professional education. These empirical studies, however, have not focused on understanding the experiences of the manufacturing employees themselves as they learn about safety. This study followed a generic qualitative inquiry research design, with 11 semi-structured interviews of manufacturing employees at four urban manufacturing sites. It was found that combining the Daffron and North (2011) and Daley and Cervero (2016) models into a single model is an effective way to conceptualize how manufacturing employees learn about safety and practice that learning in the workplace. Other key contributions include the understanding that learning which is time-flexible and done with a person whom the employee considers to be an expert is preferred; and how the safety culture, through positive supervisor examples, is critical to the actionable practice of safety learning.

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To

Uncle Marty for being an inspiration

My parents for their guidance and for instilling in me a love of learning

My husband for his patience, encouragement, sacrifice, and support

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CHAPTER 1: INTRODUCTION

Jamie just started a new job as a forklift driver on the shipping dock of a warehouse. On her first day of work, her manager, Amar, told her it was important to complete a safety check of her forklift before starting each day and gave her a document which outlined each check. She arrived on day-two, went to her forklift, took out the safety checklist, and tried to remember what her manager said. After standing there for a few minutes looking at the forklift, hoping she remembered something from her training, one of her new coworkers, Jill, stopped by and asked what she was doing. Jill told her the checks were not required and that she should just get to work. Later that day, as Jamie was driving through the warehouse, she did not see a coworker walking across an aisle behind her as she drove in reverse. She struck the coworker, Erik, with the forklift and he sustained serious injuries. Upon investigation, it was found that the rearview mirror had broken off on the previous shift and Jamie did not notice its absence because she never completed the daily check.

Matt was an employee at a global manufacturer of automotive equipment. He arrived at work at 6:00 AM and the incoming dock was already teeming with trucks delivering raw materials from suppliers which were needed for the day's production. Since his company used a just-in-time philosophy, there were not many raw materials on the production floor, and he knew he needed to get the incoming trucks processed quickly. There was a heavy box that needed to be taken off the truck and there were warnings on the box indicating its heavier-than-usual status. He vaguely remembered his training about good lifting techniques and lifting heavy boxes with another person, but he did not exactly remember what he was supposed to do. He looked up and saw his coworkers lifting boxes alone with those same warning labels. He made a quick decision to lift the box himself and, upon doing so, he suddenly felt a shooting pain in his back.

While the scenarios above are only examples of the types of situations that could occur in a manufacturing setting, on June 27, 2016, a 17-year-old employee at a Wisconsin metal fabrication company was pinned under a loading table which moved unexpectedly while he was removing scrap from under the table. He died from his injuries five days later. The Occupational Safety and Health Administration (OSHA) cited the company for, among other violations, not ensuring energy lockout procedures were followed and not training employees about those procedures. The company also failed to provide training about noise hazards, respiratory protection, forklift operation, and chemical usage (Occupational Safety and Health

Administration, 2016). As a multitude of hazards are often found at manufacturing workplaces, it is critical that employers provide training to employees about those hazards and how to prevent them. This type of training, as regulated by OSHA in the United States (Occupational Safety and Health Administration, 2015), is a key factor in creating safer working environments for manufacturing employees.

While employers are required to provide safety training to employees (Occupational Safety and Health Administration, 2015), it is difficult to ensure the employees will use what was learned when they are on the job. Millions of workers are injured in the workplace every year (Bureau of Labor Statistics, 2019) and many of the incidents could have been avoided if workers followed the safety training they received (Safety Partners LTD., 2014). While there can be a number of reasons for the disconnect between knowledge and application, the field of workplace safety could benefit from a better understanding of workers' experiences with safety training and other means of learning about safety. The study described in the following chapters aimed at doing just that.

In this chapter, a brief history of safety training in the workplace is presented, the state of urban manufacturing is explained, and what Baldwin and Ford (1988) called "the transfer problem" is described. Next, the study purpose, definition of terms, and the research questions are reviewed. Finally, a brief overview of the research design completes the chapter. This introduction will be followed by a thorough literature review and detailed discussion of the study methodology, findings, and conclusions.

Safety Training in the Workplace

According to Aldrich (2001), in the early days of manufacturing in the United States, companies focused mainly on increasing productivity and profits, and did not spend much energy

on making their factories safer. This was mainly due to the fact that accidents were cheap, as little to nothing was ever paid to injured employees or their families and more workers were always available. In the 1910s, when workers' compensation laws were passed, employers began to pay more attention to worker safety and creating safer workplaces. Machine designs introduced safety guards and power controls, managers looked for hidden hazards, and personal protective equipment, such as hard hats and safety glasses, became more prevalent.

While several public health schools developed training programs focused on injury prevention in the mid-1960s (National Center for Biotechnology Information, 2000), acknowledging the importance of safety training in the workplace was not widespread until the establishment of the Occupational Safety and Health Administration (OSHA) in 1971. At that time, training became a key tenant of the new administration (Occupational Safety and Health Administration, 2011). OSHA quickly established the OSHA Training Institute in 1972 and made training and education grants available for the creation of training programs in high-hazard workplaces in 1978 (Occupational Safety and Health Administration, 2011).

Today, OSHA has a 270-page document which outlines training requirements for different industries and hazard types (Occupational Safety and Health Administration, 2015). For example, the training outlined in that document, which could have saved the young man's life in the metal fabrication plant, would have included information about recognizing hazardous energy sources and understanding energy control procedures. He also would have been retrained on a regular basis (Occupational Safety and Health Administration, 2015). While not all workplace hazards are severe enough to be fatal, OSHA has clearly put an emphasis on training and its importance. Unfortunately, however, even when training does occur, there is still the possibility that employees may not follow what they have learned.

Urban Manufacturing

According to Mistry and Byron (2011), in the 1950s, manufacturing jobs accounted for one-third of the nonfarm workforce and many of these jobs were located in urban areas. As lower tax rates and available land lured manufacturers to more rural areas, urban manufacturing saw a significant decline in the last half of the 20th-century. More recently, however, small urban manufacturers (SUMs) have seen an increase in popularity, even as their larger counterparts continue to downsize. For example, over 80 percent of New York City's and Los Angeles's manufacturers have fewer than 20 employees. SUMs benefit from a large available workforce with a variety of skills in the urban area in which they are located, and urban workers benefit from worksites that are accessible by the city's transportation system.

The trend toward SUMs has helped bolster manufacturing in urban areas and made safety training in urban areas even more important. While OSHA does not require injury and illness records to be kept by companies with fewer than 10 employees (Occupational Safety and Health Administration, 2001), the training regulations make no mention of a minimum number of employees (Occupational Safety and Health Administration, 2015). This suggests that safety training is a critical function of any organization, regardless of size, and that SUMs can benefit from improvements to safety training programs.

Even though the trend of urban manufacturers is to lean toward small-scale operations, many large-scale manufacturers still call urban areas home. Therefore, research done at urban manufacturing sites can benefit workers in both large and small locations.

The Transfer Problem

According to Wentworth (2016), large businesses of over 10,000 employees spend an average of \$13M on their total annual training budgets, including safety and non-safety training,

with mid-size and small companies spending \$3.7M and \$0.3M, respectively. One can only assume that with budgets such as these, employers expect some type of return on their investment in training. In other words, applying what was learned in training to the job context is critical for organizations to ultimately improve profitability through improved job performance of their employees (Aguinis & Kraiger, 2009; Grossman & Salas, 2011). Without the employees' ability to apply what they learned, money spent on training is wasted; and profitability, productivity, product quality, and employee safety may also be at risk.

The concepts of transfer of training, transfer of learning, and application of learning in continuing professional education (CPE), have been the focus of numerous studies, with literature searches resulting in thousands of articles. While the academic community continues to grapple with these concepts, it appears that no complete solution has been identified which will eliminate what is commonly referred to as "the transfer problem" (Baldwin & Ford, 1988). In short, the transfer problem is the failure of workers to use on the job what they learned in training.

As evidenced by the plethora of articles written about the topic, this transfer problem is seen across all subjects and contexts where people are learning in the workplace. Specifically, in the context of workplace safety, the stakes are perhaps higher than other contexts, such as leadership skills, conflict resolution, or good presentation skills, because a failure to apply safety knowledge could result in severe injury or death. Tracey et al. (1995) have explained that knowing something does not necessarily mean the knowledge will be applied to a skill or behavior. For example, a new driver may have learned it is illegal to run a red light, but may not always follow this rule. The driver may run the red light because of being late, not seeing the light change to red, rushing a friend to the hospital, not understanding the law, or perhaps the

brakes on the vehicle failed to work. Regardless of the reason, the driver has not applied what was learned.

When translating knowledge to behavior in the context of safety in the workplace, the importance is clear: What good is it for someone to learn about safety, but then continue unsafe practices? In fact, according to Safety Partners LTD (2014), the seven most common causes of workplace accidents include shortcuts, overconfidence, poor or lack of housekeeping, starting a task before receiving all the necessary information, neglecting safety procedures, mental distractions, and lack of preparation. Many of these reasons can be traced back to employees not applying their knowledge of safety to their behaviors.

Unfortunately, the fact that workers are getting injured on the job is not isolated to a specific industry or location. While injuries steadily decreased between 2003 and 2017 as seen in Figure 1.1, according to the Bureau of Labor Statistics (2019) there were “2.8 million nonfatal workplace injuries and illnesses reported by private industry employers in 2017” (p. 1). To understand the impact of this number, 2.8 million people is greater than the populations of the states of North Dakota, Alaska, Vermont, and Wyoming combined. Poor transfer of safety learning is not to blame for every incident; however, the more that can be done to improve the transfer of learning, the better chance employees have for staying safe at work.

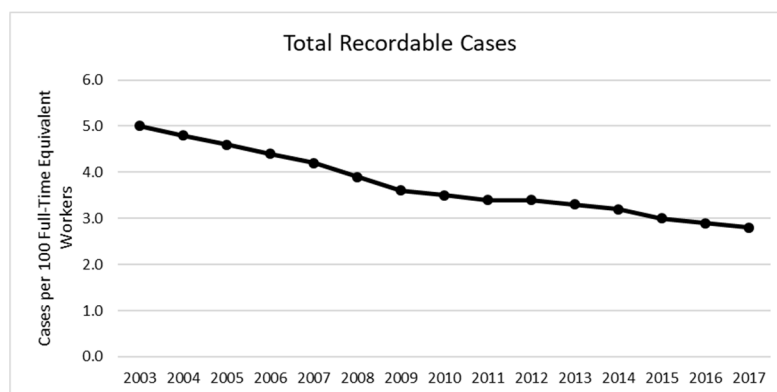


Figure 1.1: Total Recordable Cases, 2003 to 2017, adapted from the Bureau of Labor Statistics (2019)

Even with annual refresher training, the fact that employees are still being injured on tasks where proper safety techniques should be used to avoid injury, there is a disconnect between knowledge and action. To draw this conclusion, one must assume that workers have learned something as a result of training. If the possibility that workers have not even learned the material is brought into the equation, then the disconnect is not necessarily between knowledge and action, but between what is covered in training and what is truly learned by employees. This brings up the question of whether workers are learning from safety training programs, from other intentional or informal means, or if they are not learning at all.

As manufacturing-based employees continue being hurt, despite annual safety refresher training, additional investigation on ways to reduce injuries must continue. Assuming one of the reasons for these continued injuries is ineffective training, researchers have spent a significant amount of time investigating possible causes for why employees may not be applying what they have learned. Over the years, many empirical studies and meta-analyses have been conducted to try to find the answer to the “transfer problem” in the safety training context. Years ago, these studies focused primarily on the evaluation of different training methods (Bosco & Wagner, 1988; Caparaz et al., 1990; Chaffin et al., 1986; Cohen & Jensen, 1984; Curwick et al., 2003; Dortch III & Trombly, 1990; Lusk et al., 2003; Müller et al., 2007; Wallen & Mulloy, 2006). More recently, the research began to shift toward gaining a better understanding of what factors influence the transfer of safety learning (Brinia & Efstathiou, 2012; Burke et al., 2007; Burke et al., 2008; Burke et al., 2011; Freitas et al., 2018; Krauss, 2005; Namian et al., 2016; Ripamonti & Scaratti, 2015; Somerville & Lloyd, 2006). These more recent studies have generally focused on only a few areas of the transfer of training and transfer of learning models and did not investigate the on-the-job experiences of manufacturing employees and how the employees are

learning about safety. To hear their voices in the study of “the transfer problem,” qualitative research to better understand the experience of the employees is warranted.

In summary, the problem under investigation is that manufacturing employees continue being injured on the job at an alarming rate, despite the fact that organizations are spending significant amounts of money on safety training. While improved training and learning will not prevent every accident, they will have a substantial impact in reducing accident rates.

Study Purpose

Considering the history of safety training in the workplace and the significance of “the transfer problem,” the purpose of this study was to gain an understanding of how manufacturing employees learn about safety. The conclusions reached by the study can be used to aid organizations in preparing better and more impactful safety training programs for employees. In addition, this study is expected to contribute to the knowledge-base of the field of safety training by better understanding manufacturing employees’ experiences and preferences regarding how they learn about safety. Knowing this will hopefully influence safety course designers and safety leaders to provide learning opportunities for employees in ways that ultimately keep more of them safe at work.

Research Questions

By understanding the current research regarding transfer of learning in the safety context, along with statistics about safety incidents in the United States, it has become apparent that, while much research has been done, the “transfer problem” remains. It is not necessarily clear, however, if failures to apply what is covered in safety training courses or learned through other means is an issue with the application portion of the transfer process or the learning portion. Understanding learner experiences will help to shed light on this problem. With this in mind, the

following research question guided my inquiry: What are manufacturing employees' experiences with safety training? The following three sub-questions were used to explore this over-arching question: 1) How do manufacturing employees learn about safety? 2) How does the learning context influence manufacturing employees' knowledge about safety? 3) How do manufacturing employees apply their knowledge about safety in the workplace? To answer these questions, a qualitative research design was followed and is summarized in the next section.

Research Design

As suggested by Creswell and Creswell (2018), qualitative research is best used when exploring the lived experiences of people. Since this study considered the experiences of manufacturing employees and how they learn about safety, a qualitative research approach best fit this type of inquiry. The following sections will give a brief overview of the methodology, context and participants, data collection, and data analysis. A more in-depth description can be found in Chapter 3.

While a number of methodologies exist within the qualitative tradition, this study was set in an exploratory fashion as a generic qualitative inquiry, so as to be open to any types of themes which may arise in an effort to better understand the learner's experiences with safety training (Merriam & Tisdell, 2016). To do this, a recruitment survey and semi-structured interviews were used to gather information from participants, and thematic coding was used to analyze the interview transcripts.

Eleven participants were chosen through a recruitment survey as a criterion-based, typical purposeful sample (Merriam & Tisdell, 2016) of urban manufacturing employees. Information about the participants' experiences with safety training was gathered through semi-structured interviews lasting 30 to 65 minutes, which allowed for exploration of emerging ideas and

probing into the details of their experiences (Merriam & Tisdell, 2016). Information gathered during each of the interviews has been kept confidential and all identifying information has been removed before analysis began.

Using the methodology suggested by Creswell and Creswell (2018), analysis of the interviews was done both inductively and deductively. First, categories were formed from lower-level patterns and then built into themes. The interviews were then reexamined to see if there was additional information which supported those themes. With this approach in mind, after transcribing each interview, they were coded based on the holistic coding methodology which Saldaña (2009) describes as capturing the overall essence of the contents. The codes were then categorized into families and finally grouped into larger themes. Once these themes were established, a rich and complete picture was drawn using both the inductive and deductive phases of qualitative research.

Definition of Terms

To ensure the reader understands how various terms were used throughout this study, a list of terms and definitions has been provided and can be found in Table 1.1 below.

Term	Definition
Continuing Professional Development	The set of activities, including professional education, which is required for professionals to maintain their registration and often their continued practice (Boud & Hager, 2012).
EHS Training	Training conducted in manufacturing related to topics of the environment, health, or safety. EHS = Environmental, Health, and Safety.
Formal Learning	Learning that is sponsored by an educational institution whose purpose is to provide for-credit degree programs (Merriam & Bierema, 2014)
Informal Learning	Learning that occurs in the course of one's everyday life (Merriam & Bierema, 2014).

Term	Definition
Manufacturer	An establishment which transforms materials into new products (U.S. Bureau of Labor Statistics, n.d.).
Manufacturing Employees	People whose job functions directly impact the production of goods. Their jobs include material handlers, assemblers, testers, quality controllers, and shippers.
Manufacturing Support Functions	Jobs which support manufacturing functions which are often held by professionals. These include roles such as engineers, managers, material buyers, master schedulers, and administrative assistants.
Nonformal Learning	Learning that is organized by an institution, organization, or group whose primary purpose is not education and where formal degrees are not earned (Merriam & Bierema, 2014)
Safety Culture	The organizational norms related to safety (Petitta et al., 2017).
Transfer of Training	The generalization to the job context and maintenance over time of knowledge, skills, and attitudes learned during training (Baldwin & Ford, 1988).
Transfer of Safety Training	The generalization to the job context and maintenance over time of <i>safety-specific</i> knowledge, skills, and attitudes learning during training (Krauss et al., 2014).
Transfer of Learning	An effective and continued change in attitude, demonstration of new knowledge, or change in behavior on the job that results from learning (Broad, 1997; Daffron & North, 2011).

Table 1.1: Definition of Terms

Summary

While safety training is mandated by OSHA (2015), millions of employees are being injured on the job every year (Bureau of Labor Statistics, 2019). This study presents a qualitative examination of workers' experiences to understand how manufacturing employees learn about safety and apply that learning to their jobs. Eleven participants were interviewed and the transcripts from those interviews were coded to identify themes which run through the participants' experiences. Before diving deeper into the details of the methodology, however, it

is important to understand the literature which explains the conceptual frameworks and empirical studies related to learning in the workplace and specifically in the safety context.

CHAPTER 2: LITERATURE REVIEW

In the United States, employers are required to provide safety training to employees (Occupational Safety and Health Administration, 2016), but there are no regulations which require employees to use what they have learned from that training in their regular job context. For many years, researchers have studied workplace learning and even in the 1950s, Mosel (1957) recognized that workers needed to apply what they had learned by saying “the mere fact that the trainee has learned is not enough. To be effective, his training must also take account of the problems he is likely to encounter in applying his learning on the job” (p. 56). In relation to safety training specifically, it is also easy to see the importance of applying to the job what one has learned during training. For example, if an employee learns the location of emergency exits and tornado shelters but is unable to locate them and act appropriately in the case of a real emergency, serious injury could result.

This literature review explores safety training in the workplace and how learning is applied to the job context. To begin, the literature review methodology is presented, and the concepts of transfer of training, transfer of safety training, transfer of learning, application of learning, and learning in continuing professional education are explained. Finally, the review concludes with a discussion of literature gaps and the resulting research questions.

Literature Review Methodology

A comprehensive search of literature was conducted to ensure a sufficient breadth and depth of research was achieved in studying the body of knowledge related to transfer of training, transfer of learning, and learning in continuing professional education. Peer-reviewed journal articles, books, and dissertations were used as the basis of this review, while conference proceedings, opinion articles, and non-scholarly works were excluded. Although seminal works

related to the initial building of theory-based models were included in this review, empirical studies written between 2008 and 2018 were the primary source of information to ensure the focus remained on the most up-to-date literature.

To capture the literature used for this review, a general search of “University of Wisconsin-Milwaukee Libraries” was used with keywords such as “transfer of training,” “transfer of learning,” “application of learning,” “transfer of safety training,” “transfer of safety learning,” “application of safety learning,” “workplace learning,” “workplace training,” “workplace safety,” “continuing education safety,” and “continuing education manufacturing.” These searches, which tapped into databases such as ERIC/EBSCO, ProQuest, JSTOR Arts and Sciences, and Wiley Online Library, yielded over 5,000 articles, book chapters, and dissertations. To narrow the search, only literature related to workplace safety training or the workplace learning models was reviewed. In addition, the reference sections of these documents were then used to explore additional related literature.

An interesting result of these searches is that the idea of continuing education does not seem to be linked to studies related to manufacturing. In most instances, even when the keywords “continuing education” and “manufacturing” were used as search terms, the resulting studies referred to professional continuing education for groups, such as engineers, who often work in manufacturing contexts. A specific search of “manufacturing safety training” in the ERIC/EBSCO education database resulted in only seven articles written between 2008 and 2018. Unfortunately, none of these articles covered topics related to transfer of training, transfer of learning, or application of learning in the manufacturing or safety contexts. This suggests that literature from a continuing education perspective related to manufacturing, and specifically to the topic of safety training, is rather scarce.

Transfer of Training and Learning Models

To begin the review of what influences whether employees use what they learned during training, the concepts of transfer of training and transfer of learning will be explored. The bulk of research on these topics comes from human resources development literature and is focused on workplace learning. The models of transfer of training and transfer of learning are discussed, followed by examples of empirical studies tying the models to the safety training context.

The Definition of Transfer of Training

Baldwin and Ford (1988) provided one of the most comprehensive and most-referenced reviews of the concept of transfer of training in their work “Transfer of Training: A Review and Directions for Future Research.” In it, they define transfer of training as “the degree to which trainees effectively apply the knowledge, skills, and attitudes gained in a training context to the job” (p. 63). They go on to require that in order for transfer of training to have occurred, the “learned behavior must be generalized to the job context and maintained over a period of time on the job” (p. 63). These ideas of generalization and maintenance were expanded later to become the central tenants of the definition of transfer of training. According to Blume et al. (2010), generalization is “the extent to which the knowledge and skill acquired in a learning setting are applied to different settings, people, and/or situations from those trained” (p. 1067) and maintenance is “the extent to which changes that result from a learning experience persist over time” (pp. 1067-1068). Broad and Newstrom (1992) described transfer of training in their own words as “the effective and continuing application, by trainees to their jobs, of the knowledge and skills gained in training - both on and off the job” (p. 6). Tonhäuser and Bükér (2016) explained that transfer occurs when learning happens in one context and is successfully applied in a second, different context. Other researchers (Aguinis & Kraiger, 2009; Burke & Hutchins,

2007; Burke & Baldwin, 1999; Cheng & Ho, 2001) continue to use these same basic definitions of transfer of training with very little deviation.

The Process of Transfer of Training

While the definition of transfer of training has remained largely unchanged over the past 30 years, a number of different models have been created in an attempt to explain the process of how transfer of training works. The various models include different versions of what influences transfer of training and their inter-relationships. In this section, several of these proposed models are reviewed.

Baldwin and Ford (1988) created a model of what the transfer of training process looks like with the inclusion of inputs, outputs, and conditions of transfer. Their model, with an adaptation shown in Figure 2.1, includes trainee characteristics, training design, and the work environment and how these influence learning and retention, and generalization and maintenance. Learning and retention, which are considered training outputs, are influenced by trainee characteristics, training design, and work environment. This is different from the conditions of transfer which focus exclusively on how the learning is generalized to other contexts and maintained over time. Generalization and maintenance are directly influenced by

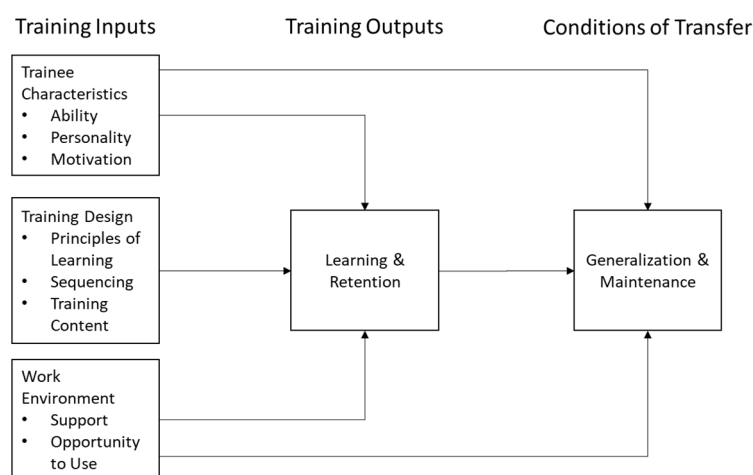


Figure 2.1: A Model of the Transfer Process, adapted from Baldwin and Ford (1988)

trainee characteristics and work environment, but are also indirectly affected by training design through learning and retention.

Thayer and Teachout (1995) expanded the original Baldwin and Ford (1988) model with reactions to previous training, prior knowledge, pre- and post-training self-efficacy, locus of control, job involvement, career and job attitudes, reaction to training, and more details about the climate for transfer. Similar to Baldwin and Ford's (1988) model is the basic principle that learning occurs, learning is transferred to job performance, and on-the-job results occur. While Baldwin and Ford's (1988) definition and model for transfer of training highlight the need for generalization and maintenance, Thayer and Teachout's (1995) model no longer calls out these requirements explicitly, but rather assumes their presence by showing "results" as an outcome to "transfer."

As research into transfer of training has continued, new researchers have provided additions of their own, looking at further ways to integrate the complicated web that influences transfer of training. For example, Holton (1996) showed how secondary influences such as intervention readiness and intervention fulfillment affected motivation, and how motivation to learn is different than motivation to transfer. Reaction to environmental elements, transfer climate, and external events were also added. Another example is Kozlowski and Salas's (1997) multilevel model for training implementation and transfer. While other models only focus on horizontal transfer of training, or transfer that occurs within the individual, team, or organization, this model also includes vertical transfer of training which shows the influence of transfer between those levels. Machin (2002) expanded this multilevel model by combining it with other previous models to create an integrated transfer of training model. Machin's (2002) model shows, for example, how team-level training outcomes such as "better team work, cohesion, and

decision making” (p. 267) will influence individual-level transfer outcomes such as “commitment to safe work practices, greater crew satisfaction and morale” (p. 267). While the model was originally introduced in an aviation team setting, it appears to be applicable to many work environments where people work individually and in teams. Other researchers (Noe, 1986; Foxon, 1994) have provided still more models on the transfer of training. Noe (1986) focused his model more heavily on the motivational influences of training effectiveness, while Foxon’s (1994) model looked specifically at what may inhibit or support the process of the transfer of training.

While each of these models has a slightly different focus, they show how factors before training, during training, and after training, as well as individual, team, and organizational influences can affect the transfer of learned material to the job. The literature on transfer of training generally points to Baldwin and Ford’s (1988) model as the first transfer of training model on which all other models and research have been built.

The Definition of Transfer of Safety Training

While the amount of literature specific to the transfer of safety training is significantly less than that of general transfer of training, there have been a number of empirical studies focused specifically on the transfer of safety training. Before investigating these in more depth, the definition of transfer of safety training is explored.

Krauss et al. (2014) define transfer of safety training based on the widely used Baldwin and Ford (1988) definition of transfer of training. They explain that “safety training transfer is defined as employees’ application of learned *safety-specific* knowledge, skills, and motivation when back at work and employees’ ongoing use of these learnings over time” (p. 183, emphasis in original). This definition still focuses on generalization and maintenance of knowledge and

skills, but replaces “attitudes” from the Baldwin and Ford (1988) definition with “motivation.” This, perhaps, is an update based on the abundance of literature focused on the impact of motivation when it comes to transfer of training.

Krauss et al. (2014) go on to discuss why transfer of safety training is different from general transfer of training and why it requires context-specific research. They explain that prior knowledge, the nature of safety training, and the work environment are somewhat different when it comes to safety training. First, employees often have strong attitudes and beliefs about safety because of their prior knowledge and the annual refresher training required by the Occupational Safety and Health Administration (OSHA) (Occupational Safety and Health Administration, 2016). In addition, since both safe and unsafe practices often become part of daily routines based on this prior knowledge, these habits can be difficult to change, even with training. Next, the nature of safety training can affect transfer because it is usually mandated by organizations due to regulatory requirements. In the United States, this is driven by OSHA and their requirement that companies provide at least some level of safety training for employees (Occupational Safety and Health Administration, 2016). Finally, the work environment, as seen through the safety climate, is also different in the safety-specific context, where the mandatory training can either be seen as a direct outcome of a strong safety culture, or merely going through the motions that are a regulatory requirement (Krauss et al., 2014). Since the general transfer of training literature has shown the importance of the transfer climate, the safety climate is likely to have a similar impact to the transfer of safety training.

As a result of the differences between safety-specific transfer of training and general transfer of training, Krauss et al. (2014) suggest that research should be conducted specifically in the area of safety, explaining that the strengths of the relationships between different transfer

predictors could be different in the safety training context than in the general context. Even with a call for this type of research, it seems that a wholistic model specific to the transfer of safety training has yet to be proposed.

One of the more inclusive models which examines how learning is applied to an employee's job is Daffron and North's (2011) model of the transfer of learning. This model is explored in the following section through examination of safety-specific literature. While many empirical studies related to the safety-specific context (Brinia & Efstathiou, 2012; Freitas et al., 2018; Krauss, 2005; Namian et al., 2016) have relied on the Baldwin and Ford (1988) model of the transfer of training for their conceptual framework, Daffron and North's (2011) model of the transfer of learning can also be applied to the safety-specific context in a more general view of learning rather than for a specific training event. Before investigating specific studies, however, the differences between transfer of training and transfer of learning will be explored.

The Definition and Process of Transfer of Learning

The difference between transfer of training and transfer of learning is subtle. Transfer of training focuses specifically on the transfer of "knowledge, skills, and attitudes gained in a training context" (Baldwin & Ford, 1988, p. 63), and transfer of learning focuses more broadly without being restricted to intentional instruction. According to Broad (1997), "transfer of learning is the effective and continuing application by learners – to their performance of jobs or other individual, organizational, or community responsibilities – of knowledge and skills gained in learning activities" (p. 2). The main difference between these two definitions is the use of "a training context" versus "in learning activities." Therefore, it appears that transfer of training refers to a specific training context or event, while transfer of learning refers, not to one specific event, but rather more broadly to any learning activity.

Expanding the models of transfer of training, Daffron and North (2011) have proposed a more general model of transfer of learning which shows the interconnected nature of seven different factors. They suggest that the following factors impact an employee's ability to apply their learning in different job contexts: 1) planning process, 2) learner characteristics and motivation, 3) design and delivery, 4) learning context, 5) immediate application, 6) workplace environment, and 7) eliminating barriers. To show how each of these factors is intertwined with the others, they are shown around a heptagon with connected lines between each factor. An adapted version of the model can be seen in Figure 2.2. Previous models, which linearly showed progress from a training event to application of learned material, are replaced here by seven factors which are always influencing each other, are not necessarily focused on a single event, and do not have to occur in a specific order. The following sections describe each factor in detail through the lens of safety-specific empirical research.

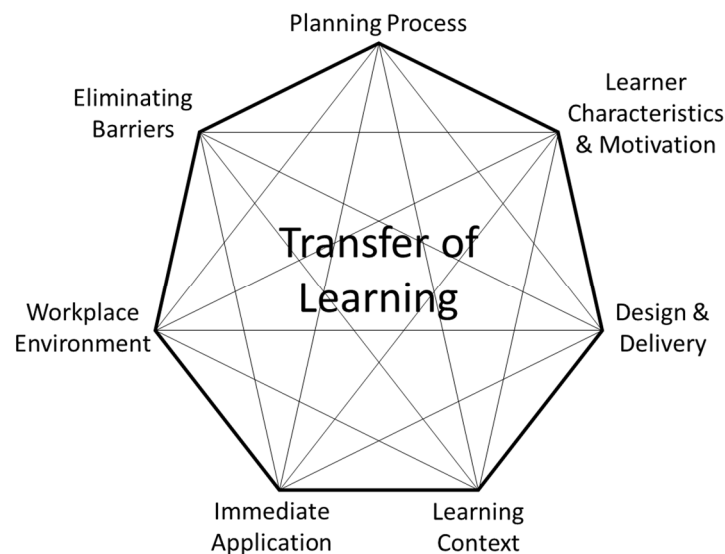


Figure 2.2: Transfer of Learning Model, adapted from Daffron and North (2011)

Factor 1: Planning Process

According to Daffron and North (2011), the planning process starts with a needs assessment which should be used to establish an advisory or planning committee that includes

the learner as a key constituent. Including the learner helps to ensure that the training or other learning activities fit the needs of the learner and are tied to job requirements.

During the literature search, there were no empirical studies found related to the planning process in the safety-specific learning context. Daffron and North (2011) cite several non-safety-related studies from the late 1990s and early 2000s which looked specifically at the impact of the planning process on the transfer of learning. While it is important to understand the impact of planning on the transfer of learning, searching for additional studies was not pursued, as this study primarily focused on manufacturing employees and not course designers.

Factor 2: Learner Characteristics and Motivation

There are many pieces to the learner characteristics and motivation factor, including the learner's ability to understand and process the information, the learner's pre-training motivation and their perception of the value of training, as well as the learner's self-efficacy in relation to the topic of the training or learning activity. In this regard, Daffron and North (2011) also explain how pre-training motivation can be influenced by the type of training or learning activity (mandatory versus voluntary), the learner's peers, and the learner's own attitude. They suggest that positive pre-training motivation and a positive perception of the value of training lead to improved transfer of learning.

While the learner's ability to understand and process the information presented may be impacted by their aptitude for learning, issues of literacy and language may also play a role. If an employee is not able to understand the content of a safety learning activity, they will simply not be able to apply it to their jobs. In Wilkins' (2011) study of 121 construction workers and their perceptions of a training course designed by OSHA, it was found that participants appreciated any attempts by the trainers to support learners whose first language was not English and who

may have been at a disadvantage according to other demographics. This appreciation made the employees more likely to apply what they had learned to their jobs.

Of the learner characteristics and motivation factor that Daffron and North (2011) discuss, pre-training motivation is quite complex, as it can be influenced by the nature of the training or learning activity (mandatory versus voluntary), the learner's peers, and the learner's own attitude. Brinia and Efstathiou (2012) confirmed this in their study of 134 workers at a foundry in Greece. They found that motivation was a large factor in the likelihood that employees applied what they had learned in a safety program about working at heights. Wilkins (2011) also talked about the influence of pre-training motivation, focusing more on the nature of the 10-hour OSHA construction safety course that participants attended. He found that nearly three-quarters of participants attended the training because it was mandated by their employers, and suggested that this reduced pre-training motivation, attributed to the low rate of satisfaction with the course, and resulted in a low occurrence of transfer of learning.

Burke et al. (2011) looked at the learner's own attitude by studying the interaction of "the dread factor" and the level of engagement of the training, and how these impacted the transfer of safety learning. In this meta-analysis of 113 studies, the authors analyzed the method of safety training along with the type of hazard covered. They found that when the threat of hazard exposure was high/severe and the training was delivered in an engaging way, employees' motivation to transfer their learning to their jobs was higher. Burke et al. (2011) explain this motivation as "the dread factor," which is "the realization of the dangers associated with ominous hazards and the experienced feelings that one has about the possibility of such events/exposures" (p. 63). They explain that, as a result of the dread factor, motivation to transfer knowledge to the work setting is increased. Since employees often know the topic the training

will cover before attending, it is easy to see how the dread factor could impact the learner's perception of the value of the learning activity, as well as their own attitudes, and subsequently their pre-training motivation. It should be noted that what was not covered in any of these studies was the influence of the learner's peers on pre-training motivation.

Factor 3: Design and Delivery

There are six different areas which Daffron and North (2011) suggest influence application of learning as it relates to design and delivery of content. They suggest the best chances for transfer of learning occurs as a result of the following: 1) There is a match between the content and the learner's work roles; 2) Learners actively participate in the training or learning activity; 3) Learners choose the delivery method that best suits their style; 4) The learning environment matches the work environment; 5) There is a general discussion about the theory behind the behavior; and 6) Multiple examples are used to highlight different contexts in which the learning can be applied.

Essentially, Daffron and North (2011) suggest that learning activities which follow the principles of adult education (Merriam & Bierema, 2014) are more likely to lead to the transfer of learning than for those that do not. Namian et al. (2016) tested this idea by comparing different types of training methodologies in the construction industry, based on the level of engagement, and measured transfer of learning for each. After learning in one of several different types of training programs utilizing different teaching methodologies, participants were asked to use case study photos showing different hazards and identify what hazards were present. It was found that "the interaction effect of high-engagement training and high training transfer levels will result in better hazard recognition" (p. 9). In other words, when steps are taken to create highly engaging training, and other factors found to improve training transfer are present, such as

supervisor support, employees will be able to better generalize and maintain the information learned during safety training.

In an interesting outcome of the Burke et al. (2011) meta-analysis, looking at the interaction between the dread factor and the level of training engagement, it was found that when the hazard severity is low, the level of engagement of the training did not have a significant impact on the transfer of learning outcome. This may suggest that, specific to the safety context, the level of engagement, and therefore the design and delivery of the training, may not be as important as it is in other contexts. They explain that further research in this area is needed to more clearly define this part of the interaction, since current research is limited.

Other researchers (Ho & Dzeng, 2010; Lukic et al., 2011; Zierold, 2016) also confirm the importance of strong, learner-centered course design and delivery methods. Ho and Dzeng (2010) focused on the key factors needed to make an e-learning safety course effective in the construction industry, while Lukic et al. (2012) looked specifically at what factors are important to create an effective program using the methodology of “Learning from Incidents,” where a site’s safety incidents are used as the backbone for the design of safety training courses. Zierold (2016) studied high school students who were employed in a number of different industries and looked specifically at how safety training was delivered to them versus how they would have preferred it to be delivered. She found that the methods used versus the methods wanted were generally different, which may impact the transfer of safety learning.

Factor 4: Learning Context

Daffron and North (2011) suggest that the learning context centers around the organizational culture and sociocultural context of the learners. In other words, an organizational climate which fosters innovation and has shared beliefs and values that place importance on

training and learning activities is needed to facilitate transfer of learning. In addition, facilitators and trainers should know their audiences and understand how different learning groups have different purposes for learning.

One study which focused specifically on the learning context of safety training was an investigation by Freitas et al. (2018). The authors suggest that the learning context can be manifested in the idea of “felt responsibility” and how that is influenced by coworkers, supervisors, and safety professionals. In the context of safety, felt responsibility is the obligation employees feel, which may affect their motivation and performance to act in a safe manner. Freitas et al. (2018) proposed that felt responsibility for transfer mediates the relationship between supervisors’, coworkers’, and safety professionals’ responses and the transfer of safety training, while supervisor support and supervisor sanctions moderate the relationship between felt responsibility for transfer and the transfer of safety training. The latter relationship will be discussed further in the section related to the work environment. Overall, however, these relationships can be seen in an adapted version of their model in Figure 2.3.

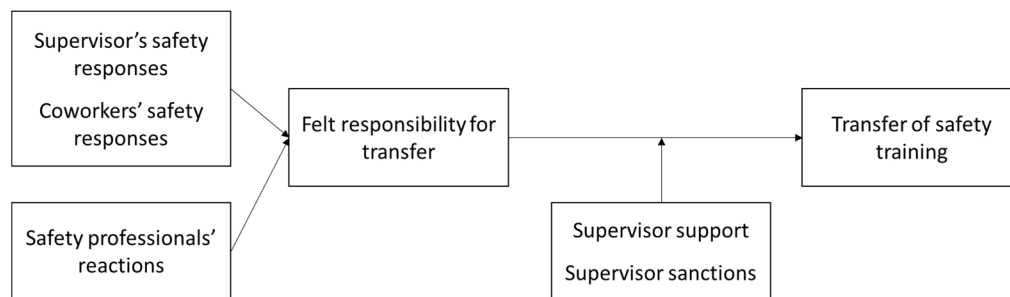


Figure 2.3: Proposed conceptual model and study design, adapted from Freitas et al. (2018)

When it comes to the learning context, Freitas et al. (2018) found that when safety professionals, coworkers, and supervisors have strong safety-related attitudes and exhibit safe behaviors, employees feel a greater sense of obligation to use what was learned in safety-related learning activities. The authors explained the following about why these results were found:

When workplace players' attitudes and behaviors are consistent with safety values, and when social interactions provide cues emphasizing the importance of safety, the learning is reinforced as well as the employee's personal responsibility to act accordingly to applying what was learned in safety training. (p. 11)

This suggests that Daffron and North's (2011) learning context factor is applicable in a safety-specific learning context.

Burke et al. (2008) found similar results as they looked specifically at the learning context by examining the impact of the organizational safety climate on transfer of safety training. They found that the better an organization's safety climate, the higher the likelihood that transfer of training occurred as seen through the performance of safety procedures and reductions in accidents and injuries.

In another investigation of the impact of the learning context on the transfer of safety training, Laberge et al. (2014) explored how younger workers learn about safety. They found that apprentices frequently develop innovative approaches to dealing with new or unexpected situations and that these strategies often circumvent safety rules. They attributed this to less than optimal working and learning conditions. If the climates were different, then the apprentices would have been more likely to apply what they had learned even in new or unexpected situations. Similarly, Olson et al. (2009) found that use of personal protective equipment by new employees is influenced by the prevalence of this behavior among their more experienced peers.

All of these examples suggest that the learning context, which refers to the organizational culture and sociocultural context, impact the transfer of safety learning. This is the first of the transfer of learning factors which is not directly impacted by the act of learning about safety. It suggests that employees could learn everything that was taught in a training course or learning

activity, but if there are parts of the learning context which discourage employees from following what they learned, then transfer of learning will not occur.

Factor 5: Immediate Application

This factor is likely the most straightforward of the seven factors. One of the keys to ensure that learning is applied, is allowing the learners to immediately use their new knowledge or skill in their day-to-day job setting. According to Daffron and North (2011), it is important that this opportunity be done deliberately, and the learner sees the connection to the training or learning activity.

Brinia and Efstathiou (2012), in their study of foundry workers in Greece, not only looked at motivation, but also briefly examined the importance of using what was learned. They found that the opportunity to use what was learned had a positive impact on transfer of learning. In fact, one of the employees they interviewed explained that “if one does not use (everyday) something he has learnt, he will forget it” (p. 228).

Factor 6: Workplace Environment

While the learning context and the workplace environment are connected, Daffron and North (2011) explain that the work environment is more closely related to peer and supervisor support rather than organizational climate. Without the support of the learner’s peers and supervisor, along with peer and supervisor attitudes related to the topic of the training or learning activity, the transfer of learning is most likely doomed to failure.

Freitas et al. (2018) not only explored the learning context of safety training in their investigation of felt responsibility, they also looked specifically at the workplace environment. They found that negative responses from supervisors influenced the transfer of training, because there was a sense of obligation. While negative responses, or sanctions, seemed to have an

impact on transfer of learning, they also found that positive responses, or support, had little impact. This is contrary to Daffron and North's (2011) explanation of how supervisor support is an important part of the transfer of learning. Freitas et al. (2018), however, cite several studies of general transfer of training which also showed how supervisor support does not necessarily impact transfer of learning for lower-skilled workers. They offer several possible reasons for why positive support is less influential than negative sanctions, including that "unskilled and semiskilled workers in Western societies are considered to have more authoritarian values, when compared with more educated workgroups" (p. 11), such that sanctions, and not support, are more respected. This suggests that job skill, and possibly the level of educational attainment, may override the effect of supervisor support. It was also mentioned during the discussion of these results that low-qualified and low-skilled workers are underrepresented in the literature on transfer of learning. In fact, Freitas et al. (2018) call for future research looking specifically at educational level and its impact on transfer of learning.

When it comes to the transfer of safety learning, there may be a fine line between an employee's ability to use what they learned within their job context and simple compliance to safety procedures. Ripamonti and Scaratti (2015) studied 30 workers at a shipping port in the Mediterranean and how their work environment influenced their compliance to safety procedures. They found that when productivity requirements, or direction from supervisors toward those requirements conflict with safety procedures, employees often lean toward meeting productivity numbers rather than following safety procedures.

Factor 7: Eliminating Barriers

The final factor in Daffron and North's (2011) transfer of learning model is the elimination of barriers. In this factor, however, they mostly discuss the importance of putting

policies, support systems, and learning-focused cultures in place which allow the other six factors to positively influence the transfer of learning. In other words, organizations need to involve learners in the planning process, understand learner motivation, plan meaningful courses, use the principles of adult education, support the learner in the workplace, and allow space for the learner to apply their new knowledge and skills.

The Definition and Process of Application of Learning

Even within the original definition of transfer of training, researchers tend to use the words “transfer” and “application” interchangeably. For example, the Baldwin and Ford (1988) definition of transfer of training mentions the “application” of knowledge, skills, and attitudes. “Transfer” may suggest a more behaviorist definition of the process and is predominantly found in the business and human resource development literature. “Application,” on the other hand, may focus more on the constructivist view from the continuing education literature. The general idea of both remains the same, though, as they each refer to the process of an employee taking specific actions in their jobs which result from learning something new. Transfer of learning suggests that the actions are continued long after the training event or activity are completed, whereas the application of learning models discussed in the continuing education literature suggest there is no completion of learning events, but rather continuous learning from ongoing experiences. In fact, one issue with Daffron and North’s (2011) transfer of learning model is that, while focusing more on a learning activity rather than an organized learning event, several of the factors still focus primarily on something that is planned. For example, the planning process and design and delivery require deliberate action in preparation for a specific learning event. As a result, the transfer of learning model may not accurately represent other types of learning that are important in the safety-context. For example, if the planning process is tied to the learning

context, does the learning context change when there is no planning process? In order to better understand these ideas, the following paragraphs explore the application of learning from the viewpoint of the continuing education literature.

Daley and Cervero (2016) suggest that professionals learn and apply that learning to their jobs through methods described by constructivist learning theory, situated cognition, and transformative learning theory. They explain that, according to constructivist learning theory, professionals make knowledge meaningful by establishing connections between prior knowledge, previous experiences, and current contexts. In other words, when applying learning to their jobs, professionals pull from these three areas, making connections which will ensure they are able to apply what they have learned. Dirkx et al. (2004) similarly describe the importance of one's experiences by explaining that prior experiences shape a person's understanding of their current situations.

Although situated cognition is based on constructivist learning theory, it places a greater emphasis on the social aspect of learning. In their study of situated cognition, Boud and Hager (2012) said the following:

In our view, learning is a normal part of working, and indeed most other social activities. It occurs through practice in work settings from addressing the challenges and problems that arise. Most learning takes place not through formalised activities, but through the exigencies of practice with peers and others, drawing on expertise that is accessed in response to need. (p. 22)

This suggests that application of learning is not only driven by the learner's ability to connect previous understandings with new information in a specific context, but also in how they learn from and with others in the job context in response to problems and challenges.

Adding a level of complexity to constructivist learning theory and situated cognition, Daley and Cervero (2016) also look at the impact of transformative learning theory. They succinctly summarize the theory by explaining that in transformative learning theory, learning is defined “as a critically reflective process wherein the learner ultimately assesses previous understandings to determine whether those assumptions still hold in the learner’s present situation” (p. 23). Whereas constructivist learning theory and situated cognition consider the learner’s ability to make connections between previous experiences and new information, transformative learning theory goes deeper to suggest that it is the assumptions made during past experiences that are re-examined, compared to present experiences, and ultimately result in new learning when those assumptions no longer hold true. Using an extreme example, when explorers and astronomers were presented with evidence that the world was round, they had to re-examine their previously held assumption that the world was flat. They ultimately learned that the earth is round, and this opened entirely new ways of understanding physical phenomenon they had previously observed.

Combining constructivist learning theory, situated cognition, and transformative learning theory, Daley and Cervero (2016) suggest a model of learning in continuing professional education (CPE) and how it links to professional practice, or application of learning within the job context. An adapted version of the model is shown in Figure 2.4. It is seen here that learning during CPE is linked to knowledge that is developed through both constructivist learning and transformative learning. The learners then link that knowledge to their job context as well as their professional practice. The context can also be seen as the organizational environment, which may include structural relationships within the organization, the personal needs of the employees, conflicts for power and resources, and organizational culture. Daley and Cervero

(2016) highlight the importance of context by explaining that “the context shapes how professionals look at new information, influencing not only what information professionals seek to learn but also what information they try to incorporate into their professional practice” (p. 25). This, at its heart, is an explanation of the influence of the context on the application of learning.

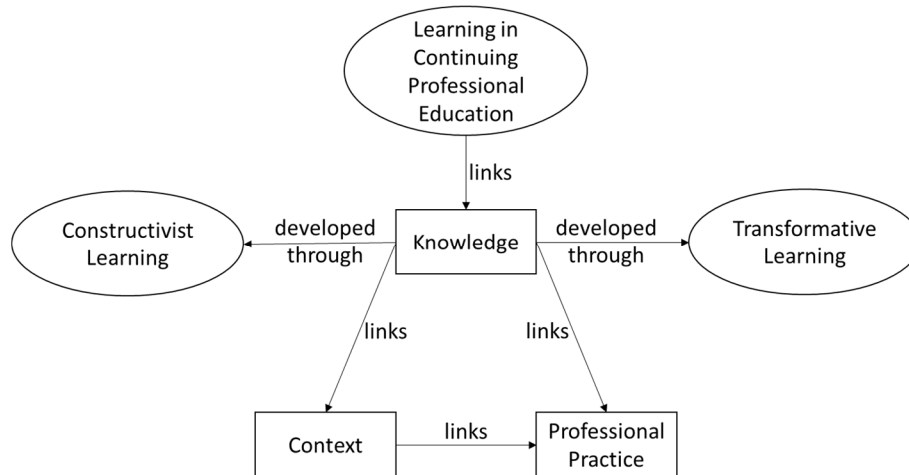


Figure 2.4: Model of Learning in CPE, adapted from Daley and Cervero (2016)

Daley and Cervero (2016) also discuss how context can affect different types of professionals, such as nurses, social workers, and lawyers in different ways, such that the manner in which the individual is affected may be a result of their unique profession. This would further suggest, similar to Krauss et al. (2014), that research in a manufacturing, safety-specific context is warranted. In fact, Daley and Cervero’s (2016) research looks exclusively at the professions and does not include laborers in manufacturing roles.

In an example of continuing education literature loosely linked to the safety context, Sommer and Njå (2011) explored, through first-hand participation, how, when, and where Norwegian fire-fighters learned. They found that “learning to act appropriately in emergency situations is mainly a result of the embodiment of skills and knowledge, . . . personal experience and interpersonal sharing of stories” (p. 435). This suggests that the Daley and Cervero (2016) model of learning in CPE applies to fire-fighters, who may be considered non-professional. In

another study of non-professional workers, Ripamonti and Scaratti (2015) explain that a worker's ability to apply safety rules and procedures in situations that may deviate from those which are standard, is mainly based on the worker's tacit knowledge, which largely comes from their experiences and tends to be situational (Hallowell, 2012).

While there are many studies which explore the transfer of training, transfer of learning, learning in continuing professional education, and learning in the safety context, gaps still exist in the literature, suggesting additional research is warranted. The next section explores these gaps and the types of questions they raise.

Literature Gaps

While reviewing the theoretical literature on transfer of learning and application of learning, along with empirical studies that explored these ideas in a safety context, several points stood out that suggested additional investigation was needed. This section walks through each of those points, arriving at the research question that guided this study.

Freitas et al. (2018) found that supervisor support does not necessarily impact transfer of training for lower-skilled workers. While they do not give specific references, they explain that “previous research has signaled differences in how blue-collar, low-skilled/low-qualified employees respond to support from their supervisor” (p. 5). Daffron and North (2011), however, explain that supervisor attitudes toward the trainee and the learning topic can influence the employee's desire and ability to transfer any new knowledge, skills, or attitudes to their jobs. Daffron and North (2011) only reference studies with professionals and do not mention studies completed in the manufacturing context. Does the difference between the Freitas et al. (2018) findings and the Daffron and North (2011) transfer of learning model suggest that the model applies differently for manufacturing employees than for professionals?

While searching for continuing education literature specific to manufacturing, the few studies found did not actually focus on manufacturing employees in non-support functions. In other words, the context of manufacturing has not been a focus of the continuing education literature. Whereas, in the human resources development literature, several of the studies which focused on the transfer of safety training hinted at outcomes, such as constructivist learning, which suggests that the application of learning models also apply to non-professionals in a manufacturing context. There is, however, little to no empirical research which confirms this. Does the learning model in CPE apply to manufacturing workers as well?

In the safety context, there is an interesting dichotomy of compliance versus learning. As the transfer of learning model (Daffron & North, 2011) suggests, learning itself is a small piece of what is needed for a learned skill to be used on the job. The model of learning in CPE (Daley & Cervero, 2016), on the other hand, focuses mostly on learning, but recognizes the influence of context on professional practice. How do the transfer of learning and model of learning in CPE differentiate between compliance and learning?

Another observation that was made is how the literature on transfer of training and transfer of learning is found mainly in business and human resources journals, whereas the literature on application of learning is found mainly in education journals. With the vast number of general studies completed in each realm, it seems like a fair conclusion that both approaches can explain how adults learn in the workplace. Instead of continuing to treat the topics differently, can the transfer of learning and the application of learning models be combined to show a fuller and clearer picture of how adults learn about safety in the workplace?

Through the review of numerous studies related to learning about safety, it was observed that the majority of the studies had nearly all male participants and mostly compared different

training methods, focused on a single training event, or looked at what outside influences may affect the use of what was learned. In all of these, the assumption is that manufacturing employees are learning by attending safety training and their propensity to transfer or apply that learning to their jobs is what, therefore, becomes the focus of the study. Is assuming that manufacturing employees are only learning about safety during organized safety training events an accurate assumption to make?

At the heart of each of these questions is a quest to better understand how manufacturing employees learn about safety, how the job context influences their knowledge, and how both their knowledge and context influence their ability to apply what they have learned. With these broader questions in mind, Daffron and North's (2011) transfer of training model and Daley and Cervero's (2016) learning in CPE model provided a framework to answer these questions.

Summary

In this chapter, the definitions and models of transfer of training were explored and the nuances of transfer of safety training were examined. Transfer of learning was then discussed, along with a review of empirical studies related to safety training in the manufacturing context. Finally, the transfer of learning model (Daffron & North, 2011) was compared to the model of learning in CPE (Daley & Cervero, 2016). Reviewing these topics and understanding the gaps in the literature have focused this study on exploring how the transfer of learning and learning in CPE models, can be adapted to reflect the ways in which manufacturing employees learn about safety. The next chapter explains the methodology used to explore these ideas.

CHAPTER 3: METHODOLOGY

Millions of workers are injured in the workplace every year (Bureau of Labor Statistics, 2019) and many of the incidents could have been avoided if workers followed the safety training they received (Safety Partners LTD., 2014). While there can be a number of reasons for the disconnect between knowing and doing, the field of workplace safety training could benefit from a better understanding of workers' experiences with learning about safety.

In this chapter, details are provided about the methods employed during the study of how manufacturing employees learn about safety in the workplace. The chapter begins with a review of the research purpose, research questions, and the conceptual framework. Details are then presented regarding the research design, including the design itself, participant selection and recruitment, data collection, and data analysis. Finally, internal validity, study limitations, ethical considerations, and researcher bias are explained.

Research Purpose and Questions

Employees in manufacturing jobs in the United States continue being injured on the job at an alarming rate. Previous studies looking at the transfer of safety learning have focused mainly on quantitative analyses related to training methods, the work environment, and social influences, with little discussion about the employees' actual experiences with safety training. This suggests that understanding the workers' experiences is an area where additional research is needed. The purpose of this study, therefore, was to gain an understanding of how manufacturing employees learn about safety. To do this, the following research questions guided my inquiry:

RQ: What are manufacturing employees' experiences with safety training?

SQ1) How do manufacturing employees learn about safety?

SQ2) How does the learning context influence manufacturing employees' knowledge about safety?

SQ3) How do manufacturing employees apply their knowledge about safety in the workplace?

These research questions characterized the places, contexts, and situations where workers are learning about safety and how those experiences impact how they work in regard to safety on the job.

Conceptual Framework

The transfer of learning and the learning in continuing professional education (CPE) models (Daffron & North, 2011; Daley & Cervero, 2016) were used as the conceptual framework throughout this study and guided each portion of the research design. The models, shown in Figure 3.1, highlight the inputs and contexts which affect a person's ability to apply what they have learned to their jobs.

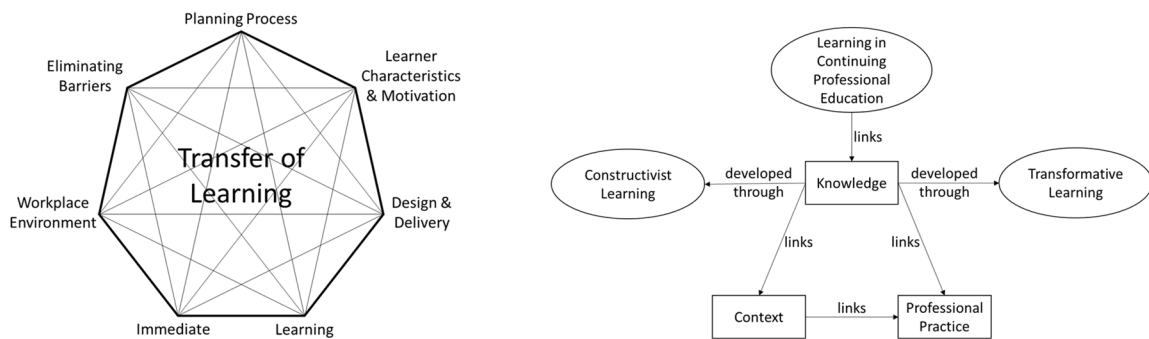


Figure 3.1: Model of Transfer of Learning, adapted from Daffron and North (2011) and Model of Learning in CPE, adapted from Daley and Cervero (2016)

To better use these models as guides to the research design, they were combined to show how they interrelate, while maintaining a focus on the learner. In this combined model (Figure 3.2), the type of learning has been split into nonformal and informal as opposed to simply “learning in continuing education” (Daley & Cervero, 2016). Nonformal learning considers

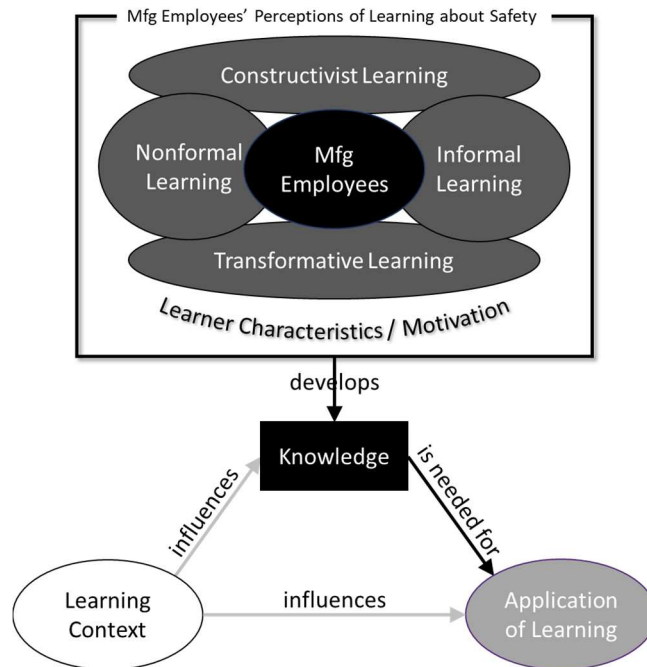


Figure 3.2: Combination of the models of transfer of learning (Daffron & North, 2011) and learning in CPE (Daley & Cervero, 2016)

learning that occurs during intentional instruction that is organized by institutions whose purposes are something other than conferring degrees and offering for-credit classes, such as a university (Merriam & Bierema, 2014). In the safety training context, nonformal learning refers to in-person or online classes organized by the employer. Informal learning, on the other hand, refers to learning which happens in the course of one's everyday life (Merriam & Tisdell, 2016). In the safety training context, this could refer to a hallway conversation between an employee and a supervisor about a safety incident or suggestions from an experienced worker to a new hire about how to stay safe. The addition of these two distinctions, nonformal learning and informal learning, highlights the type of learning which workers may experience and allowed for the exploration of both types separately during the interviews. Learner characteristics and motivation from Daffron and North's (2011) model have also been included. In addition, the learning context, workplace environment, and immediate application (Daffron & North, 2011) are all related to the context in the Daley and Cervero (2016) model. The combination of these factors

is, therefore, simply called Learning Context and represents a combination of these elements. Finally, the shades of gray in the combined model were not chosen randomly. Overall, combining black and white together create gray, just as knowledge and learning context are needed for and influence the application of learning. It is the manufacturing employee's knowledge in black which is developed through different types of learning in dark gray. While the shades themselves are not necessarily important, they do aim to show connections between learning, knowledge, context, and application of learning. Each section of this chapter refers back to this combined model to show the section's link to the conceptual framework.

Research Design

Since this study focused on understanding the experiences of manufacturing employees, generic qualitative inquiry fit well with this real-life, practical approach. According to Patton (2015), generic qualitative inquiry can help solve problems in real-world settings through the use of methods such as open-ended interview questions. Merriam and Tisdell (2016) also suggest that generic qualitative inquiry should be used when interpretation of people's experiences is the goal of the research and the additional criteria of other approaches, such as phenomenology, ethnography, narrative inquiry, and case studies, are not met. Examining which research designs were not appropriate for the study of safety training in manufacturing was an effective way in deciding that generic qualitative inquiry was best suited to answer the research questions posed earlier. Each of the reviewed research designs are detailed next.

In phenomenology, researchers are more interested in the essence of the meaning of an experience, which often focuses on intense human emotion (Merriam & Tisdell, 2016) or significant life events (Glesne, 2016). While learning about safety in manufacturing could be seen as a phenomenon, it is not full of intense emotions or considered a significant life event. If a

person is injured at work or witnesses a coworker being injured, it could impact the way they think and learn about safety in a significant way; but these types of experiences are not the focus of the study and can be analyzed through the conceptual framework as constructivist or transformative learning as suggested in the learning in the CPE model.

Similarly, ethnography is also not an appropriate research design for this study, since ethnographies generally focus on culture by examining the beliefs, attitudes, values, and behaviors of a specific group of people (Merriam & Tisdell, 2016). The safety culture of an organization may influence how and when employees apply to their jobs what they have learned in safety training (Daffron & North, 2011), but the safety culture itself is not the focus of the study.

Narrative inquiry is the next research design that is not appropriate for this study of employee experiences with safety training. While the participants shared stories during the interview process, the purpose of the study was not to analyze the actual story itself. In studies using narrative inquiry, the story is analyzed for how it is constructed, what tools are used, and its cultural context (Merriam & Tisdell, 2016) to illustrate each person's uniqueness and complexity (Glesne, 2016).

Finally, a case study approach is also not appropriate for this study, as there is no specific bounded system which is being considered. Merriam and Tisdell (2016) suggest that if there is no end to the number of people who could be interviewed, then there is not enough of a boundary to consider using a case study. In the study of manufacturing employees' experiences with safety training, there are millions of people who could have, theoretically, been interviewed.

By using a generic qualitative inquiry design, manufacturing employees were able to share their experiences with and perceptions about safety training. Using the conceptual

framework (Figure 3.2) as a guide for the interview questions, answers were found to how the manufacturing employees learn about safety, how the learning context influences their knowledge about safety, and how they apply their knowledge about safety in the workplace.

Participant Selection and Recruitment

To explore the experiences of manufacturing employees with safety training, employees at a U.S.-based manufacturing company were recruited. The company has a number of high-level assembly and chemical manufacturing sites located in large, urban cities in the United States.

In order to be eligible for participation, employees had to meet the following criteria: 1) Be a manufacturing employee (not office support staff) at one of the urban manufacturing sites; 2) Have completed general Environmental, Health, and Safety training within the last six months; and 3) Have completed general Environmental, Health, and Safety training online within the last 6 months. These criteria were chosen to ensure that only manufacturing employees who have had some nonformal safety training experiences could participate. This way, both nonformal and informal methods of learning could be highlighted during the interview per the conceptual framework. In addition, no other demographic criteria were needed to select participants since the combined model does not differentiate between types of people.

Recruitment of participants began with a survey (Appendix C – Eligibility Survey) being sent out via e-mail (Appendix B – Recruitment E-mail) to all of the manufacturing employees at the Company who were located at four different urban manufacturing sites. The University of Wisconsin-Milwaukee's Qualtrics survey tool was used to create the survey and it was only sent after approval was received from the Internal Review Board (IRB), the Company's safety council, and the union leadership representing the Company's manufacturing employees

(APPENDICES

Appendix A – Letter to the Safety Council and Union Leadership). The purpose of the survey was to gather eligibility information so participants could be selected from those who met the study requirements. The initial survey request was sent out two weeks before the requested survey completion date and one reminder was sent a week before the survey response was due (Appendix D – Recruitment E-mail Reminder). Several iterations of survey requests and reminders were required to secure the needed number of study participants.

In all, surveys were completed by 40 individuals, while only 23 of them met all of the requirements for eligibility. After the survey due date, e-mails were sent to all 23 of the eligible employees. Unfortunately, 11 employees had left the company and one never responded. Therefore, meetings were scheduled with the remaining 11 employees through the Company's e-mail system. This reserved the employee's time, as well as the onsite location where the interview would take place when applicable. The meeting notice (Appendix E – Interview Meeting Notice) included the call-in phone number for interviews done virtually. The employee's immediate supervisor was included on the meeting notice to ensure the participant's duties and responsibilities were covered during the interview time. The supervisor, however, did not attend or participate in the interview in any way. An electronic reminder was set on the meeting notice for 30 minutes prior to the start of the interview. This reminded the supervisor and the participant of the interview time and location, where applicable. In addition, a reminder (Appendix F – Interview Reminder) was sent to the supervisor and the participant one day before the interview.

The IRB consent form (Appendix G – Informed Consent Form) was attached to the interview meeting notice sent to the participants and they were asked to review the form before the interview. The consent form was discussed before the interview began to ensure the

employee understood what they were consenting to and to ensure they were still interested in participating in the study. They then signed the consent form, and the interview began. For those participating in the study via a telephone or Zoom meeting, the employee e-mailed the consent form before the start of the interview.

Although all 11 of the participants were employed by the same company, they worked in four different sites, with 10 in the Midwest and one in the Southeast. Those working at the midwestern sites held a variety of jobs in one sector of the Company's manufacturing portfolio, while the participant in the southeastern location worked in a different sector. In the table of demographic information (Table 3.1), MW represents the midwestern sites and SE represents the southeastern site. In addition, the job description highlights whether the employee is considered to be a technician or an associate. In general, the work technicians do tends to be more focused on the mechanical, electrical, or chemical functionality of a product or manufacturing process, whereas an associate works more generally with less of a technical focus. In addition to individual demographic information, Table 3.2 provides a comparison between Sites 1 and 2. It should be noted that Site 3 and Site 4 are not included in this comparison, since there was only one participant at each of those sites.

Name (Pseudonym)	Gender	Age	Site Location	Shift	Job Description	Time in Current Job	Union Affiliation
Emma	Male	Over 18	MW: Site 1	1 st	Technician	4.5 year	No
Olivia	Female	Over 18	MW: Site 1	1 st	Associate	10+ years	Yes
Liam	Male	48	MW: Site 1	1 st	Technician	6 years	No
Noah	Male	27	MW: Site 1	1 st	Technician	3 years	No
William	Male	Over 18	MW: Site 1	1 st	Associate	1 year	Yes
James	Male	50	MW: Site 2	1 st	Technician	10+ years	No
Charlotte	Female	45	MW: Site 2	1 st	Technician	8 years	No
Sophia	Female	46	MW: Site 2	1 st	Associate	9 years	No
Isabella	Female	38	MW: Site 2	2 nd	Technician	3 years	No
Oliver	Female	32	MW: Site 3	1 st & 3 rd	Technician	1.5 years	No
Ava	Female	55	SE: Site 4	1 st	Technician	10+ years	No

Table 3.1: Participant Demographics Information

Demographic Information	Site 1	Site 2
Union Affiliation	2 of 5 are affiliated with a union	0 of 4 are affiliated with a union
Shift	5 of 5 work on 1 st shift	3 of 4 work on 1 st shift 1 of 4 works on 2 nd shift
Length of Service	Average 4.9 years	Average 7.25 years
English as a Second Language (based on accent)	0 of 5 are non-native English speakers	2 of 4 are non-native English speakers
Part of a Safety Team	4 of 5 are on a safety team	3 of 4 are on a safety team 1 of 4 has an unknown status
Type of Work (Assembly Line vs. Individual)	5 of 5 work individually	4 of 4 work individually
Gender	4 of 5 are male 1 of 5 is female	1 of 4 is male 3 of 4 are female

Table 3.2 Site 1 & Site 2 Demographics Comparison

Data Collection

Semi-structured interviews lasting 30 to 70 minutes were conducted with participants who met the criteria and agreed to be interviewed in a conference room at their worksite or via telephone/Zoom. Each interview was recorded and transcribed. By using a semi-structured type of interview, follow-up questions were asked as needed to explore the experiences the employees shared (Creswell & Creswell, 2018) and probe deeper for additional information (Merriam & Tisdell, 2016).

The interviews (Appendix H – Interview Questions) were divided into three sections based on the research questions and the conceptual framework, plus an additional section to gather demographic information. The sections were as follows: 1) Demographics, 2) Learning about safety, 3) Applying safety learning, and 4) Job impact. The applicable portion of the conceptual framework is listed in brackets under each interview question. Three questions focused on learner characteristics and motivation, four each focused on design and delivery, learning context, workplace environment, and professional practice, and one focused on constructivist/transformative learning.

Each of the interviews were recorded on two devices to ensure redundancy, should one fail. In addition, notes were taken during the interview to capture high-level ideas and topics as another method of redundancy. All electronic data, including the recordings were stored on a password-protected, non-networked, non-company computer, while all paper data were stored in a locked filing cabinet in a locked, non-company office. All data will be kept for two years after the study is completed.

Data Analysis

Participant pseudonyms were chosen based on a predetermined list (Appendix I – Pseudonyms). Each participant was asked to choose between two names: one male and one female. It should be noted that the choice in names did not necessarily reflect the participants' gender identification. The name for the second participant was similarly chosen from the second line of the table. This continued through all the interviews. When the original list of predetermined pseudonyms was created, the exact number of participants was unknown. This explains why 30 names were available for each gender, for a total of 60 available names.

After transcribing the interviews, the two-cycle coding method was used as described by Saldaña (2009). First-cycle codes focused on the details of each interview, while second-cycle codes were used to create thematic observations about the interviews. Of Saldaña's (2009) suggested coding types, five different types appeared to be relevant to this study and were used for first-cycle coding. The types of codes, uses, and reason for choosing the coding type can be found in Table 3.3 on the next page. The conceptual framework served as a coding guide with the first part of the code being part of the combined model. Some examples of first cycle codes included "Application = Impacted by Body Limitations," "Influence/Manager = Cares about Safety and Employees," and "Informal-Alone = Self-Paced (+)," where a "(+)" or "(-)" was used

Code Type	Code Focus	Code Choice Reason
Process Coding	Use of verbs ending in “-ing”	Many questions focused on doing, acting, or applying learning.
Emotion Coding	Participant’s feelings	Some questions focused on feelings and reactions toward training.
Versus Coding	Conflicts or comparisons between entities.	Some questions focused on preferences toward different learning methods.
In Vivo Coding	Verbatim language	Best used when participants’ words are perfect descriptions for the thoughts they are expressing.
Descriptive Coding	General description	Helpful code type when something appears to be relevant, but other coding methods do not apply.

Table 3.2: First-Cycle Coding Types, based on Saldaña (2009)

in some codes to indicate if their feelings were positive or negative. Once the interviews were coded for the first time, a list of all the codes was made and each interview was reviewed to see if codes created from later interviews could be applied to the earlier interviews. Next, the first-cycle codes were organized into second-cycle themes. Finally, code weaving was used as a means of analysis. By weaving codes, categories, and themes into sentences or paragraphs, conclusions were drawn about the ways manufacturing employees learn about safety in the workplace. The findings are presented in Chapter 4 on an aggregated basis by theme, with individual stories being used as examples to support those themes.

Internal Validity

To ensure this study was meaningful and other researchers can have confidence in the findings, the importance of internal validity was considered in the research design. According to Merriam and Tisdell (2016), triangulation is an effective means of controlling for internal validity. This can be achieved by using multiple methods, sources of data, investigators, reviewers, or theories. In the research design for this study, both multiple sources of data and multiple reviewers were used. Instead of interviewing just one manufacturing employee, 11 employees were interviewed, ensuring that multiple viewpoints were heard. In addition, a peer

review of the data analysis was completed by two doctoral students who were not directly involved in this study. Independently, they were each given copies of an interview transcript, codes, and the code weaving analysis. They were asked to review the information and provide feedback for other themes or discrepancies they may have found. Their feedback was then used to further improve the analysis.

Ethical Considerations

Since manufacturing employees are considered a vulnerable population in qualitative research (Office for Human Research Protections, 2019), steps were taken to reduce any risk for them. The reason for this vulnerability is that workers may feel pressure from supervisors or union leadership to participate or to answer questions in a certain way. To minimize this risk, details of the study were shared with the company's safety council, union representatives, and human resources leaders to explain the research being done, how recruitment and selection were to be handled, and how employee information would be protected. A statement of confidentiality was included with the survey and participation in the survey was voluntary. Participants were assured that anything discussed in the interviews would remain confidential and not shared with supervisors or managers. It was explained that the overall results would be shared with the Company's Environmental Health and Safety Department, but that all identifiable information would be removed.

Researcher Bias

As I have been working in various engineering and management roles within large manufacturing organizations for nearly 20 years, I have seen many safety training programs come and go. Some of these involved classroom sessions where an instructor took the employees through a slide presentation and then each employee had to take a written test, which they often

did as a group. Other programs involved the completion of a set of computer-based modules where the employee read information and then completed several online activities like matching games and clicking on the incorrect safety practices in a picture. This computer-based module also included a multiple-choice test at the end which had to be completed to receive credit for finishing the training. Regardless of the method, I have found these types of programs to be tedious, time-consuming, and mostly uninteresting. In general, they do not spark any excitement about safety and are seen as one of those necessary evils that are only caused by working in a regulated environment. This is compounded by the fact that general safety training must be renewed on an annual basis (Occupational Safety and Health Administration, 2001) and evidence of the training is needed to comply with regulatory requirements. If the online training package does not change from year to year, I believe this breeds a sense of complacency among employees. It is based on these frustrations that I became interested in looking for different ways to make general safety training more fun, engaging, and meaningful, while maintaining or even improving application of the material to everyday practice.

These past experiences have created a bias for me toward discontent with certain types of safety training programs. To combat this bias, I was careful not to ask leading questions in the interviews, and instead, let the employees share their own experiences regarding learning about safety. I was also careful not to let my bias influence with my coding and analysis. To help ensure my views were not interfering in this way, my results were examined by my advisor and peer reviewers.

Summary

In this chapter, details regarding the research design were shared. This generic qualitative inquiry was guided by a combined model of the transfer of learning and learning in CPE models

as the conceptual framework. Eleven participants were chosen, data collection was done through the transcription of semi-structured interviews, and two-cycle coding was used to analyze the data. Internal validity, ethical considerations, and researcher bias were also highlighted. The next chapter provides details about the study's findings by highlighting quotes from each of the participant's interviews.

CHAPTER 4: FINDINGS

The purpose of this generic qualitative inquiry was to understand how manufacturing employees learn about safety by understanding their experiences. Semi-structured interviews were conducted with 11 employees located at four urban sites, working for a single manufacturing company. The following three research questions aimed to fulfill the purpose of the study: 1) How do manufacturing employees learn about safety? 2) How does the learning context influence manufacturing employees' knowledge about safety? 3) How do manufacturing employees apply their knowledge about safety in the workplace? These three questions and the three major parts of the conceptual framework helped to focus the findings presented in this chapter into themes related to learning about safety, the learning context, and the application of learning.

Learning about Safety

To begin to answer the first research question, two key ideas are explored. It is necessary to first understand what methods the employees use to learn about safety, and second, to examine how they feel about each of the methods.

Learning Methods

During the interviews, the manufacturing employees discussed the following five different methods for learning: nonformal online classes, nonformal in-person classes, informally from a coworker, informally as an individual, and informally from a person they consider to be an expert, such as a manager, Environmental Health and Safety (EHS) leader, or an outside expert. This section provides descriptions of each of these learning methods through the eyes of the participants.

Nonformal Online Modules

In general, the participants described the nonformal online classes as being a method to learn about safety awareness and safety in general. The format of the modules is fairly standard as seven participants talked about reading slides, five talked about mouse-click activities, six mentioned that comprehension is checked throughout the module, and eight discussed the need to complete a quiz at the end of the module. In some examples, Noah explained that “you just go through the slides. Some of them are interactive. Some of them are just text. And then, at the end, we take a quiz.” Similarly, William described the online courses as being “kind of like a slide show and there’s some interactive parts of it. . . . They’re anywhere from five pages to 70 pages . . . and then it usually ends with taking a five to 10 question test.” Oliver described an online module as being “a bunch of slides with different things to click on. . . . And sometimes they do quiz questions throughout, which are usually pretty helpful, because those prep you for the quiz at the end.”

In addition to describing what the nonformal online modules are like, nine employees explained that they are often used for generic refresher training that raises awareness to a specific topic. Liam, for example, said, “We have an EHS training online that we have to essentially [recertify] every year, and it’s basic general questions . . . very, very generic.” Olivia explained that “you do the same training every year,” as she described how the online modules are used as refresher training. When asked to describe the most recent online training she had, Charlotte said, “A couple of months ago we had the online learning. Annual learnings that we normally take, like biohazards and chemicals. Just the normal annual trainings that we usually take every year.” Sophia also talked about the online refresher training by saying that “every year, they do refreshers on different things depending on where you’re working.” Emma specifically talked

about the online training focusing on awareness by saying, “A lot of it has to deal with the awareness factor that there’s things in the building that you need to be aware of and these are the things to look for.”

Finally, one employee also described how the online modules can be taken on-demand when an employee wants additional information. While this is not the norm, it still provides people with additional, nonformal learning opportunities. Noah described the situation, by saying,

The last one I took online was electrical safety and it was basically just a touch up. I started on to a new area that had a little bit higher voltages and higher amps, so I took it upon myself to ask to take that training. Our safety coordinator unlocked it for me, and I took it.

While this example that Noah described may also be seen as learning informally by himself, all of the online modules described by the employees are completed in an individual, self-paced fashion. They fall into the category of nonformal online learning since each module must be selected in the online learning management system and the content is owned and updated by the Company. It should be noted that none of the participants described any online learning experiences that included synchronous or asynchronous learning done with others or with an instructor. This type of learning method does not seem to be employed by the company for safety training.

Nonformal In-Person Classes

While there was a general consensus on what nonformal online learning looks like, the descriptions of nonformal in-person classes were much more varied. The one description seven of the participants shared, however, is that in-person training focuses on practical application.

For instance, Ava explained how “the trainer may have a little bit more to add from a personal perspective in the in-person training,” so they tell stories about practical applications. In this example, Ava went on to describe one such story where the trainer was “talking about instances where there was [a chemical] put in an area and they didn’t know what it was, so they had to put in a work order for hazardous waste or someone to come pick it up.” Through this story, learners can see the practical application of why labeling secondary chemical containers is important.

Similarly, Oliver said the following about nonformal in-person learning:

I do think the topics there seemed more relevant. I don’t know if that’s why we do those as classroom-based training. They seem more like the people you’re talking to understand exactly what you do and exactly how the safety aspect applies to you, so it’s very well-tailored to what you’re actually going to use.

In another example, Emma described a training course related to an electrical safety analyzer and explained that “it wasn’t about the device, so to speak, in how it operates. It’s how to use it with your laptop in order to get the tests completed.” Here, the in-person training did not go into detail about the workings of the device, but rather explained how to actually use it during the testing process.

When describing nonformal in-person training, five employees said the training has been impacted by the COVID-19 pandemic. Liam explained that “classes had to be smaller” and William described how classroom activities had to be changed. For example, in the medical response course, the learners would normally do the following:

[We would] get assigned a group and you have to sit there in front of everyone and tell one person to call 911, tell one person to go and find the first aid kit . . . [but] we didn’t have to do that this year because of COVID.

Not only were in-person class sizes reduced and activities changed, but some were postponed or cancelled altogether. Charlotte said, “Before COVID, I would say most of the trainings were done in class. Now, [only] 50% of them were done in class.” Oliver explained that with “COVID going on, [training] got canceled sometimes [or rescheduled].”

Four employees explained that in-person training is often physically involved. For example, when talking about fork truck and crane training, Olivia said, “You actually have to operate pallet jacks, fork trucks, stand-up fork trucks, and the different levels to make sure you know how to use them properly.” Liam talked about fire extinguisher training where “you get to go outside and start things on fire and put them out.” William described that same training by saying “they’ll set a fire out in the parking lot and have us all go and spray out everything.”

Nonformal in-person training was also described by three people as a way to learn from other’s experiences. Like Ava, Olivia explained that during in-person training “you get other people there and they’re talking about their scenarios and maybe I’ve never experienced that.” William gave an example from an in-person first-aid class where each person was assigned a different first-aid task to perform and “afterwards, they go around and look, and they have you describe the injury that you were given and how you were able to handle it.” He went on to explain how they show “different kinds of injuries instead of having everyone do the same thing every time,” so the class participants are able to learn from each other’s experiences.

Finally, while not asked specifically who teaches the nonformal in-person sessions, Emma, Liam, Charlotte, and Isabella mentioned three different types of people who teach at their site. First, Emma explained that “the last person that did [in-person safety] training was a manufacturing engineer.” Liam gave the name of the outside vendor “that comes in and does the

[fire safety] training.” Like Isabella, Charlotte said “our safety manager would present it with the same slides that we see on the computer.”

While the two types of training described thus far have been nonformal in nature, meaning that they are planned and organized by the company, the next three types of learning discussed are all informal. These are times when the employees learn about safety throughout the course of their normal day. What differentiates the three separate types of learning is from whom the employees are learning. In the next sections, learning from a coworker, as an individual, and with an expert are all defined through the eyes of the participants.

Learning Informally from a Coworker

When describing their experiences of learning informally from a coworker, eight of the participants talked about how they are able to learn from the coworker’s experiences and knowledge. For example, Isabella was talking about needing safety information from a different team, so she asked them about the process because she “never worked in that area, but those employees have a great knowledge of the decontamination process.” Similarly, Noah talked about learning the safety aspects of electrical repairs and said the following:

You know there’s always the person that’s the master at that repair. It’s good getting their knowledge through certain safety things. . . . [It’s] just a lot of good experience from people that have been doing it a long time.

When talking about learning from her coworker’s experiences, Ava said, “Listen, as old as I am, when you get to the age where you can’t learn from anybody else, well it might be time for you to exit.” In other words, learning from other people’s experiences is a critical part of learning about safety.

Not only did employees talk about learning from other's experiences, eight participants talked about how informally learning from a coworker is done in the context of their jobs, where area expectations can be explained, and learning is more in-depth than simply reading high-level procedures. Ava gave the example of a time when she was loading the top shelf of a rack in the warehouse and a coworker told her that she had to wrap anything being stored above a certain level. She explained that she "did not know that until [she] was working with them." In this case, Ava learned about a safety rule as she was performing the task as part of her job. Isabella clearly explained this part of informally learning from a coworker by saying, "When you receive [safety training] from a coworker, they address the actual point that can be used in day-to-day work." Similarly, James described a time when "there was a situation when somebody came and said, 'oh this part is not magnetic, it does not belong on this table. . . . It should be somewhere in a safe place.'" In another example, Oliver brought together the ideas of learning from other's experiences and learning within the context of the job activities themselves, where information can be more in-depth than what is given in procedures. Here, Oliver talked about the following scenario in the quality inspection lab where radioactive chemicals are used:

People that are more experienced will come over and tell you, 'oh, hold your arm like this,' and it's just really specific stuff that they can't really put in a procedure or in a safety training because it's so specific to that exact pipet motion that you're doing. . . . It's not technically wrong, usually, to do it the other way. You can do it either way, but there's a slightly better way to position the shield and then you'll get less [radioactive] dose and people that have done it 8000 times know that.

When talking about informally learning from a coworker, six of the employees described scenarios where they are the teacher and not just the student. James gave several examples of

how he teaches others about safety or alerts them if they are not following a procedure correctly.

In one example, he described the following situation:

When I was working on the ESD [electrostatic discharge] test with another person, . . . she was trying to do [it a] little bit faster. I said, ‘hey, it’s 16 kV and it could have shorted out. Just slow down. Don’t rush. I would not recommend that you rush the installation at all, because it’s very bad. 16 kV is a lot.’

In this example, James was explaining to a coworker the importance of caution with high voltage tests. Similarly, Charlotte said, “If I would teach somebody new on my team, I would definitely show them how to do the job safely,” and Emma frankly said, “I’m usually the one that’s training coworkers on safety.”

Finally, two employees explained that learning informally from a coworker is more about reinforcing learning already done through other methods. For example, Sophia said the following:

Maybe you learn about something and then you don’t always retain everything. So, maybe a coworker would mention something and you’re like, ‘oh yeah, I remember that now.’ Something like that, I think, more often happens than learning directly about it.

In Ava’s facility, there is a team of safety observers made up of coworkers from different areas. She explained that when something did not look safe, the manufacturing employees are “looking for their safety observer to come over so they can say, ‘oh well, that’s okay’ or ‘that’s not okay,’” reinforcing or further explaining training that had been received through another method.

Learning Informally as an Individual

When describing times when they learned about safety individually in an informal way, the manufacturing employees described two different types of learning. Six participants

explained that they learn about safety by themselves when they have some kind of injury or near-miss, and seven participants talked about doing research to proactively learn about a safety topic related to their jobs. Olivia, Charlotte, Sophia, and Isabella all told stories about when they were injured or almost injured. Emma, Liam, Noah, Oliver, and Ava explained situations where they did research or gathered more information to learn about safety. William and James, however, discussed both ways of learning. Elaborating on the ideas of learning through direct experience and doing research, six employees described how experiences are tied to trial and error and figuring out what works best for them as an individual, and three employees talked about how safety procedures, signs, or labels provide means to research or gather additional information. Table 4.1 on the next page provides examples from each of the employees about their experiences with this type of learning method. The table provides a more extensive view of the variety of experiences each employee shared.

Two employees also told stories about significant events outside of work where they learned about safety from experience. In the first story, Emma explained a time when there was an issue at home with the furnace. Emma went on to explain the following:

So, I'm like a handyman myself. I can fix this. I took it apart. I rebuilt what's called a gun inside the combustion chamber for mixing oil and air velocity to create the combustion. And I rebuilt it, put it back together and it was working great for a couple of weeks. And all of a sudden, one day it sent boom, literally went boom in my basement. I'm like, 'oh my God, what happened?'

The repair technician came to the house, repaired the furnace, and explained to Emma why the original repair was faulty. Even after it was fixed, Emma explained that "every time I walked

into my basement afterwards, I was like, ‘oh my goodness, is this going to blow on me?’” In the second example, Liam explained about a time when he was doing some welding in his garage at

Learning Type	Employee	Experience
Experience	Olivia	While working part-time at a different company. “You have rollers that you’re walking on the edge of, and it was so unsafe . . . I knew I was going to end up hurting myself.”
Experience	Charlotte	“I know there’s rules that we follow, but I also learn little ways how to move, how to turn, how to hold my hands when I do that [tasks] to make it safer for me.”
Experience	Sophia	“Whenever you have the pallet jack, you put it under your pallet. You take it to your spot and then, I was unloading my pallet and it started moving. And I was like, ‘I guess I should probably put that down all the way.’”
Experience	Isabella	“I don’t like hurting myself. Typically, that’s how you learn on your own about safety. I like to learn by example and not by experience.”
Experience / Research	William	“So, I had to really learn all that on my own and finding out the hard way how to do some of [the procedures]. I have a nice scar this long down my shin . . . Usually that’s what causes you to start looking for better alternatives, easier ways to do it, safer ways.”
Experience / Research	James	“When I was young, I learned from myself, from my mistake and then I started to read more, start to use information that was available to make sure it’s not going to happen to me or somebody who is staying near me, because it could be [very] bad.”
Research	Emma	“So, the unit comes in . . . and it goes through a decontamination process. When I looked it up, it was one minute of wet saturation of a chlorine-based solution.”
Research	Liam	“I sat online for probably two days, not two days straight, but two days for a couple of hours, just reading everything I could on galvanized metal and what these effects could be.”
Research	Noah	Referring to how safety training at work has led to learning about safety at home, “It’s taught me to, in my garage, take better safety measures and [take it] upon myself to look up safer ways I can work on my car without being crushed by it. So, that’s something you’ve got to teach yourself.”
Research	Oliver	“In some cases, I’ve looked at [the Material Safety Data Sheets] and read the sheet, or I’ll read the label on a chemical bottle before I use it.”
Research	Ava	“I wasn’t really familiar with that lathe, so I got the manual to look up the safety aspects of that machine.”

Table 4.1: Employee Experiences Learning about Safety by Themselves

home. He described the incident as follows:

So, I was welding the galvanized steel and I noticed what looked like smoke rising, like regular welding smoke, but it solidified and then it looked like cobwebs and I'm sitting there thinking, I have no mask, no respirator, or anything. And I'm sitting there going, what could that do to your lungs? So, I looked into it and found out how hard core that actually is. If carcinogens could actually have a physical appearance, that's what they look like. . . . I immediately stopped doing that in my garage, at my house, and started doing it outside with a respirator because I didn't want any of that to even possibly float into the house, because [I had] two little kids at the time.

Learning Informally from an Expert

Another type of learning described by the employees was learning informally from someone they consider to be an expert. Five participants described this type of learning as focusing on the “how” and “why” of a process, done in the context of their particular job. For example, James said, “It's pretty much like that time when my manager explained to me [the] lock-out/tag-out procedure. He used [the] real equipment we're working on, and he said we must do it this way, not like we did years ago.” Isabella's description was similar when she described a time when a manager “came and explained further, in greater detail, that . . . we were in no danger [due to the decontamination process].” In each of those cases, James and Isabella saw their managers as experts. Ava and Charlotte, on the other hand, described how the site's Environmental Health and Safety (EHS) Leader is an expert. Specifically, Ava said the EHS leader sits down with the site's safety observers and “because we're safety observers, they may talk to us about fork truck incidents.”

After the employees discussed their overall experiences with different types of learning methods, they then explained their feeling about each method. Their positive and negative reactions to each of the learning methods are found in the next section.

Feelings about Methods

Each learning method was met with a number of positive and negative feelings from the employees as they described their likes and dislikes. In some cases, the same aspect of a learning method could be viewed as positive by some and negative by others and in other cases, the same employee could see a feeling as being both positive and negative at the same time. In each of the following sections, feelings most frequently described by the employees are highlighted, while more detailed lists of reactions are available in Appendix J – Feelings about Learning Methods.

Nonformal Online Modules

As described earlier, the nonformal online modules are completed individually by employees through the company's learning management system. Seven people mentioned during the interviews that this type of online learning is self-paced and provides time flexibility to the employees. For example, Noah described online learning as when “you have stop and play power on the videos.” This is contrary to in-person classes when, as he explains, “you can't just pause the [instructor].” In other words, Noah appreciates the ability to pause, rewind, or replay the online modules at any time. William, James, Charlotte, Isabella, Oliver, and Ava all shared similar sentiments about their experiences with online learning modules.

On the other hand, the most often referenced issue employees had with nonformal online learning modules is the lack of personal context and personalized interaction. This was mentioned by six employees. For example, Isabella said “I think [the online learning] could be more site-based. It's kind of generic for the entire [company] and it's not really focused on the

specific items that we may have here.” Emma, Liam, William, James, and Oliver also noted the lack of personal context in a similar fashion. This is consistent with the definition provided earlier that nonformal online learning modules are generic in nature.

Nonformal In-Person Classes

Unlike the nonformal online learning modules, the nonformal in-person classes are done in a group setting, with the types of classes varying by site. According to the employees, one of the greatest advantages to learning in an in-person class is the social aspect of learning. This is seen by the six participants who enjoy the social interaction, sense of team, and ability to learn from the multiple perspectives they experience during an in-person class. For example, Liam said the following about learning with others:

Not to be another sheep in the herd, but sometimes it’s pretty cool being in a herd, you know. There is something to be said about power in numbers, and when I say power in numbers in the classroom setting, [I mean] the amount of brain power is exponentially [higher]. It could be [that] the dumbest person in the room actually has the greatest idea. In his comments, echoed by Sophia, James talked about benefitting from the questions asked by other people in class and explained that he was able to better answer quiz questions because coworkers had asked questions he had not thought to ask.

In addition to their feelings about learning with other people, four employees specifically talked about the impact of the instructor. This was difficult to categorize as being either a like or dislike, because depending on the instructor, the impact could be positive or negative. Liam described this feeling by saying the following:

I like [in-person] training as long as the instructor's engaging . . . It almost always falls on the instructor as to whether or not you're going to have a productive class, whether you're going to enjoy it or not.

James, Sophia, and Oliver expressed similar ideas, saying a good instructor will make the class fun, engaging, and interesting, while a poor instructor is incredibly frustrating.

Learning Informally from a Coworker

As described earlier, learning from a coworker can include learning from someone who is seen as more experienced who provides suggestions on better ways to do things, or could include times when the employee actually does the teaching or makes suggestions about safety to others. In this case, five employees explained that learning from a coworker is not always welcomed. For example, Liam explained, "I don't like how some people get obtrusive . . . It's people that are generally younger than you that, maybe they're trying to . . . [give themselves] an ego boost." Similarly, Olivia said, "There tends to be coworkers that think they're being helpful, but they're not approaching something in a safe manner. I kind of feel like they want to show off that they know how to do this or that." Noah also stated that "You've got the people that will just say things because they want to sound smart."

On the other hand, employees seemed to like learning from a coworker when the coworker is knowledgeable, a good teacher, and focused on what the employee sees as applicable. Oliver explained this type of learning in several different ways and also expressed a desire to be considered an expert one day by saying the following:

I think it's really useful, the people that have experience. We're lucky in the lab.

Everyone's super nice and super helpful, so there's people that have been here, I think the longest guy has been in my lab for 20 years. He's a pro and just super helpful if you ever

have a question, [he's] very happy to share his knowledge. But I think that is a type of learning that you can't get any other way, because you're not going to get it online. You're not going to get it when you're first trained. They can't go into every, tiny, minute detail or even if they do, you're not going to retain it all, so just having those experienced people around to talk you through it [is helpful]. And then, we're always noticing what each other is doing, so even if it's not someone specifically going through it with you, but they just see you doing something and say 'hey, I think you could do that a little better.' I think that's the best way to learn and I hope eventually I'll be here long enough that then I'll be one of the experienced ones.

Isabella also described how coworkers "have a better perspective [and] can address the necessary concerns." Noah echoed their comments by saying, "it is good getting their knowledge about certain safety things . . . Just a lot of good experience from people that have been doing it a long time."

Learning Informally as an Individual

In the next type of learning, the employees described two scenarios of how learning happens when they are alone. The first is when they experience a safety-related event, and the second is when they do proactive research related to safety. Similar to their preference toward the self-paced nature of nonformal online learning, four employees described how they liked that learning individually can be done on their own time. When asked about the positive aspects of learning individually, Emma said, "I go at my own pace and my comprehension for the subject matter usually excels." William explained in his response to the same question that "I can do it at my own pace, on my own accord." In each case, the self-paced nature of learning informally as

an individual can be tied to situations where the employee did proactive research, rather than when a safety-related incident caused the person to learn about safety.

Another positive feeling that four employees had about learning as an individual is how successful they feel when they have figured out something on their own. For example, Sophia said, “In the case of the pallet jack [incident, I feel] successful, because I prevented anything from getting damaged or hurt, [including] myself.” Similarly, Oliver said, “If I’m confident that I learned it correctly, or I figured out whatever my question was, then I feel really good because I like to solve my own problems.”

As expected, the downside of learning about safety informally as an individual may mean an injury was sustained. Three employees talked about this specifically. Isabella gave an example of when she reached over a hot pot and burned herself. When asked about what she liked and disliked about learning this way, she said, “I don’t like hurting myself. Typically, that’s how you learn on your own about safety.” She went on to say that when it comes to safety, “I like to learn by example and not by experience.” William and Sophia voiced similar reactions to being injured.

Learning Informally from an Expert

In the final type of learning, the employees explained how learning informally from an expert focuses on the specifics of a safety process within their job context. It should be noted that due to the semi-structured nature of the interview process, questions about learning from an expert were not asked of all employee at Site 1, since it was a Site 1 employee who brought this up as a unique way to learn about safety.

For those who were asked about learning informally from an expert and who could think of an example when that happened, three employees appreciated that learning this way was very

informative. James described a time when his manager talked with him specifically about a change in the lock-out/tag-out procedure. After explaining the nuances of the change, James said, “I think this was very informative, a lot of details. It was a good experience for me.” Charlotte talked about a time when her safety manager spoke to her about the procedures her site follows during a severe weather event. She said, “It’s a good way to learn. The person definitely knows his job, and if you follow what he tells you to do, then you’re going to be safe if the situation happens.” In Ava’s example, other safety observers would share information they had found about fork truck incidents at other locations. She explained that this was informative because “it gives me insight to what is actually going on somewhere else.”

Other positive feelings about learning informally from an expert are the expert can use their experience to explain common mistakes that are easy for the employee to relate to, and the learning experience seems to have practical application. Four employees provided examples of these ideas. In Emma’s example about the repair technician who came to fix the furnace, the technician “actually taught me how to fix it while he was doing it.” In this case, Emma will know how to safely fix the furnace in the future. In another example, Isabella explained that “because they know the ins and outs and the rhyme and reason behind it, and with them being at the expert level, they know the common mistakes of regular people underestimating what the chemical can do.”

Overall, the manufacturing employees who participated in this study described five types of learning and had a number of perceptions related to their learning preferences. As shown in the conceptual framework, learning and knowledge are not the only concepts which influence the application of learning. Since the learning context influences both knowledge and application of learning, it is explored next through a discussion of the second research question.

The Learning Context

Before specifically examining the second research question regarding how the learning context influences manufacturing employees' knowledge about safety, it is important to first define the learning context as it is used in this study. To maintain focus on the perspectives of manufacturing employees, the definition of the learning context is taken from the participants' own points-of-view.

Definition of the Learning Context

As described earlier, the learning context in the conceptual framework is multi-faceted. Daffron and North (2011) describe context in three different ways. The first is in the learning context, which centers around the organizational climate, or in this case, the safety culture of the organization. The second is the workplace environment, and the third is availability of opportunities to immediately apply a concept or process that was learned. Here, the workplace environment refers to the peer and supervisor support outside of the organizational climate itself. In the Daley and Cervero (2016) model, context is defined similarly to Daffron and North's (2011) learning context, focusing on the organization. In a discussion with Dr. Daley (B. Daley, personal communication, August 21, 2021), she explained that one of the most important pieces to the learning in CPE model (2016) is to clearly define what context means within the framework of the study. Therefore, this section looks at how the manufacturing employees defined context while discussing learning about safety. In their view, context includes the location in which they work, the material and equipment they use, their job responsibilities, the people they work with, and the organizational safety culture. Each of these elements are discussed next.

Location

At a macro level, the participants referenced the “site” or the “plant” where they work, referring to the building itself. When talking about the nonformal online training especially, they would mention how the training was not site specific, but was geared toward the company as a whole. For example, Emma said, “They’re never site related” and Isabella felt the online training “could be more site-based.”

Within the site itself, the employees used the word “floor” to describe where they work. For example, Emma said, “I’m a technician out on the floor,” while William and Charlotte both explained that they “work on the floor.” In these cases, “the floor” is the designated area where manufacturing activities happen, as opposed to offices where management, engineers, and other support functions have their desks. It is used interchangeably with “the manufacturing floor” or “the shop floor.”

The employees then used the word “area” to describe the locations of their particular teams on the manufacturing floor, to differentiate where they work from where other teams work. James talked about “his area” versus different areas for other departments, Sophia mentioned “the area you actually work in,” and Isabella described repair, production, and decontamination as all being different areas.

Finally, at a micro level, the employees talked about working at their desks, in their bays, in the paint booth, inside a semi-trailer, or in a lab. These locations were much more specific and were a way for the employees to give an “exact address” for where they do their work. In one case, however, Noah explained, “I don’t have a home desk. I am at multiple different areas throughout the day.” While not every employee has a single specific location where they work,

any one of the locations described in this section provides a context for where their work happens.

Materials, Equipment, and Job Responsibilities

While the location context was fairly universal among all the participants, the materials and equipment each person talked about during the interview was quite varied and dependent on that person's job responsibilities. Materials and equipment such as chemicals, carts and dollies, electronics and electrical equipment, fork trucks and forklifts, pallet jacks, and soldering equipment were mentioned by at least three employees each. In total, 22 types of equipment were discussed at various times in the interviews. In discussing context, these were most frequently mentioned by the employees when describing how they had learned about safety or if they had a specific example of a safety incident.

One or more of these different types of materials and equipment are used with the different job responsibilities held by each of the manufacturing employees. For example, William said, "I bring in the heavy equipment and then . . . use an overhead crane to open or pull the parts out of the crates; . . . then I process [them], receive them, and deliver them to the floor." Sophia described her job as requesting Return Material Authorizations and then packing and shipping the parts. While each employee has specific job responsibilities, Olivia characterized the type of work she does, saying, "the things I'm doing [here] are not things that you are doing in normal, everyday life [outside of work]." This distinction is important when it comes to safety training and applying safety procedures at work, and will be discussed later in this chapter as it relates to the dread factor (Burke et al., 2011).

People and Organizational Safety Culture

During the interviews, the manufacturing employees talked about the various people with whom they interact during the workday. Each of the participants referred to coworkers, managers, and the person in charge of safety for the site. The latter was given a number of different names, such as the safety coordinator; safety manager; Environmental, Health, and Safety (EHS) manager; EHS supervisor; and the “EHS guy.” Regardless of the title, this is the person responsible for the site’s safety, safety training, safety incident investigations, and safety improvements. In addition to these people, three employees also mentioned contractors who could be at the site on a temporary basis, either working in a specialized area, such as electricians from the power company, or they could be temporary manufacturing employees working to support short-term surges in production demand. All of the participants made it clear that while training may be different depending on job responsibilities, everyone is required to follow the same safety guidelines, no matter what their role.

Both Daffron and North (2011) and Daley and Cervero (2016) discuss the influence of the organization’s culture on the application of learning. Throughout each of the interviews, the participants talked at length about the strong safety culture at their sites, along with their desire to keep their coworkers safe (Appendix K – Quotes about Safety Culture and Felt Responsibility). Five of the employees talked about the positive influence of their managers and how their managers set a good example when it comes to safety. Four participants gave examples of how safety incidents are viewed as a time when they feel their management teams care about them. Rather than a time to be reprimanded, they explore ways to improve safety to help prevent future occurrences. Three employees gave examples of the work-stop program, where they are encouraged to stop production if they feel something is unsafe. Three participants talked about

the culture itself and their site's high standards when it comes to safety. Safety slogans were even mentioned, such as "Safety First" and "Take two for safety," highlighting the safety culture that has been engrained into the working environment. Finally, two employees talked about times when they asked for safety improvements and the manager or EHS leader did their best to quickly implement the improvement.

In addition, Freitas et al. (2018) explain the idea of felt responsibility as the obligation employees feel to act in a safe manner when safety professionals, coworkers, and supervisors have strong safety-related attitudes and exhibit safe behaviors. Eight of the employees talked about this same idea (Appendix K – Quotes about Safety Culture and Felt Responsibility), explaining how they "look out for each other," "[do not put] each other in harm's way," and that they "don't want to see anyone else get hit [by a forklift]." While these are examples of why an employee would act in a safe manner, they also show the strong sense of safety culture that is felt by the employees.

As additional evidence to the strong safety culture of the Company, eight of the 11 employees mentioned during the course of the interviews they were members or leaders of safety teams. These teams include the medical response team, the chemical spill response team, the fire safety team, and the safety improvement team. It is possible that the remaining three participants were also part of safety teams, but did not mention it during the interview since there was not a specific question related to safety team involvement.

In this section, the five different concepts which make up the employee's learning context were defined. Next, the manner in which the employees feel context influences knowledge is explored.

Influence of Learning Context on Knowledge

In the conceptual framework, the learning context is shown as influencing knowledge, which is a departure from the original Daley and Cervero (2016) model of learning in continuing professional education, where the influence is shown in the opposite direction. While Daley and Cervero did not necessarily focus on the direction of the influence (B. Daley, personal communication, August 21, 2021), this section provides evidence as to how the learning context influences knowledge, rather than knowledge influencing the learning context.

Consistent with the principles of adult education (Merriam & Bierema, 2014), the employees indicated their preference is to learn about what is applicable to their job responsibilities. Six employees talked about how they prefer to learn only what is pertinent to them. This suggests that what they will remember is significantly influenced by the job responsibilities, materials, equipment, and location portions of their context. For example, when talking about an ideal safety training program, Liam explained that he “would like to see them . . . tailor [the training] to each particular building” and William said he “would cut out probably 90% of [the current training]. Not that it’s not important, [but] there’s so much of it that . . . just doesn’t pertain to my daily work.” Similarly, Sophia said she would gear safety training “more towards what people actually work with, like the area you actually work in.”

The manufacturing employees also explained that learning and practicing in their own context helps to improve their understanding of the safety topic. Six employees described how their ideal way to learn about safety would be to use the actual equipment or be in the actual location where they need to apply the safety training. For example, Noah said, “You gotta take the training and then you have to apply that training in real life to really get the gist of what it’s all about.” Charlotte explained that using photos from her site, rather than generic photos, would

help people “better [understand] what we’re talking about.” Isabella suggested making simple diagrams for where chemicals are located at her site, “so [people] can relate directly to it.”

Application of Learning

To answer the final research question about how manufacturing employees apply their knowledge about safety in the workplace, it is important to look at the influence of both knowledge and the learning context on application. This section explores the perceived enablers and barriers to application of learning described by the study participants as they relate to knowledge and the learning context.

Enablers to Application

The main enablers to application of learning discussed by the employees were the safety culture, a desire to follow the rules, and a desire to avoid rework or being hurt. Each of these enablers involve the learning context portion of the conceptual framework.

Safety Culture and Following Rules

As discussed in the literature review, a number of studies (Burke et al., 2008; Olson et al., 2009; Laberge et al. 2014; Freitas et al., 2018) highlight the importance of a strong safety culture as an enabler to the application of safety learning. In addition to the evidence already presented about the strong safety culture at the four sites involved in this study, the employees also talked about their desire to follow the rules when it comes to safety. This motivation to comply with safety rules is part of the organization’s safety culture and therefore, the learning context. Six employees explained how their manager is seen as an enforcer of safety rules. James said, “[My manager is] watching that I’m wearing safety glasses and wearing [the] proper [electrostatic discharge] jacket. . . . He’s always saying, ‘use your safety strap,’ ‘use your safety glasses,’ ‘use your safety shoes.’” Olivia, Sophia, and Ava also talked about how their managers will check to

be sure the manufacturing employees are using the proper personal protective equipment (PPE). Isabella talked specifically about her manager's involvement in documenting any safety incidents, saying that "we have to document any incidents that occur, so we just understand this is part of the process." Noah also added that "if [the manager] ever found out that you were doing something really dangerous, you would definitely get a scolding or be fired if it was bad enough." To avoid getting in trouble or being fired, the employees talked about how they want to follow the safety rules. For example, Sophia said, "I pretty much follow the rules. Gonna do what I'm supposed to do." She also shared an example when a coworker got in trouble for having an open soda container on the floor and because of that she's ". . . pretty conscientious about not bringing anything with open tops on the floor. I'm extra careful." Isabella described how she's vigilant about what she puts in the trash because "if anything looks like lead or solder, you may be written up." Oliver even said, "I sound like such a goody-goody . . . but I'm a rule follower."

Avoiding Rework and Being Hurt

Not only do the employees want to follow the rules when it comes to safety to avoid getting in trouble, they also want to avoid rework. Five employees explained that while it might seem faster to circumvent safety procedures, that usually results in rework. For example, Isabella, like James, talked about a situation where, if the electrostatic discharge strap is not worn, "you could cause a shock on the device, so that just makes more work for later on." Oliver explained that "if you were to disregard safety, I think everyone here would agree, that if you spill something radioactive, it'll be a huge pain to clean up. You'll have to shut everything down. It's just so much more trouble in the long run." Sophia talked more generally saying, "I'd rather

not make the mistake to begin with, than to make the mistake and be like, ‘oh my gosh, I just did this and [wow] what a mess!’”

Finally, the employees described how they apply what they have learned about safety in an effort to avoid being injured. In talking about electrical safety and the importance of learning about it, Noah said, “Learning about hard shut off buttons and learning about . . . the system itself, [with] its amps and its voltage [teaches you] that the thing can literally kill you if you don’t shut the power off.” Additionally, William said “You take what you know and apply it in a way that you can still safely do it without breaking something or hurting yourself.” Isabella simply said, “I don’t find myself not [following] the rules, because I kind of like [being] a whole person and I don’t want to get hurt.”

While different types of avoidance can be strong enablers to apply safety knowledge, there are also barriers which can make it more difficult for employees to apply what they have learned about safety. These are explored in the next section.

Barriers to Application

Employees talked about two main barriers to the application of learning, including lack of knowledge and learner characteristics and motivation. Whereas the enablers to application seem more closely tied to the learning context, the barriers to application appear to come from the knowledge portion of the conceptual framework.

At the most basic level, five employees talked about how lack of knowledge was the reason they did not follow a safety procedure; but only two of the examples were situations where the person was simply not taught the safety procedures. First, Sophia discussed a time when a coworker informed her that items stored on a top shelf in the warehouse had to be wrapped. She told the following story:

I did not know whenever you put things up on the top shelf in the storage area that you have to wrap it in [something] like Saran Wrap. Yeah, I did not know that until I was working with [a coworker] and he said, ‘you know you have to wrap that before you put it out there,’ and I’m like, ‘what?’

Sophia gave another example of when she was first learning about using isopropyl alcohol. Her on-the-job trainer, a coworker, told her to get the alcohol from the flammable cabinet and bring it back to their work area. She explained the following:

I go over and I open the cabinet. Well, there are signs inside that say you’re supposed to wear your gloves whenever you’re filling up your alcohol. Well, they didn’t tell me that. I had to walk back and try to find a pair of gloves before I can fill my alcohol container. Now, whether everybody follows the sign, or nobody does and that’s why they didn’t remember to tell me, I don’t know.

In other examples of barriers to application of learning, the employees talked about factors that may have caused them to forget the procedure. Oliver explained that how a person is feeling during training may influence their ability to remember the safety procedures. This would suggest not remembering equates to lack of knowledge, which impacts the ability to perform the procedure. Oliver said the following:

If I’m super tired, if I’m just really stressed because I know I have a ton of stuff to do that day and I feel like I don’t have two hours to sit and train . . . or if I’m really hungry because I didn’t eat lunch or anything that’s kind of a big distraction, I think that has a big impact on long-term retention [of the material.]

Liam talked about how “many people . . . in times of crisis, [forget]. They just lose it.” Unrelated to times of crisis, William said, “I’ve been guilty of forgetting to raise my hook high enough and

I've hit my head on it once or twice.” Regardless of whether the lack of knowledge is caused by never learning a safety procedure or learning it and simply forgetting to follow it, the employee is not able to follow the procedure.

Even if the employees have learned, and remembered, the safety procedures, there are times when the procedures were not followed. Seven employees described how feelings of stress, fatigue, hunger, distraction, or over-confidence in their abilities could cause them not to follow safety procedures. For example, Olivia shared the following:

There're times [when] you think, 'oh, I can shortcut this.' I think it's human nature, but I also think it's dangerous because if you do take the shortcut and everything goes great, then I worry about trying to continuously shortcut. So, I try not to do that.

In a more specific example, William explained a time when he was part of a safety incident when a stack of skids toppled over after he did not complete the truck loading procedures as required.

He said the following about why he did not follow the safety procedures:

Part of it was just the irritation of getting in and out of the trailer that just kind of made me be quicker about it. I took the turn too fast, knowing I was being irresponsible, but I was doing it anyway, because I was being pissy at four o'clock in the morning. That's the last thing I want to deal with, and I ended up dumping all of them and destroyed a computer too. So, that lack of safety interest almost lost me my job. . . . Normally when it comes down to that, it's just little things where you're in a bad mood or something, you just start to work quicker. You don't think as much. That's where a lot of my mistakes come from.

In another example, Sophia was talking about lifting heavy boxes and how she has often asked for help if the box is too heavy or awkward to carry herself. She explained that some of her

coworkers, however, are “that bravado kind of person” and think they can lift the heavy boxes by themselves, having the “oh, I can handle this” attitude.

While some portions of knowledge and the learning context seem to be strongly associated with either being enablers, or being barriers to application, there are additional ideas that could be either, depending on the situation. These are discussed in the next section.

Situational Enablers and Barriers to Application

When discussing the safety culture as it relates to the learning context earlier in this chapter, several examples were shared of how the employees’ managers set good examples of acting in a safe manner. While there were no specific examples shared, Sophia explained that “if I had a manager that was really lax about it . . . then maybe I wouldn’t be like, ‘I feel I need to do every one of these and they’re important because my boss does them.’” In other words, if her manager was not setting a good example regarding the implementation of safety procedures, then she would not be as focused on following them either.

A person’s age and personal body limitations may also act as enablers or barriers to application of learning. Olivia, for example, explained that she uses the overhead crane “because the parts are very big and heavy” and she knows her own limitations. Because of these limitations, she follows the requirement to use the crane without hesitation. On the other hand, Liam said “I don’t have the greatest knees, so if I go down there and bend at the knees, I’m not coming back up.” While he does not use the crane, he also does not use proper lifting techniques, which would require him to bend his bad knees farther than his body would let him do comfortably. Instead, he chooses to lift boxes manually using poor lifting techniques.

Another concept that can be either an enabler or a barrier to application of learning is the dread factor, which Burke et al. (2011) define as “the realization of the dangers associated with

ominous hazards and the experienced feelings that one has about the possibility of such events/exposures” (p. 63). They concluded that when the dread factor is high and training methods are engaging, then employees are more motivated to follow safety procedures. They also found that when the dread factor is low, the level of engagement of the training did not have a significant impact on the application of learning. The influence of the dread factor could be seen in this study as well when employees were asked about times when they did not apply something they had learned. For example, Oliver explained, “If it’s picking up a pencil, I feel confident that even if I understand that there is a better way to do it, . . . if I’ve done that my whole life and I know what the consequences are,” then following the procedures is not as critical for these mundane, common tasks. This relates back to the learning context, where what happens at work is different than what happens in normal, everyday life outside of work.

Finally, the availability of personal protective equipment (PPE) can be either an enabler or a barrier to the application of learning. If proper PPE is not available, then the employee may decide to circumvent the safety procedure, whereas when it is available, they are more likely to apply what they have learned. When talking about ergonomics, Noah explained that since he does not have a home desk with a chair best suited for him “it’s impossible for me to [sit with] a perfect straight back [using various chairs].” On the other hand, Charlotte has “an ergonomic desk. There’s a button that makes my desk go up and down if I want to stand up or if I want to sit down.” Ava described a case where the ear plug dispenser is on the manufacturing floor, so if she did not have ear plugs with her already, she would have to first enter the area that requires hearing protection without ear plugs. To ensure this does not happen, she “wears the ones with the string and then when I leave, I have them with me.” This way, she has her ear plugs for the next time she goes into the hearing protected area.

Summary

In this chapter, findings related to each of the three research questions were shared. Manufacturing employees learn about safety through nonformal and informal methods and there are a number of positive and negative feelings they have toward each method. The learning context influences the manufacturing employees' knowledge when learning happens within their own context and is related to what is applicable for their job responsibilities. Finally, both knowledge and the learning context impact how and if manufacturing employees apply their knowledge about safety in the workplace through enablers and barriers to application of learning. A discussion about these findings, their implications, and conclusions are shared in the next chapter.

CHAPTER 5: DISCUSSION, IMPLICATIONS, AND CONCLUSIONS

With millions of employees injured on the job in the United States every year (Bureau of Labor Statistics, 2019), there is still a significant amount of work to be done to make workplaces safer. Improving safety training and opportunities for learning about safety is just one portion of what can be done to create safer working environments. To this end, the purpose of this study was to gain an understanding of how manufacturing employees learn about safety in the workplace. Eleven interviews were conducted based on the following research question and sub-questions: RQ) What are manufacturing employees' experiences with safety training? SQ1) How do manufacturing employees learn about safety? SQ2) How does the learning context influence manufacturing employees' knowledge about safety? SQ3) How do manufacturing employees apply their knowledge about safety in workplace?

It was found that employees learn through nonformal and informal methods and have a variety of feelings about each method. In general, they appreciate when the time of learning can be flexible, when they can focus on what is applicable, and when they consider the person from whom they are learning to be an expert. In addition, they are frustrated when training is not personalized or applicable to their jobs. The learning context was defined through the employees' perspectives as being related to the space they work in, the materials and equipment they use, their job responsibilities, the people they work with, and the safety culture of the organization. Learning within their personal context was also shown to influence their understanding and retention of the material. Enablers and barriers to application were found related to the safety culture, avoidance of rework and being hurt, feelings of stress, not knowing or understanding a safety procedure, the dread factor (Burke et al., 2011), learner characteristics, and the availability of personal protective equipment.

In this chapter, findings related to the literature review are discussed, study limitations are detailed, future research is proposed, and implications for practice are recommended. Finally, conclusions are drawn about the study, the research process, and how my personal perspective has changed.

Discussion

During the analysis process, several themes emerged with regard to how manufacturing employees learn about safety and how the learning context influences both knowledge and application. Some of the findings support existing literature, others reject the findings of previous studies, and some help to fill literature gaps. These themes are discussed in the following paragraphs, highlighting key points related to the conceptual framework, learning about safety, and the learning context.

A Combined Model of Learning and Actionable Practice

At the end of the Chapter 2, several questions which went unanswered in the literature were discussed. First, do Daffron and North's (2011) and Daley and Cervero's (2016) models apply to manufacturing employees in the workplace safety context? Next, can the two models be combined to show a single picture of how manufacturing employees learn about safety? Finally, can a combined model show the impact of compliance to safety regulations, as well as the different types of learning which manufacturing employees experience? These model-related questions were then set to be answered through the study of employees' experiences with safety training.

Before answering the first question, it is important to understand the types of learners about whom the transfer of learning (Daffron & North, 2011) and learning in CPE (Daley & Cervero, 2016) models were developed. It was found that none of the authors used

manufacturing employees as the basis for the creation of their models. In fact, of the 70 references listed in Daffron and North's (2011) book, none of them referred to manufacturing workers, while there were references to professionals such as professors (Daffron & Davis, 2005), software company professionals (Daffron & North, 2006), judges (Daffron et al., 2007), police officers and fire fighters (Daffron et al., 2008), engineers (Finley, 1997), social workers (Gregoire, 1994; Rooney, 1985; Taylor, 2006), medical workers (Mazmanian, 1998), business executives (Olivero et al., 1997), and professionals in general (Daley, 2001; Jeris, 2001). Similarly, of the 40 references listed in Daley and Cervero's (2016) book chapter, none of them referred to manufacturing workers; instead, there were references to nurses (Benner, 1984; Fonteyn, 1991), teachers (Brookfield, 1995), and professionals in general (Boud & Hager, 2012; Daley, 1999; Daley, 2000; Daley, 2001; DeGroot et al., 2014; Nowlen, 1988; Reich et al., 2015; Webster-Wright, 2009). While this shows that the models were not created based on studies related to manufacturing employees, it was also found that other empirical research which references the models has not focused on manufacturing employees either. Using Google Scholar, it was found that 32 books and articles cite the work by Daffron and North (2011) and 23 books and articles cite the work by Daley and Cervero (2016), and none of this research refers to manufacturing employees. Although this study did not look specifically at the models separately and how they apply to manufacturing employees, the conceptual framework I developed combined the Daffron and North (2011) and Daley and Cervero (2016) models and was successfully used to conceptualize the experiences of manufacturing employees when learning about safety in the workplace. In analyzing the employee interviews using the conceptual framework, I found that several additional changes to the model were warranted based on these findings.

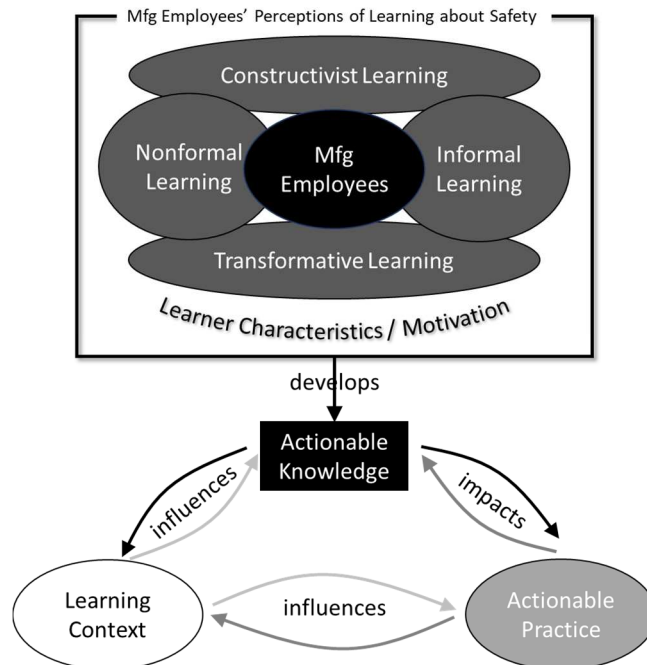


Figure 5.1: Model of Safety Learning and Actionable Practice for Manufacturing Employees

The first major adjustment to the conceptional framework was the change from “application” to “practice,” as well as the addition of “actionable.” “Application” suggests a static interaction between knowledge and action, when something learned is finitely applied to a resulting behavior. Adding “actionable” highlights that learning about safety requires action to avoid injury and that the construction of knowledge simply for the sake of knowledge itself is not enough. Second, additional arrows were added to show the continual interaction between knowledge, the learning context, and practice. As described by the employees, knowledge is fluid and dynamic and not only affects actionable practice, but is impacted by it as well. In Sophia’s example of needing gloves to fill the isopropyl alcohol bottle, she had learned about filling the bottle from her co-worker and acted based on that knowledge. Upon reading the signs in the flammable material cabinet, however, she learned additional information and changed her practice to include the use of gloves while filling the bottle. Similarly, the learning context is influenced by both knowledge and actionable practice by making safety improvements to

equipment used on the manufacturing floor based on the employees' experiences and safety training, for example.

While the previous paragraphs explore the first two literature gap questions, the final question related to compliance and learning methods is considered next. Since compliance to safety procedures and regulations is an important part of the safety learning context (Ripamonti & Scaratti, 2015), it is critical that any model which describes the actionable practice of safety training for manufacturing employees also considers compliance. As shown in Chapter 4, the employees participating in this study expressed a desire to follow the safety rules, or more specifically, to act safely to avoid being reprimanded. In other words, one of the reasons employees act safely is to comply with safety rules and regulations. This desire to comply is tied to the organizational safety culture, which is part of the learning context. Both the original models and the combined model show the influence of the learning context on the actional practice of safety training and, therefore, correctly represent how working safely can be impacted by the desire to comply with safety rules through the learning context.

Finally, any model of the safety learning and actionable practice must account for the different ways in which manufacturing employees learn about safety. Before examining the combined model (Figure 5.1), the original two models are considered. The transfer of learning model (Daffron & North, 2011) connects each factor to the concepts of the planning process, as well as design and delivery. This suggests that the model focuses mostly on nonformal delivery methods of intentional instruction. For example, Daffron and North (2011) said, "For learning to transfer, newly learned [knowledge, skills, and abilities] must be put into use as quickly as possible once training participants return to their work environments" (p. 102). They also often refer to strategies to enhance learning and encourage transfer which occur before, during, and

after a course or program. While they do spend several pages on various theories surrounding the learning context and even cite Daley's (2001) study regarding learning and professional practice, the majority of the book focuses on nonformal learning. In fact, the final section related to strategies which improve transfer of learning describes how "planning meaningful training courses" (Daffron & North, 2011, p. 132), "understanding training participant motivation" (p. 133), "designing and delivering the training course" (p. 134), and "involving the participant" (p. 135) are keys to enabling transfer of training. Nowhere here is the importance of informal learning discussed.

The learning in CPE model (Daley & Cervero, 2016), however, differentiates types of learning as being either constructivist or transformative in nature, but it does not highlight where learning occurs for professionals in terms of nonformal and informal learning. As found in this study, there are other ways manufacturing employees learn about safety besides nonformal, intentional instruction. This type of informal learning should be included in a comprehensive model. The purposeful inclusion of nonformal and informal learning, along with constructivist and transformative learning, in the combined model accurately depicts the different types of learning experienced by manufacturing employees.

Overall, the employees' experiences with learning about safety and how they act or do not act in a safe manner, shows that the combined model is an accurate way to represent the connections between learning, actionable knowledge, the learning context, and actionable practice. Now that it has been established that the combined model accurately depicts how manufacturing employees learn about safety and what influences whether safety learning is put into practice in the workplace, the learning portion of the model is examined in greater detail.

Learning about Safety

In the combined model, the manufacturing employees themselves are at the center of the learning portion. This was done to highlight how the learning experience is centered around them as the learners. Part of this learner-centered focus is to ensure their preferences as learners are fully understood. In addition to a discussion about these preferences, the following sections also explain how the topic of safety presents unique learning challenges.

Learning Preferences

When trying to understand manufacturing employees' experiences with learning about safety, it is not only important to understand how the employees learn, but also how they prefer to learn. This stems from the importance of a positive perception of the value of training, leading to improved application of learning (Daffron & North, 2011). If employees are able to learn about safety through their preferred methods, they are more likely to have a positive perception of the value of the training (Brinia & Efstathiou, 2012; Burke et al., 2011; Daffron & North, 2011; Wilkins, 2011). By examining the employees' feelings about the different methods of learning presented in Chapter 4, it is possible to create a picture of which types of learning they prefer. The study participants prefer learning about safety when it relates to their personal context (Zierold, 2016), when learning is hands-on (Burke et al., 2011; Namian et al., 2016; Zierold, 2016), when the learning time can be flexible, and when the person they are learning from is viewed as an expert.

The employee's preference toward learning in their own context confirms Daffron and North's (2011) and Zierold's (2016) explanation that making the learning environment match the work environment is important to the design and delivery of training. When reviewing the participants' feelings about the different learning methods, personal context was often

mentioned. The employees appreciated when learning occurred in, or related to, their specific location, materials and equipment, or job responsibilities. This was the case in both nonformal in-person learning and informal learning situations. They also mentioned disliking when their personal context was not part of the learning activity in nonformal online learning. The same holds true for hands-on learning. Just as Burke et al. (2011), Daffron and North (2011), Namian et al. (2016), and Zierold (2016) suggest the importance of in-context learning, they also highlight that learners should actively participate in the learning activity.

While preferences toward in-context and hands-on learning are well understood (Brinia & Efstathiou, 2012; Burke et al., 2011; Daffron & North, 2011; Namian et al., 2016; Wilkins, 2011; Zierold, 2016) in relation to learning, and specifically learning about safety, time flexibility and learning from experts have not been well documented as strong drivers in the actionable practice of safety information. First, the participants often mentioned how learning methods that provided them with time flexibility are preferred. As manufacturing employees who must meet production demands, learning activities that require a bounded start and stop time can be difficult. For example, nonformal online learning, which is presented as self-paced learning modules completed individually by employees, can be started and stopped at any time, and the employees are able to fit them into their schedules when it is convenient. Like nonformal online learning, informal learning can also begin and end whenever convenient for the employees, as long as the employees are not in the middle of a time-sensitive task when a coworker begins sharing safety suggestions with them. If the time is not appropriate, the suggestions may not be welcomed at that particular time. This, then, leads to the next learning preference described by employees that is not well documented in the literature. Participants described how they prefer to learn from a coworker when they view that person as an expert. In

Daffron and North's (2011) discussion about the transfer of learning model, they spend a significant amount of time describing how to plan and design learning activities which enable transfer of learning. They do not, however, discuss the credentials of the trainer or facilitator. Olson et al. (2009) found, through the investigation of social modeling, that new hires are more likely to use personal protective equipment (PPE) when they see such behavior among their coworkers. This study, however, did not specifically examine whether or not those coworkers are viewed as experts and the use of PPE is only one facet of safety. As described in Chapter 4, the time when employees enjoy learning from a coworker is when they view that person as an expert. Otherwise, that type of learning is generally not appreciated. The employees also highlighted the difference between mere experience, and being an expert. A coworker with 40 years of experience may still not be considered an expert when it comes to safety, while someone with 10 years of experience who always works in a safe manner, shows they care about safety, and is viewed as being good at what they do, might be highly respected as a safety expert.

Safety Training is Unique

Not only is it important to understand employees' learning preferences, it is also crucial to consider how learning about safety may provide unique challenges requiring special consideration. As discussed in the literature review, Krauss et al. (2014) describe three ways in which safety training is unique. First, employees are likely to have long-held beliefs about safety which could have been developed as far back as their childhood. Second, both safe and unsafe behaviors may already be engrained in workplace routines. Finally, Krauss et al. (2014) suggested safety training tends to be mandatory, which may reduce pre-training motivation and negatively impact the application of learning.

During the interviews for this study, the employees did not talk specifically about long-held safety beliefs or engrained routines in the workplace. They did, however, touch on the subject of mandatory training. When describing the nonformal online training modules, each employee mentioned that the training was mandatory, requiring annual refreshers, and it was simply part of their responsibilities. With each employee saying they would still participate in safety training even if it were not mandatory, it does not appear that the mandatory nature of safety training reduces pre-training motivation, at least at this company. This is contrary to the findings of Brinia and Efstathiou (2012) at a foundry in Greece and Wilkins (2011) at a construction company. They argue the influence of the organization's safety culture through the learning context (Freitas et al., 2018; Krauss et al., 2014) may influence the impact of the mandatory nature of safety training to the application of learning. This is illustrated in the model of safety learning and actionable practice for manufacturing employees (Figure 5.1) showing that knowledge is indeed influenced by the learning context.

In addition to the three concepts which Krauss et al. (2014) found that make learning about safety different than other topics, participants in this study talked about two additional ideas which make safety training unique. When asked about times when they apply what they learned about safety, the employees often spoke about the concept of avoidance. More specifically, they act safely to avoid getting in trouble, to avoid rework, and to avoid being injured. In other words, to effectively learn about safety, the employees must learn how to avoid safety incidents. This differs from other types of training in manufacturing, where for example, employees may learn how to use a certain piece of equipment, assemble a product, or perform a certain type of test. In those cases, the outcome of the action is to have a completed product that can be sold to customers. In the case of safety, one may learn how to safely use a ladder, but the

outcome of safely using a ladder is the avoidance of being injured. The outcome of learning where to go during a tornado is the avoidance of being struck by debris. The outcome of learning how to properly place a radiation shield is the avoidance of receiving a high dose of radiation. In this way, learning about safety is different than learning about other activities performed by manufacturing employees. While there is literature related to avoidance learning in the realm of behavioral psychology (Andreatta et al., 2017; Dymond et al., 2011), no empirical studies were located that inclusively cover avoidance learning, safety, and manufacturing.

The employees explained how they prefer to learn about safety through other people's experiences, rather than their own. This is counterintuitive when considering the various principles of adult education laid out by Merriam and Bierema (2014), where it is suggested learning should be experiential. The manufacturing employees shared stories about instructors or coworkers who were able to share their experiences or common mistakes, hoping the employees would not have to experience the same issues. For example, as described in Chapter 4, Ava had explained a time when her trainer told a story about unlabeled secondary containers, and how the chemical spill response team had to be called to dispose of the chemical. This story stood out in her mind because she was able to relate to it in her own context, but she did not need to live the experience herself in order to remember it. Isabella even said she "like[s] to learn by example and not by experience." To this point, simulations and role playing are important parts of first aid and medical response training. Employees are able to gain experience in the security of a safe learning environment where trainers are able to provide situational examples without actually having to use their first aid skills on someone who needs assistance.

While the topic of safety poses several unique challenges, learning about safety can still be represented by the learning portion of the combined model (Figure 5.1). The model also

shows how the learning context can influence knowledge and actionable practice. Several facets of the learning context are discussed next.

The Learning Context

Similar to the model of transfer of learning (Daffron & North, 2011) and the model of learning in CPE (Daley & Cervero, 2016), the learning context is also critical for the actionable practice of safety learning (Figure 5.1). When considering this portion of the model, several themes arose which both confirmed and rejected previous research. In this section, supervisor support and felt responsibility, along with choosing safety over productivity are explored.

Supervisor and Peer Support and Felt Responsibility

Daffron and North (2011) explain that supervisor and peer support is crucial for the transfer of learning. Freitas et al. (2018) agreed with this, but found that, for lower-skilled workers, supervisor sanctions or negative responses were more important to the application of learning than positive interactions. While the participants in this study explained they did not want to get into trouble for being unsafe, they also described how the positive examples regarding safety set by their managers were important to them. If the assumption is made that manufacturing employees are considered lower-skilled workers, then the participants in this study confirm Daffron and North's (2011) stance that supervisor support is more impactful to transfer of learning than supervisor sanctions, disagreeing with Freitas et al. (2018).

Regardless of the type of interaction with supervisors, Chauhan et al. (2016) found that employees' peers are more influential than their supervisors. This contradicts the manufacturing employees in this study who explained how their peers had little influence on the way they practice safety. This also opposes Daffron and North's (2011) findings that peer support is crucial for transfer of learning.

While the employees talked about how acting safely is minimally influenced by their peers, they also talked about their feelings of obligation to act in a way which keeps their coworkers safe. This is the concept of felt responsibility described by Freitas et al. (2018). Felt responsibility is the obligation employees feel toward their coworkers which motivates them to act in a safe manner and follow safety procedures they had learned. Many such examples were shared by the participants. For instance, Sophia said she is not influenced by her peers, and she “just [tries] to do it the best [she] can,” but that she feels “pretty safe working around [her] coworkers because [she knows] they’re being careful also.”

Choosing Safety Over Productivity

Due to the positive supervisor support felt by the participants of this study, they explained that safety always comes first, and they would never sacrifice safety to meet production requirements. The stop-work program, safety slogans, and examples given by employees are all evidence of this strong belief. Charlotte’s description (Appendix K – Quotes about Safety Culture and Felt Responsibility) is a perfect example of this. She said, “They could ask you if you can get certain things done in a certain time, but they will never say ignore the safety. No. Absolutely not.” This idea of always putting safety first contradicts Ripamonti and Scaratti’s (2015) study at a shipping port where workers tended to be more worried about meeting productivity requirements than following safety procedures. It is, therefore, likely that the tendency to choose either productivity over safety, or safety over productivity, is tied to the company’s safety culture, and therefore the learning context.

Summary of Key Study Contributions

The discussion in this chapter has focused on the creation of a single model to represent how manufacturing employees learn about safety, what influences the actionable practice of that

learning, and various aspects of the learning and context portions of the model. Although each of the concepts discussed sheds light on agreements and discrepancies with existing literature on the topic, three parts of the discussion stand out as key contributions this study has made to the body of literature.

First, the creation of the combined model (Figure 5.1) is a significant contribution, as it was created through the perceived experiences of manufacturing employees rather than professionals. Integrating constructivist, transformative, nonformal, and informal learning highlights the way manufacturing employees learn, and serves as a reminder to Environmental, Health, and Safety departments of all the various methods of learning that should be considered when creating effective safety training programs and cultivating informal learning opportunities. The model also highlights the importance of the learning context and its influence on both actionable knowledge and practice, in addition to the two-way interactions between each element.

The second key contribution of this study is identifying the importance of time-flexible learning where the trainer is considered to be an expert. While a strong safety culture encourages employees to choose safety over productivity, ensuring that learning can be done in a manner such that employees can choose when and how learning fits into their daily schedule enhances their perception of training and encourages actionable practice. This does not necessarily mean, however, that nonformal online learning is the answer. The lack of personal context and hands-on interaction did not make this type of learning a favorite among the study participants. On the other hand, informal learning from a coworker or manager they view as an expert, or an outside expert, was preferred. Such informal learning offers the time flexibility they desire, along with the personal context and hands-on interaction they prefer.

The final key contribution of this study is understanding the criticality of a company's safety culture and the positive influence of supervisors. While other studies suggest that supervisor sanctions (Freitas et al., 2018) and coworkers (Chauhan et al., 2016) have a greater influence than the positive examples of supervisors, the participants in this study did not feel the same way. While supervisor sanctions and coworkers may influence how manufacturing employees practice safety learning in some situations, the positive examples of proper safety behavior set by supervisors must not be dismissed. They are highly influential on how employees act when it comes to safety.

Overall, the findings of this study show both support and rejection of existing literature. The combination of Daffron and North's (2011) model of transfer of learning and Daley and Cervero's (2016) model of learning in CPE into a single model is supported by the experiences of the employees. The combined model, along with key points raised by the participants, suggest opportunities for additional research that should be explored, and provide ideas that can be put into practice to improve the chances of learning is successfully put into practice. Before describing these opportunities for future research and implications for practice, understanding the limitations of this study is important and is found in the next section.

Study Limitations

In this study, several limitations related to the participants should be noted. First, all of the participants work for the same company, with 10 of the 11 participants working in the same sector of that company. The significance of this was seen earlier where findings from this study contradict findings in other industries and companies. In addition, this study only focused on manufacturing employees and did not include managers, executives, or those who work in the offices in support functions. It is conceivable that different outcomes may have occurred

depending on the types of employees participating, as the focus of the study is limited to the experiences of those specific employees. As a result, this study is not able to provide a full picture of employee experiences about safety training at all levels of an organization.

The next limitation is the small number of participants that were interviewed for the study. Unfortunately, there was a high rate of turnover at the time of recruitment, so a number of those who were eligible to participate had left the company before the end of the recruitment cycle. Supply chain pressures due to COVID-19 were also a likely cause of people's reluctance to take time out from their day to participate, since many were already working the maximum amount of overtime. With the employee's focus on time flexibility, it is logical that the interviews were seen as an extra, optional task, and there simply was not time for them to participate. While data saturation was reached after 11 interviews, such a small number of participants prevents the conclusions from being generalized for all manufacturing employees and suggests that additional, larger studies may be needed to confirm these conclusions. In addition, comparisons between sites were difficult to make due to the low number of participants at each site.

While some employees decided they were too busy to participate, the 11 who chose to be part of the study talked about the importance of safety training in their jobs, and how they feel they could not safely perform their jobs without it. Since nearly all of the participants seemed to have a strong focus on safety, and are part of one or more safety teams at work, it seems plausible that those who chose to participate are those who view safety and safety training as an important part of their job, and desired to make a contribution to the subject. The findings of this study could, therefore, be skewed toward the experiences of those who are strong proponents of safety versus those who are not.

Finally, not all of the participants were asked about their experiences with learning informally from an expert. This was not part of the original interview questions (Appendix H – Interview Questions), but was suggested as another learning method by one of the participants. Due to the semi-structured nature of the interviews, questions related to this type of learning were added only for interviews that were conducted at a later time. In addition, another question that could have been added was whether the employees had other types of learning they could think of besides the five that had already been discussed. This could have opened the door to discovering still more methods of how manufacturing employees learn about safety.

Future Research

In the course of discussing the findings and reviewing study limitations, several areas of additional research have presented themselves. One of the study limitations discussed earlier was that almost all of the participants were part of safety teams and expressed how important safety training is. This suggests a very strong safety culture in support of the learning context, influencing both their knowledge about safety and the likelihood of applying that knowledge in the workplace. The experiences of these employees may be different than those who are less focused on safety. Understanding the differences between these types of people, and gearing a study toward those who are not on safety teams, could expand the understanding of manufacturing employees' experiences with learning about safety in the workplace. This could be achieved by expanding the study to those who are not on safety teams within the same company, and including both safety-conscious and non-safety-conscious employees from multiple companies and multiple industries. This would enhance the ability to provide insights to the broader manufacturing community.

Expanding future research to include other industries would also be important to better understand the impact of both constructivist and transformative learning. The majority of learning experiences shared by participants in this study seemed to be constructivist in nature. While Emma's story about the exploding furnace and Liam's experience with the carcinogenic nature of welding galvanized steel leaned more toward the transformative side of learning, the participants did not share any such examples that took place at the Company. Nevertheless, the transformative learning portion of the model of safety learning and actionable practice for manufacturing employee (Figure 5.1) was left in place, since other industries may have more opportunities to learn in this way. This, however, should be explored more in-depth in future research.

While most empirical studies related to safety training of manufacturing employees included significantly more men than women (Amezcuca, 2013; Barrett et al., 2012; Bosco & Wagner, 1988; Chaffin et al., 1986; Chauhan et al., 2016; Freitas et al., 2019; Ho & Dzeng, 2010; Krauss, 2005; Laberge et al., 2014; Lusk et al., 2003; Olson, et al. 2009; Wilkins, 2011; Zierold, 2016), this study was more evenly distributed, with five men and six women. In comparing the employees' preferences toward different learning methods, there appears to be some differences in how men and women prefer to learn, but these differences were not the focus of the study. Furthermore, the number of participants was insufficient to generalize the differences in learning preferences between genders. Future research with more participants and an even distribution of men and women, could help expand the understanding of all employee's experiences and highlight any gender differences.

Similarly, asking participants about their level of educational attainment in a larger study could also help to better understand how this learner demographic may impact experiences with

safety training and actionable practice. It would also help address the impact of the learning context on lower-skilled workers (Freitas et al., 2018), since it is possible the level of educational attainment of the employee is more influential than the skill level of the job responsibilities. In addition, expanding the study to include more people with English as a second language could shed light on the learning and knowledge portion of the model of safety learning and actionable practice for manufacturing employees (Figure 5.1). In this study, two employees spoke in heavy accents that would make one believe that English is not their first language. Amezcua (2013) completed a comprehensive quantitative study which explored the relationship between language and safety training for construction workers in New Mexico and found the majority of participants in his study did not believe that language affected the quality of the safety training. Building on Amezcua's (2013) study by focusing on this key learner characteristic to identify certain learning methods which should be available to those who are not native English-speakers, would provide additional contributions to the existing literature.

Finally, several participants had mentioned they had learned certain safety procedures, but they had not yet had a chance to use them. This is especially true with regard to emergency preparedness training such as chemical spill response, fire response, and medical response. Considering this type of learning and practice circumstances, do immediate and as-needed practice need to be differentiated in some way? Future research in this area could be especially important for emergency responders in manufacturing, who are usually first on the scene before professional first responders arrive.

Implications for Practice

Although there continue to be areas where future research will strengthen this area of inquiry, this study does provide several ideas that can be put into practice for Environmental,

Health, and Safety departments in manufacturing organizations. This section covers these implications for practice.

First, designers of safety training should seriously consider tapping into employee's preferences for learning informally from those who they consider to be experts. Daffron and North's (2011) discussion about the planning process, as well as design and delivery, lead one to believe that methods which enhance actionable practice must be planned for, specifically designed, and delivered in a structured manner. Nevertheless, the time flexibility and in-context learning that informal ways of learning provide can be tapped into and utilized. Companies could choose respected, experienced employees to act as informal safety trainers. These people would be responsible for providing informal safety training to their coworkers as they see fit. Maintaining the time-flexible, in-context, and informal nature of the training would be critical to the success of the program. This is similar to a program at Ava's site where employees are chosen to be safety observers; but in the suggested scenario, there would be more focus on training than simply on observation.

Next, designers should be certain to focus on the learning context and not just the content of nonformal learning. One of the leading complaints the employees had about nonformal online learning modules is they lacked a connection with the learning context. One example of putting into practice a better focus on the learning context would be development of a mobile safety application (app). Instead of employees being tied to a stationary computer for the completion of the nonformal online modules, they could tap into the app where a host of safety-related activities could be programmed. For example, the app could require learners to physically go to their tornado shelter, emergency exit, or nearest fire extinguisher. GPS tracking would confirm the employee was in the correct place, give feedback if needed, and give credit to the employee

for finding the correct location. When learning about chemical labeling, the app could tell them to go to the location where the chemicals are used and identify the different labels they see. Each topic would have a short activity that required the learner to complete an activity in their site, their area, or their immediate location. In this manner, they would gain the benefit of in-context learning while maintaining the time flexibility they desire. The result would be akin to having the experience of informal learning from an expert coworker, but in a nonformal mobile application.

Another idea Environmental, Health, and Safety departments should consider exploring is what makes safety training different than other types of training in manufacturing. More specifically, departments need to remember that the purpose of learning about safety is to learn ways to avoid injury. This suggests that using simulations, role playing, and hearing stories from others in similar contexts are important methods which should be employed. In some of the online modules, stories of fatalities from different industries and companies are included to highlight the importance of a certain safety topic. If, however, the story is difficult to relate to because the context is not close enough to the employee's learning context, the story may not have the strong impact the designers intended. If similar stories can be found to which employees can relate more closely, this would be ideal when trying to influence knowledge about safety and the actionable practice of that learning.

Finally, as suggested by Burke et al. (2008) and Freitas et al. (2018), the safety climate has a significant impact on the safety performance of an organization. In this study, the same outcome was achieved when strong supervisor support, a sense of felt responsibility (Freitas et al., 2018), and good safety programs are present. With this in mind, even before looking at improving training programs or informal learning opportunities, manufacturing organizations need to first examine their own safety culture. Are employees choosing productivity over safety

(Ripamonti & Scaratti, 2015)? Are employees more worried about supervisor sanctions than positive examples set by the supervisors (Freitas et al., 2018)? Do employees tune out when they know they have to attend mandatory safety training (Krauss et al., 2014)? If organizations answer yes to any of these questions, then improvements to safety culture may be the first step to creating a safer workplace for their employees.

Conclusions

The results of this study present insights I wish I had known 15 years ago when I first became a manufacturing engineer and manufacturing quality manager. I saw employees struggle with safety training, and at the time, did not fully understand how I could help them. After completing this study, I feel I am in a much better position to make a difference in how they learn about safety. I also intend to share the results with the company whose employees participated in the study.

Although I am no longer working in a manufacturing role, nor specifically with manufacturing employees, I am now responsible for creating learning content for the non-manufacturing portion of a large organization. From this study, I now recognize that the learning context is often a forgotten piece of the design, the use of experts to drive informal learning can be extremely effective, and may actually be preferred by learners. Providing more time-flexible learning options may also be an important way to help the learners. Perhaps I will use the basis of this study to survey my learning community to better understand how they prefer to learn and what their experiences have been in learning about topics critical to their job responsibilities.

The purpose of this study was to understand how manufacturing employees learn about safety and to contribute the employees' perspectives to the extensive body of existing literature. This goal was achieved through enlightening interviews with 11 manufacturing employees. The

stories they told about learning helped to shed light on how learning about safety can be continually improved so fewer employees will be injured on the job.

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APPENDICES

Appendix A – Letter to the Safety Council and Union Leadership

Dear Safety Council Member and Union Leadership,

My name is Melissa Meier and I am currently an employee at [company name] as the Integrated Business Planning Project and Learning Leader. While I am part of the Integrated Supply Chain function, I do not have any direct association with any of our manufacturing sites.

For the last six years, I have been working toward a Ph.D. in Urban Education with a focus on Adult, Continuing, and Higher Education Leadership at the University of Wisconsin – Milwaukee. Since I began my program, I have been interested in studying the experiences of manufacturing employees with regards to safety training. The purpose of my study is to better understand these experiences, which may lead us to help create better and more effective safety training programs.

With your permission, I will be reaching out to manufacturing employees at the three local sites and asking for voluntary participants for one-on-one (via video/audio conference if needed), confidential interviews which will be conducted during regular business hours. Overtime may also be used at your discretion.

While the results of the study may benefit the employees through the creation of improved training programs, all identifying information will be removed from the analysis and results and the interview transcripts will be kept strictly confidential. The University of Wisconsin – Milwaukee Internal Review Board has approved this research and the approval documentation is attached.

Please let me know if you would like to discuss this further and I will schedule a time to meet with you.

Thank you,
Melissa I. Bloch-Meier
Doctoral Candidate
Department of Administrative Leadership
University of Wisconsin-Milwaukee School of Education
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Under the supervision of Dr. Simone C. O. Conceição, Ph.D
Professor & Administrative Leadership Department Chair
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IRB#: 20.328

Appendix B – Recruitment E-mail

Dear Manufacturing Employee,

As you know, safety at [Company Name] is the number one priority. As a manufacturing employee, you have the opportunity to participate in a confidential research study about safety training. Those employees who are randomly selected to participate will be asked to talk with me about their safety learning experiences in a one-on-one interview (via video/audio conference if needed). The interviews will be conducted during business hours and participants will be paid their normal hourly wage during this time.

If you are interested in participating, please complete and submit the eligibility survey found at the link below by MM/DD/YYYY.

www.xxxxxxxx.xxxxxxxx.edu/

I will contact those who are randomly chosen to participate in order to arrange a meeting time and place.

Thank you,
Melissa I. Bloch-Meier
Doctoral Candidate
Department of Administrative Leadership
University of Wisconsin-Milwaukee School of Education
Tel.: XXX-XXX-XXXX
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Professor & Administrative Leadership Department Chair
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Tel.: XXX-XXX-XXXX
simonec@uwm.edu

IRB#: 20.328

Appendix C – Eligibility Survey

Please complete the following questions:

1. What is your current position? (ASSEMBLY/CONFIGURATION/PRODUCT TESTING/QUALITY CONTROL/MATERIAL HANDLER/SHIPPING/OTHER – OFFICE SUPPORT/OTHER – NON-OFFICE SUPPORT)
2. Have you completed general EHS training within the last 6 months? (YES/NO)
3. Have you completed general EHS training online within the last 6 months? (YES/NO)

(If #1 does not equal OTHER – OFFICE SUPPORT, #2 equals YES, and #3 equals YES then),

4. Would you be interested in participating in a confidential interview regarding your experiences with learning about safety? (YES/NO)

(If #4 equals YES then)

5. Please provide your e-mail address so the researcher can contact you to schedule an interview. Please note: your e-mail address and interest in participating will be kept confidential. You will also receive an informed consent form to review and sign when the interview is scheduled.

Appendix D – Recruitment E-mail Reminder

Dear Manufacturing Employee,

Last week, you received an e-mail from me regarding your possible participation in a confidential, one-on-one interview for a research study about safety training. If you are interested in participating, please be sure to complete and submit the eligibility survey found at the link below by MM/DD/YYYY.

www.xxxxxxxx.xxxxxxxx.edu/

I will contact those who are randomly chosen to participate in order to arrange a meeting time and place.

Thank you,
Melissa I. Bloch-Meier
Doctoral Candidate
Department of Administrative Leadership
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Appendix E – Interview Meeting Notice

Dear [Manufacturing Employee],

Thank you for agreeing to participate in my study about safety training. I'm looking forward to talking with you about your experiences. We will meet in [location] at [time] on [date]. You can expect the interview to last 45 to 90 minutes.

Attached is a copy of the research participation consent form. Please review it before the meeting.

While I have copied your supervisor on this meeting notice, it is only for scheduling purposes to ensure your responsibilities are being covered while you are away from your duties. Your supervisor will not participate in the interview in any way and all of our discussions will be kept strictly confidential.

Thank you and see you soon.

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Appendix F – Interview Reminder

Dear [Manufacturing Employee],

I just wanted to send you a quick reminder of our meeting tomorrow in [location] at [time]. If you have a conflict or are no longer interested in participating, please let me know so I can reschedule or cancel our meeting.

I have copied [Supervisor] on this reminder for scheduling purposes only and to help ensure you are available during our scheduled time.

Please let me know if you have any questions or concerns.

Thank you and see you soon.

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IRB#: 20.328

Appendix G – Informed Consent Form



Informed Consent for Research Participation

IRB #: 20.328

IRB Approval Date: 18-Jun-2020

Study title	Understanding how Manufacturing Employees Learn about Safety
Researcher	Melissa I. Bloch-Meier, Doctoral Candidate, Department of Administrative Leadership Under the supervision of Dr. Simone C. O. Conceição, Ph.D., Professor & Administrative Leadership Department Chair

I'm inviting you to participate in a research study. Participation is completely voluntary. If you agree to participate now, you can always change your mind later. There are no negative consequences, whatever you decide. Your choice to participate or not will have no impact on your employment and your relationship to GE Healthcare.

What is the purpose of this study?

The purpose of this research study is to examine the experiences of manufacturing employees related to learning about safety.

What will you do?

Fifteen to twenty-five workers will participate in this study. If you agree to participate, you will be asked to participate in a one-on-one interview that will take approximately 45 to 90 minutes of your time. This interview may take place in person or via video conference, such as Skype or Zoom. You will be asked questions related to your experiences with how you learn about safety, how you apply what you've learned to your job, and how learning impacts your job.

Risks

Possible risks	How we're minimizing these risks
Breach of confidentiality (your data being seen by someone who shouldn't have access to it)	<ul style="list-style-type: none">• I'll remove all identifying information and replace it with a pseudonym (a fake name).• I'll remove all identifiers after transcription of the interviews is completed and I will report all study results without identifying information.• I'll store all electronic data on a password-protected, non-networked, non-company computer.• I'll store all paper data in a locked filing cabinet in a locked, non-company office.• I'll keep all identifying information separate from your research data, but will be able to link it to you by the given pseudonym. I'll destroy this link after data is collected and analyzed.

There may be risks I don't know about yet. Throughout the study, I'll tell you if I learn anything that might affect your decision to participate.

Other Study Information

Possible benefits	You'll have an opportunity to share your experiences about learning about safety and to help expand research in this area.
Estimated number of participants	15 to 25 employees will be randomly selected to participate out of those who meet the criteria (see "Removal from the study" for list of criteria).
How long will it take?	The interview will last approximately 45 to 90 minutes. An additional, follow-up interview may be scheduled if insufficient information was gathered at the initial interview.
Costs	None
Compensation	The interview will take place during normal business hours and you will be paid your normal wage during this time.
Future research	Your information won't be used or shared for any future research studies.
Recordings	I'll make an audio recording of the interview, which will be transcribed into a written record of the interview. If interviews are conducted virtually via video conference, the video conference software will be used to record the interview.
Removal from the study	You will be removed from the study if you are not a manufacturing employee who has received safety training in the last 6 months, with at least some of that training occurring online.

Confidentiality and Data Security

I'll collect the following identifying information for the research: your name, job title, and e-mail address. This information is necessary to contact you to setup the interview and ensure you meet the criteria of being a manufacturing employee.

Where will data be stored?	<ul style="list-style-type: none"> I'll store all electronic data on a password-protected, non-networked, non-company computer. I'll store all paper data in a locked filing cabinet in a locked, non-company office.
How long will it be kept?	All data will be kept for 2 years after the study is completed.

Who can see my data?	Why?	Type of data
The researcher	To conduct the study and analyze the data	<ul style="list-style-type: none"> Identifiable (with your name, job title, and e-mail address included)

		<ul style="list-style-type: none"> • Coded (names removed and labeled with a pseudonym)
The IRB (Institutional Review Board) at UWM The Office for Human Research Protections (OHRP) or other federal agencies	To ensure we're following laws and ethical guidelines	<ul style="list-style-type: none"> • Identifiable (with your name, job title, and e-mail address included) • Coded (names removed and labeled with a pseudonym)
Anyone (public)	If I share my findings in publications or presentations	<ul style="list-style-type: none"> • Aggregate (grouped) data • De-identified (no names, birthdate, address, etc.) • If I quote you, I'll use a pseudonym

Contact information:

For questions about the research	Melissa I. Bloch-Meier Dr. Simone C. O. Conceição, Ph.D.	XXX-XXX-XXXX / mib@uwm.edu XXX-XXX-XXXX / simonec@uwm.edu
For questions about your rights as a research participant	IRB (Institutional Review Board; provides ethics oversight)	XXX-XXX-XXXX / irbinfo@uwm.edu
For complaints or problems	Melissa I. Bloch-Meier	XXX-XXX-XXXX / mib@uwm.edu
	Dr. Simone C. O. Conceição, Ph.D.	XXX-XXX-XXXX / simonec@uwm.edu
	IRB	XXX-XXX-XXXX / irbinfo@uwm.edu

Signatures

If you have had all your questions answered and would like to participate in this study, sign on the lines below. Remember, your participation is completely voluntary, and you're free to withdraw from the study at any time.

Name of Participant (print)

Signature of Participant
Date

Name of Researcher obtaining consent (print)

Signature of Researcher obtaining consent
Date

Appendix H – Interview Questions

Participant Pseudonym:

Date:

Time:

Interview Location:

INTERVIEW QUESTIONS

Demographics:

#	Lead-Off Question	Probing Questions
1	What is your job here at [Company Name]?	
2	How long have you been in this role?	
3	How old are you?	

Learning about Safety:

#	Lead-Off Question	Probing Questions
4	Tell me about the last time you learned about safety using the online learning system. [learner characteristics & motivation, design & delivery, learning context]	<ul style="list-style-type: none"> Is that story representative of what typically happens or was it unique? (Why was it unique?) What did you like about learning that way? What didn't you like about learning that way? How do you feel after the training is done?
5	Tell me about the last time you learned about safety in an in-person safety class or meeting. [learner characteristics & motivation, design & delivery, learning context]	<ul style="list-style-type: none"> Is that story representative of what typically happens or was it unique? (Why was it unique?) What did you like about learning that way? What didn't you like about learning that way? How do you feel after the training is done?
6	Before you start any kind of formal safety training, what kinds of pre-conceived notions do you have about how the training will go? [learner characteristics & motivation]	<ul style="list-style-type: none"> Why do you feel that way?
7	Tell me about a recent time when you learned about safety from a coworker. [learning context]	<ul style="list-style-type: none"> Is that story representative of what typically happens or was it unique? (Why was it unique?) What did you like about learning that way?

#	Lead-Off Question	Probing Questions
		<ul style="list-style-type: none"> What didn't you like about learning that way? How do you feel after learning that way?
8	<p>Tell me about a recent time when you learned about safety by yourself.</p> <p>[learning context]</p>	<ul style="list-style-type: none"> Is that story representative of what typically happens or was it unique? (Why was it unique?) What did you like about learning that way? What didn't you like about learning that way? How do you feel after learning that way?
9	<p>Of all of these types of training we've talked about, is there one that you prefer more than the others?</p> <p>[design and delivery]</p>	<ul style="list-style-type: none"> Why?
10	<p>Let's say you no longer had to complete annual refresher training in the way you do today, but you at least have to learn about the same topics in some way. Tell me about how you would like to learn about safety in the workplace?</p> <p>[design and delivery]</p>	<ul style="list-style-type: none"> Would you learn by yourself or with others? What types of activities would you do? Where would you do the training?

Applying Safety Learning:

#	Lead-Off Question	Probing Questions
11	<p>Tell me about a time when you were able to apply something to your job that you learned in safety training?</p> <p>[professional practice]</p>	<ul style="list-style-type: none"> How did the training change what you did in your job?
12	<p>Tell me about a time when you didn't apply something you learned in training to your job?</p> <p>[professional practice]</p>	<ul style="list-style-type: none"> Why didn't you use what you learned? (If needed, provide examples like good lifting techniques, PPE, or ergonomics)
13	<p>Tell me about a time when you saw, heard about, or were involved in a safety incident that made you act differently when it comes to safety.</p>	

#	Lead-Off Question	Probing Questions
	[constructivist or transformative learning]	
14	What are some examples of how your manager impacts how you apply what you've learned about safety to your job? [workplace environment]	
15	What are some examples of how your peers impact how you apply what you've learned about safety to your job? [workplace environment]	
16	What are some examples of how your union representatives impact how you apply what you've learned about safety to your job? [workplace environment]	

Job Impact:

#	Lead-Off Question	Probing Questions
17	How does safety training impact your job? [professional practice]	
18	What are some examples of how your peers influence the way you work when it comes to safety? [workplace environment]	Can you share any examples with me?
19	If safety training weren't mandatory, would you do it? Why or why not? [professional practice]	

Demographics:

#	Lead-Off Question	Probing Questions
20	When referring to you under your fake name, what gender pronoun do you prefer that I use?	

Appendix I – Pseudonyms

Interview #	Male Names	Female Names
1	Liam	Emma
2	Noah	Olivia
3	William	Ava
4	James	Isabella
5	Oliver	Sophia
6	Benjamin	Charlotte
7	Elijah	Mia
8	Lucas	Amelia
9	Mason	Harper
10	Logan	Evelyn
11	Alexander	Abigail
12	Ethan	Emily
13	Jacob	Elizabeth
14	Michael	Mila
15	Daniel	Ella
16	Henry	Avery
17	Jackson	Camila
18	Sebastian	Aria
19	Aiden	Scarlett
20	Matthew	Victoria
21	Samuel	Madison
22	David	Luna
23	Joseph	Grace
24	Carter	Chloe
25	Owen	Penelope
26	Wyatt	Layla
27	John	Riley
28	Jack	Zoey
29	Luke	Nora
30	Jayden	Lily

Appendix J – Feelings about Learning Methods

Feeling about the Nonformal Online Learning	Likes (# of Employees)	Dislikes (# of Employees)
Reading	3	4
Repetition year after year	3	3
Learning aids are/aren't available	3	2
Self-Paced/Time Flexible	7	
Feel more knowledgeable after completion	3	
Feel more experienced after completion	2	
Can ask manager for help outside of tool	1	
Can remember what is read	1	
Can use right away	1	
Efficient way to learn	1	
Feel accomplished/checked of to-do list after completion	1	
Interactive slides	1	
Learning is centrally located	1	
Multiple chances to retake	1	
Slides	1	
No personal context or interaction		6
Difficult to remember what's not applicable		4
Too long		4
Difficult to remember		3
It's boring		3
Tim is not flexible enough		3
Feel relieved when it's done		2
Has static pictures / not enough photos		2
"A little bit of time I cannot get back"		1
Incorrect / old information		1
Is dependent on the computer (technical difficulties)		1
Not hands-on		1
One chance only		1
Online learning is a "method for kids"		1

Table J.1: Feelings about Nonformal Online Learning

Feeling about the Nonformal In-Person Learning	Likes (# of Employees)	Dislikes (# of Employees)
Diverse ideas from multiple learners	5	
Creates sense of team / social interaction	4	
Personalized interaction	4	
Chance to ask questions	3	
Fun	3	
Hands-on	3	
Can remember demonstrations	2	
Can remember examples of when other people didn't follow rules	2	
Feel a sense of accomplishment when it's completed	2	
Immediate feedback	2	
Seeing/hearing instructor improves understanding and retention	2	
Allows space for suggestions	1	
It's engaging	1	
Materials are easily referenced	1	
Is dependent on instructor	4	
Have to wait for others to learn		3
Sometimes instructors read from slides		3
Time is not flexible / bound by class start and end time / not convenient for off-shifts		3
Only learn one way of doing things		2
Being in front of a group		1
Dependent on AV Equipment (technical difficulties)		1
Fell exhausted upon completion		1
May not be given credit		1
May not have time for questions		1

Table J.2: Feelings about Nonformal In-Person Learning

Feeling about the Informal Learning from a coworker	Likes (# of Employees)	Dislikes (# of Employees)
Dependent on the coworker: If they're a good teacher	3	
Focused on What's Applicable	3	
Good when the coworker is seasoned or an expert	3	
Better from a coworker than a manager	1	
Easy to follow-up if there are additional questions	1	
Not always welcomed		5
Does not always include complete information		2
Can be Intimidating		1

Table J.3: Feelings about Informal Learning from a coworker

Feeling about the Informal Learning as an Individual	Likes (# of Employees)	Dislikes (# of Employees)
Feel successful when they figure something out	4	
Self-paced	4	
Can share findings with coworkers	2	
Makes their job easier	2	
Private	2	
Helps to really understand the situation	1	
Means they got hurt		3
Feel disappointed if they've hurt themselves		2
Higher likelihood of mistakes		2
Miss getting other's perspectives		2
Boring		1
Hard to focus		1

Table J.4: Feelings about Informal Learning as an Individual

Feeling about the Informal Learning from an expert	Likes (# of Employees)	Dislikes (# of Employees)
Informative	3	
Can be warned about common mistakes	2	
Has practical application	2	
Feel confident after completion	1	
Feel enthused after completion	1	
Hands-on	1	
Is detailed	1	
May talk over their head		1

Table J.5: Feelings about Informal Learning from an expert

Appendix K – Quotes about Safety Culture and Felt Responsibility

Who	Quotes about Safety Culture
Emma	"[My manager] confirms that he wants everything to be done safely."
Olivia	"If a safety thing comes up, you gotta remember you got work-stop where you can stop the work and go get your resources, your EHS technicians, to help you with a scenario."
Liam	"As a result of that, they changed some of the protocols and now you have to wear waterproof goggles which will actually strap to your face and completely cover that. That way, that doesn't happen again."
Noah	"If you want something at your desk that's more ergonomic, they'll do their best to get it for you."
Noah	"He went out of his way to build a lift for it and got me some pads in the meantime so that I'm not on the cement floor."
Noah	"We have a stop-work policy"
Noah	"I think everyone is pretty good here. We have a pretty good culture on the whole not getting ourselves killed thing."
William	"Anytime I've had a problem, I've told my boss right after it happened. I'll send pictures and all they want to do is get to the bottom of how it happened. How can we prevent it from happening in the future? Make sure no one's hurt."
William	"This is the highest standards I've ever experienced in the workplace"
James	"I stopped the work and raise it to my supervisor and I said something goes wrong there and I turn off power. And if somebody can go and check, and the next day they fix it and everything was fine."
Charlotte	"We're trying to get to the bottom of it to make sure what cause him to get this injury and we're working on changing the process to make sure that doesn't happen again."
Charlotte	"Every time we talk, they always say the same thing. Safety First."
Charlotte	"They could ask you if you can get certain things done in a certain time, but they will never say ignore the safety. No. Absolutely not."
Sophia	"[My manager] tends to be really safe too, so it's a matter of following his example."
Isabella	"Even when someone burns themselves, the Environmental Specialist, he'll come around and we'll have a discussion about the situation, about what was done wrong and how we could, in the future, alleviate the problem."
Isabella	"Usually when something happens, they're more concerned, are you okay, and they don't want it to happen to anyone else. So, it's comforting to know they're actually caring about you and your well being."
Isabella	"Sometimes, you may have forgotten [your safety glasses] in the car or just don't have them that day. And then, that's [your manager's] first priority. They give you another pair of safety glasses so you can go ahead into the area and get started working. I think they have a great [bearing] on our safety measures at work."

Who	Quotes about Safety Culture
Oliver	"You feel like everyone is encouraging people to be aware of the safety issues. I feel like our manager emphasizes being aware of preventing things is always a lot easier than trying to fix them later. So, you definitely feel like your manager is on board with everything we learned about safety and encourages us to be safe."
Ava	"Even while we're out there, the leaders will actually look at you . . . Reminding us to have our PPE, your steel toed shoes before you actually go to work and just to think about taking an assessment, before you start, around your work area. Before you actually start to work, take two for safety."

Table K.1: Quotes about Safety Culture

Who	Quotes about Felt Responsibility
Emma	"As a group, we look out for each other"
Liam	"I've walked past people and I'm like, you probably shouldn't hold that like that."
Noah	"I think most people I work with here, we're all pretty good at making sure we're not putting each other in harm's way."
William	"The last thing I want to do is get hit [by a forklift] and I don't want to see anyone else get hit."
William	"Everyone around here is pretty, pretty solid with each other and everyone's really just looking out for each other"
James	"I'm trying to be safe and I'm trying to share this with others if I see something not going right."
James	"I don't want to be in trouble and I don't want other people to be hurt"
James	"It's not because they're mean or something. Just because if somebody sees something going wrong, we're on the team. We should help each other."
Sophia	"I feel pretty safe working around my coworkers because I know they're being careful also."
Oliver	"From what I see, people do follow the rules, so then it just helps reinforce me feeling comfortable being careful about thing."
Ava	"I always see whatever I'm doing, whether it's inside or outside, we're all in it together. It's not just me. We're all just one big team."

Table K.2: Quotes about Felt Responsibility

CURRICULUM VITAE

Melissa I. Bloch-Meier

Place of birth: Milwaukee, WI

Education

B.S., Miami University (OH), May 1998

Major: Engineering Physics, Minor: Mechanical Engineering

M.S., University of Illinois at Urbana-Champaign, May 2000

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Dissertation Title: Understanding how Manufacturing Employees Learn about Safety