Supporting Workplace Learning: Supervisory and Peer Support Effect on Novice Firefighter Informal Learning Engagement

DISSERTATION

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Abstract

Workplace learning outcomes are linked to reducing workplace injuries and fatalities. Employees acquire the majority of their workplace knowledge from engaging informal workplace learning processes and activities. Workplace learning scholars are interested in promoting this mode of learning by inciting engagement. Socio-cultural factors that influence the frequency that workers engage informal learning have been identified, however, previous research findings lack generalizability. Understanding the degree to which selected variables correlate to the frequency of informal learning engagement by high-risk workers is the focus of this study. This study explored the informal learning engagement practices of 54 novice career metropolitan firefighters.

A survey was conducted to determine the extent that variability in the frequency of informal workplace learning engagement is explained by a support climate comprised of supervisory support, psychological safety, knowledge sharing and relationship building. The key findings of this study indicate that supervisory support, knowledge-sharing and relationship-building are positively correlated with the frequency that novice career firefighters engaged informal learning. Results showed that relationship building and knowledge sharing were less important than supervisory support in the final model. Participating in structural firefighting, representing core work tasks, did not mediate the relationship between support climate and engagement. Implications of these findings extend our current understanding of informal workplace learning engagement.
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Chapter 1: Introduction

In the United States (U.S.), property and citizens are protected from the destructive forces of uncontrolled fire by approximately 1.1 million career and volunteer firefighters (United States Fire Administration (USFA), 2013). Firefighting is a hazardous, dynamic, and unpredictable occupation that claims the lives of an average of 100 firefighters each year and injures another 70,000 (Karter & Molis, 2013; Tabor, Plumb & Jolemore, 2014; USFA, 2014). According to the U.S. Department of Labor, career firefighters experience a 26% higher chance of being killed on the job and two and a half times greater chance of being injured while working than the average U.S. worker (United States Department of Labor - Bureau of Statistics (USDOL), 2012). Firefighter casualties occur in a broad range of situations; however, nearly half of firefighter injuries and one-third of fatalities occur on the emergency scene during firefighting operations (USFA, 2013).

In a recent study of metropolitan U.S. fire departments, novice career firefighters who have six or fewer years of experience account for 31% of those injured (Moore-Merrell, Zhou, McDonald-Valentine, Goldstein & Slocum, 2008). Firefighters working in teams perform a multitude of highly complex firefighting tasks in high-risk and time-constrained work environments (Taber, Plumb, & Jolemore, 2008). Learning to operate in these dynamic and dangerous conditions is essential if firefighters are to avoid injury and death (Kunadharaju, Smith & DeJoy, 2011). The focus of this study was to
investigate the informal learning strategies used by novice career metropolitan firefighters to advance their personal firefighting competence.

Firefighters in Canada and Norway learn how to put out fires predominantly by interacting with more experienced firefighters, while preparing for firefighting duties in the fire station, while participating in structural firefighting, and by sharing and reinforcing experiences following firefighting activities (Kunadharaju, Smith & DeJoy, 2010; Sommor & Njå, 2011; Taber, Plumb, & Jolemore, 2008;). Canadian and Norwegian firefighters participate in an abundance of formal developmental activities, however, were found to learn predominantly through personal experience and practice. These firefighters learned by observing and collaborating with other firefighters outside of planned training routines (Sommor & Njå, 2011; Tabor, et al., 2008).

Studies examining teachers, nurses, and flight instructors found that workers learned using both approaches; by interacting with others informally and while also situated in their work (Eraut, 2005; Lohman, 2005). Informal learning results from unstructured and unplanned learning processes and activities when the learner has domain over the time, place and method for learning (Eraut, 2004; Lohman, 2005). Individual agency, referring to the psychological sense of personal power to control one’s thoughts, decisions, and actions, is key to activating informal learning (Eraut, 2004; Schuck, 2011). Additionally, as much as 70% of all workplace knowledge is acquired informally; outside of organizationally-sponsored training and development programs (Ellinger, 2005; Livingstone, 2001; USDOL, 1996).

One way to approach and examine informal workplace learning is through the lens of Marsick and Watkins’ (1990; 1992) informal workplace learning model. This
process-based model orients workplace learning in a continuous cycle of reflection and action (Cseh, Watkins, & Marsick, 1999). The model proposes that informal learning is activated when an individual’s personal repository of knowledge or skills fail to meet a given situation – requiring the need to acquire new knowledge or skills and to seek a revised understanding. Unlike organizationally sponsored and directed training, the learner is responsible for recognizing a learning need and activating their learning processes (Marsick, 2009). Marsick (2009) goes on to explain that the learner will select a learning activity of their choice to resolve the knowledge gap.

The informal learning process ideally concludes with an altered understanding, new knowledge or skill, and a reframing of beliefs which workers then apply to immediate or future work situations (Wofford, et al., 2013). The premise of informal learning theory suggests that the individual worker, a novice firefighter in this context, initiates and engages informal learning processes and practices on their terms and in a manner, they prescribe (Marsick & Watkins, 1999). Empirical research on informal learning processes and activities, including antecedents, is limited and much of what is available remains descriptive and unavailable for broad application (Noe, Tews, & Marand, 2013). This study is in response to a call for more empirical research on organizational factors that influence the informal learning processes and activities of adult workers.

Informal workplace learning engagement is broadly described by the behaviors of the individual learner who activate and engage context-specific informal learning processes and activities (Lohman, 2005). Three categories of informal learning activities include learning on one’s own and independently from others, learning from or with
others, and learning that is not relational or socially dependent (Noe, Tews, & Marand, 2013). Reflection following one’s actions, or the actions of others, and personal experimentation, are examples of learning on one’s own (Jeon & Kim, 2011; Lohman, 2005). Learning from others includes soliciting feedback, sharing personal experiences, stories and lessons learned, and through peripheral participation that results from working alongside more experienced co-workers (Bjork, Toeien, & Sorensen, 2013). Searching for information in trade journals and online sources are examples of activities that are non-relational (Lohman, 2009).

Workplace contextual factors can inhibit or incite individual learners to activate informal learning processes thus influencing the frequency an individual engages informal learning activities (Doornbos, Simons, & Denessen, 2008; Kyndt, Dochy, & Nijs, 2009; Noe et al., 2013). Contextual factors are categorized by Marsick and Watkins (1999) as social-relational, structural-hierarchical, and work conditions. Social-relational factors describe the ways in which relationships are formed and maintained among employees and employee groups (Korte, 2009; Van der Rijt, Van de Wiel, Van den Bossche, Segers, & Gijselaers, 2012). Examples include building trusted relationships, informal feedback, and knowledge sharing among others (Connelly, Zweig, Webster, & Trougakos, 2012; Wang & Noe, 2010). Structural hierarchical factors include how the organization arranges its employees and managers to accomplish work (Bjork et al., 2013). Examples include functional and physical job assignments and reporting structures, distribution of authority and roles, and access to information and technology. Work conditions include discreet aspects of the work being performed, for instance, how frequently a given work task might be required or performed, the relative risk of
performing specific duties or tasks, and the types of equipment or tools required to perform work (Marsick & Watkins, 1999). This study will combine and examine selected socio-cultural factors that are implicated by previous qualitative research findings to influence informal learning engagement.

Previous studies have examined the influence of informal learning support on the informal learning engagement of information technology professionals and teachers (Lohman, 2005), human resource development professionals (Lohman, 2009), police officers (Doornbos, Simons & Denessen, 2008) flight instructors (Wolford, Ellinger & Watkins, 2012), public sector managers and supervisors (Cunningham & Hillier, 2012), and nurses (Bjork, Toin & Sorenson, 2013). These studies generally found that social-relational and structural hierarchical factors promoted or inhibited the activation and frequency of informal workplace learning engagement. Building workplace cultures that support and facilitate informal workplace learning is an important line of inquiry (Bjork, et al., 2013). A recurrent combination of informal learning support factors were identified following a review of the adult learning literature. The recurring themes stressed an organizational culture in which workers can create and maintain interpersonal relationships that are built on mutual trust and respect, are open to knowledge-sharing and are managed in a way that values learning and feedback (Kyndt et al., 2009; Lohman, 2005; Van der Rijt, et al., 2012).

Scholars have called for more research to understand how informal workplace learning support may facilitate informal learning engagement (Noe, et al., 2013). Understanding how supervisory support, psychological safety, knowledge sharing and
relationship building influence the frequency that novice firefighters activate and engage informal workplace learning was the basis of this study.

Background of the Problem

Multiple studies have examined ways in which self-regulated informal learning processes may be encouraged or inhibited by organizational, socio-relational and personal factors (Cho & Jacobs, 2011; Cunningham & Hillier, 2012; Froehlich, Segers, & Van den Bossche, 2014). The present study focused on socio-relational and structural hierarchical factors and excluded personal and work factors. Personal characteristics including demographics such as age and gender, as well as personal learning characteristics such as motivation to learn, were excluded. The primary reason was to focus on a single discreet set of variables. Additionally, the population offers little variation among gender and age, and a panel of experts suggested that attempting to capture this data might influence participation. Four factors have been predicted in previous descriptive studies to interact with informal learning engagement. Those four independent variables comprise the construct informal workplace learning support in this study of novice firefighters; (a) supervisory support (Doornbos, Simons & Denessen, 2008), (b) psychological safety (Edmondson, 1999), (c) knowledge-sharing (Connelly & Kelloway, 2003), and (d) relationship-building (Doornbos, Simons & Denessen, 2008). Organizational informal learning support in this study was operationally defined as the extent to which these four independent variables are present.

The scholarly research on fire service injury and fatality prevention is limited to engineering studies designed to advance firefighting protective gear and safety equipment
(Deuser, Barker, Deaton & Shepherd, 2012; Mensch, Braga, & Bryner, 2011), fitness and wellness (Brown & Stickford, 2009), and staffing levels (Bauman, et al., 2010). Fire and smoke behavior research have generated workplace safety interventions targeting safety policies, operational practices, and safety culture among firefighters (Kerber, 2013; Kunadharaju, et al., 2011). Additionally, a new federal database has been developed to collect and analyze injury and fatality data (Karter & Molis, 2013). Unfortunately, the current body of literature does not specifically examine or address how U.S. firefighters learn their practices - including how they learn and apply the results of previous research aimed at reducing the frequency and severity of firefighter casualties. According to Livingstone (2001), most of what novice firefighters learn will be the result of seeking out sources of knowledge and activating learning strategies on their own.

Firefighters are often busy performing non-firefighting tasks such as fire station and vehicle cleaning and maintenance, checking their firefighting tools and personal protective equipment, and responding to emergency calls (Landen & Wang, 2009). Firefighters work in teams of three to five and operate in a high stress, highly social and interactive work environment (Landen & Wang, 2009). U.S. firefighters are expected to be similarly situated. How they spend their time interacting may or may not contribute to stimulating the triggers necessary to activate their curiosity about a specific firefighting issue (Marsick & Watkins, 1999). Informal workplace learning engagement requires a personal investment of affective, cognitive, and psychomotor resources which may be affected by other activities or workplace distractions (Schuck, 2011). Learning engagement also requires action (Schuck, 2011). Once a worker commits personal resources they must be acted upon and dedicated to a specific learning purpose (de
Feijter, de Grave, Koopmans, & Scherpbier, 2013). In the context of firefighting the availability of these personal resources and ability to act on them is called into question as a result of work activities, company assignment, and support by peers and supervisors.

Informal learning support has been linked to both positive and negative learning outcomes at the individual, group, and organizational levels (Cunningham & Hillier, 2012; de Feijter et al., 2013). Outcomes include permanent changes in knowledge, skills, and improved performance (De Feijter et al., 2013). Although informal learning outcomes are not the purpose of this study, firefighter safety through the prevention of injury or death is a primary motivation. Organizations are similarly motivated to improve safety outcomes (Nahrgang, Morgeson, & Hofmann, 2010). According to Nahrgang, et al. (2010), one way to improve safety outcomes is by supporting the learning efforts of workers.

Support for informal learning has been associated with organizations whose supervisors and managers create and value learning opportunities and promote a climate of psychological safety, where employees can freely express their personal knowledge, skills, or deficiencies without fear of reprisal or embarrassment (Bjork et al., 2013; Jeon & Kim, 2012). Supervisory support and psychological safety are linked to informal feedback in the workplace which have been associated to informal learning engagement (Vander Rijt, Van de Wiel, Van den Bossche, Segers, & Gijselaers, 2012). Support also includes work environments where employees develop relationships and interact with others socially and functionally while simultaneously participating in work activities (Doornbos et al., 2008; Jeon & Kim, 2012). A supportive environment includes one in which knowledge is freely shared and exchanged (Connelly, Zweig, Webster, &
Trougakos, 2012). It is unclear whether the highly social and directly supervised work context of novice firefighters supports informal learning.

Problem Statement

The United States Fire Administration (USFA) set a goal in 2003 to reduce firefighter fatalities by 25% within five years and by 50% within a decade (TriData Corporation). According to the same agency, this goal was not achieved by the target dates (USFA, 2013). The acquisition of knowledge by activating informal learning processes is empirically linked to improved worker performance and reduced risk of injury or death (Bjork, et al., 2013). Informal learning accounts for more than 70% of workplace knowledge acquisition and should be supported by organizations to motivate learning and reduce worker risk (Cunningham & Hillier, 2012; de Feijter et al., 2013; Eraut, 2004 Livingstone, 2001; Marsick, 2009).

Despite evidence that informal workplace learning improves safety outcomes, organizations fail to recognize and address relational and structural factors that inhibit workplace informal learning engagement (Marsick, 2009). Additionally, most studies investigating informal workplace learning support factors are descriptive and lack generalizability (Noe, et al., 2013). Present studies have failed to confirm, or specify, the degree to which supervisory support (Doornbos, et al., 2008), psychological safety (Edmondson, 2011), knowledge sharing (Connelly & Kelloway, 2003), and relationship building (Doornbos, et al., 2008) influences informal workplace learning engagement. Additionally, no present study has combined these measures to empirically examine how
this combination may influence the frequency that novice firefighters engage informal workplace learning.

Failing to support the informal learning engagement of firefighters may delay or impede the intended goal of reducing firefighter fatalities. As a result, there is a need to investigate and specify the degree to which supervisory support, psychological safety, knowledge-sharing, and relationship-building influences the informal learning engagement of novice firefighters.

Given that much of the informal learning support and engagement research is descriptive and inaccessible for broad application, and specifically, the degree to which the combination of supervisory support, psychological safety, knowledge sharing, and relationship building may influence informal learning engagement is unknown, research was conducted to examine the relationships between this combination of variables.

**Purpose Statement**

The purpose of this correlational research study was to test the theory of informal workplace learning by relating supervisory support, psychological safety, knowledge sharing and relationship building to informal workplace learning engagement among novice career firefighters within a metropolitan Midwestern Fire Department. The degree to which the perceived presence of supervisory support, psychological safety, knowledge sharing, and relationship building influenced the frequency they participated in informal learning activities was examined. A single moderating variable was assessed to determine the effect that participating in structural firefighting may modify the relationships between predictor variables and the dependent variable.
Theoretical Framework

This study was grounded in the theory of informal and incidental learning developed by researchers Marsick and Watkins (1999) and later adapted with Cseh (Marsick & Watkins, 2001). The informal and incidental learning model depicts eight progressive non-sequential, non-linear process steps that differentiate their theory of informal workplace learning from other models. These non-linear process steps include (a) triggering events, (b) interpreting the experience, (c) examining alternative solutions, (d) selecting from among learning strategies, (e) producing the proposed solutions, (f) assessing intended and unintended consequences, (g) reflecting on lessons learned, and (h) (re)frameing in the context (Marsick & Watkins, 2001). Individual, socio-cultural, and organizational factors interact to influence engagement in these eight process steps. The premise of this model suggests that improvement in learning support will increase the frequency that novice firefighters activate and engage in informal learning activities.

Among the contextual factors identified within the literature, four were selected to represent the independent variable group - informal workplace learning support. This framework represents the theorized influence among the relationships that the independent and moderating variables may exert on the fifth process step in Marsick & Watkins (1999) model, the frequency of informal workplace learning engagement.

Proposed conceptual framework

Figure 1 illustrates the conceptual framework for this study. This conceptual model illustrates the potential interactions among variables of the study and the socio-relational context in which they operate. These include four previously identified and described independent variables, one dependent variable, and one moderating variable.
The final element represents relational and structural climate of the organization that the variables operate within.

![Socio-Relational and Structural Support Climate]

Figure 1. Conceptual Framework

Novice firefighter workplace learning engagement represents the frequency of acting on one or more of a Lohman’s (2005) eight informal learning activities. Informal workplace learning support represents the presence, individually and collectively, four previously described relational and structural factors including supervisory support, psychological safety, knowledge-sharing, and relationship-building. A single work function variable, participating in structural firefighting, was examined to determine if it changes the effect of informal learning support on informal workplace learning engagement. These variables were examined through the lens of the informal and incidental learning model developed by Marsick et al. (2006).
For this study, four frequently discussed socio-relational support variables were identified in the literature and selected. The presence (or absence) of these variables may or may not activate, or trigger, a learning action on the part of the novice firefighter. Triggers represent the “ah-ha” moment when a worker recognizes that individual learning is required (Marsick, 2006). This study examined the influence that a combination of support variables had on triggering and activating informal learning engagement.

Method

A correlational research design, using standard multiple linear regression was used to analyze the data collected in this study. A single instrument, measuring five variables, (four independent, one dependent, and one moderating variable), comprised of 34 items, was administered electronically via email link to participants. The dependent variable for this study is novice firefighter informal workplace learning engagement. The variable was comprised of eight items adapted from the eight measures of informal workplace learning engagement developed by Lohman (2005). The items were not weighted. The construct of informal learning support contained four independent variables including supervisory support, psychological safety, knowledge-sharing, and relationship-building. Twenty-three items made up the independent variables which were adapted from Edmondson (1999), Connelly and Kelloway (2003) and Doornbos, Simons, and Denessen (2008).

Participating in core work activities, like firefighting, can trigger informal learning (Skule, 2004). Police officers were found to more frequently engage informal learning when faced with increased work pressures requiring them to work hard and or
fast (Doornbos, et al., 2008). Structural firefighting is such a work environment combining both factors of time sensitivity and physically demanding work. For this reason, a single moderating variable, participating in structural firefighting was included in this study to examine its impact on the interaction between the informal learning engagement and the predictor variables.

The population for this study was career novice firefighters who had graduated from a firefighting academy but had six or less years of full-time employment with a single Midwest metropolitan fire department. Participants were recruited using a department provided email distribution list. Participants were informed that their participation was voluntary and that their data will remain strictly confidential. An electronic survey tool, Qualtrics, was used to present the instrument to respondents. The data were analyzed utilizing standard multiple linear regressions to examine the relationship between the frequency of informal workplace learning engagement and supervisory support, psychological safety, knowledge-sharing, relationship-building, and the combination of all four independent variable factors. Multiple regression was also used to examine the effect of the moderating variable while holding the other independent variables constant.

Research Questions

This study sought to broadly understand the influence that selected organizational informal learning support factors had on the informal workplace learning engagement of novice career firefighters. This research investigated the extent that variability in the dependent variable, self-reported frequency of informal workplace learning engagement, was explained by the independent variables. Relationships between each independent
variable and the dependent variable, including combinations of the independent variable
were examined. Additionally, this study examined the effect that participating in
structural firefighting had on informal workplace learning support and the frequency of
informal workplace learning engagement.

Specific research questions included:

1. To what degree are organizational informal learning support factors of
   supervisory support, psychological safety, knowledge sharing, and relationship
   building present in the work climate of novice firefighters?

2. To what degree do novice career firefighters engage in each of the eight informal
   learning engagement activities?

3. What is the relationship between novice firefighter informal workplace learning
   engagement and informal learning support factors supervisory support,
   psychological safety, knowledge sharing and relationship building?

4. To what degree does supervisory support, psychological safety, knowledge
   sharing, and relationship building predict the frequency of novice firefighter
   informal workplace learning engagement?

5. To what degree does the moderating variable, participating in structural
   firefighting, alter the predicted frequency of firefighter informal learning
engagement when controlling for informal learning support variables selected in the final model?

Significance of the Study

This study is the result of the emergence of two important broad issues; one theoretical and one practical. The first is to extend previous research findings by exploring relationships among informal learning support factors supervisory support, psychological safety, knowledge sharing and relationship building and informal workplace learning engagement. Much of the previous research on informal learning support was qualitative and descriptive in nature and difficult to apply to practice (Noe, et al., 2013). As a result, scholars have called for additional empirical research to examine isolated factors that may promote or inhibit the frequency with which employees activate informal learning processes or participate independently in activities that resolve personal learning needs (Ellinger, 2005; Lohman, 2009; Wofford, 2012). This study was conducted in response to the need for more empirical research on the influence of supervisory support, psychological safety, knowledge sharing and relationship building in informal learning engagement. This study contributed to the knowledge base by examining the degree to which each variable influences informal learning engagement. This study also contributed by examining the informal learning practices of a population not previously studied.

The second important broad issue this study addresses includes practical efforts by the nation’s fire services, as well as various professional associations to support learning processes and outcomes to reduce casualties. The informal learning processes and activities that U.S. firefighters use to acquire the technical skills and knowledge
necessary to perform during firefighting operations lacks scholarly attention (Noe, et al., 2013; Somer & Njå, 2011; Taber et al., 2008).

Previous studies involving firefighter safety in the U.S. have been focused primarily on safety equipment, engineering best practices, staffing levels, fire behavior, and safety culture (Averill, et al., 2010; Brown & Stickford, 2009; Deuser, et al., 2012; Mensch & Bryner, 2011; Karter & Molis, 2013; Kunadharaju, et al., 2011). The findings of this study will contribute to the efforts of the fire services to support firefighter learning which is linked to improving learning outcomes.

Limitations

Several limitations should be considered while reviewing the findings and conclusions of this study.

1. First, the scope was limited to the 54 novice firefighters of a single metropolitan fire department who responded to the survey and therefore results are not generalizable to other fire departments.

2. Additionally, novice firefighters were asked to retroactively self-report and provide an estimate of the frequency they engaged informal learning activities during the previous month. This limitation may cause firefighters to underestimate the frequency they engage in learning activities.

3. Novice firefighters were asked to respond to questions that examined their perceptions of supervisory and peer informal learning support. Novice firefighters may experience psychological pressure and unconsciously respond in a manner that results in unintentional bias.
4. The scope of this study was limited to socio-relational support factors that are perceived by the individual learner. This study did not include individual or personal characteristics nor consider team or organizational factors that may influence engagement.

Assumptions

An underlying assumption of this study was that U. S firefighters were currently engaged in informal learning processes and activities to improve their firefighting knowledge and acumen. Additionally, that increased engagement in these informal learning activities would improve learning outcomes, particularly those involving reducing casualties among novice firefighters. Finally, it was assumed that novice firefighter respondents self-reported honestly and to the best of their abilities based on their personal beliefs and perceptions.

Organization of the Study

This study was organized into five Chapters that include the introduction, the literature review, methodology, analysis of data, summary conclusions and recommendations. Chapter 1 outlines the research that was conducted, its purpose and aims, research questions, conceptual framework, and methodology. Chapter 2 contains the recent and relevant research findings contributing to the informal workplace learning phenomenon. Chapter 2 details informal learning theory, employee workplace learning engagement, and constructs of workplace informal learning support including supervisory support, psychological safety, knowledge sharing and relationship building. The
methodological approach and research design using multiple linear regression to explore relationships are presented in Chapter 3, along with relevant measures and instrumentation. Chapter 4 provides a comprehensive analysis of the empirical findings for each research question. Finally, Chapter 5 provides a summary of discussions, implications, and recommendations for future research.
Chapter 2: Review of the Literature

Background

This study empirically examines the potential interactions among informal learning support factors and the informal workplace learning engagement of novice career metropolitan U.S. firefighters. This extensive literature review critically examines the socio-relational and organizational structural factors that are suggested to influence informal workplace learning engagement. The primary context of the literature review focusses on the workplace learning engagement of novice career metropolitan firefighters. This study is the result of an interest to understand how supervisory support, psychological safety, knowledge sharing, and relationship building influence a novice firefighter’s use of informal learning activities.

Firefighting exposes novice and experienced firefighters alike to highly complex, dynamic and dangerous work situations that often change rapidly (Tabor, et al., 2008). This work environment responds to the decisions that are made and acted out by firefighters who operate from their individual and collective reserves of knowledge and skills. Failing to adequately acquire skills and knowledge places firefighters at risk of being injured or killed and learning is a matter of life and death for firefighters (Fahy, 2010). According to a 2012 U.S. Department of Labor Statistics report, career U.S. firefighters experience a 26% higher chance of being killed on the job and more than twice the chance of being injured than the average U.S. worker (U.S. Department of Labor Bureau of Statistics, 2012). The U.S. Fire Administration reports that approximately 100 career and volunteer firefighters are killed in the line of duty each
year, and another 70,000 are injured (Karter & Molis, 2013; USFA, 2013, 2014). In 2012, approximately 50% of these firefighters had six years or less on the job (USFA, 2013). In 2000, the US Fire Administration issued an edict to the nation’s fire services to reduce fatalities by 25% by 2005, and by 50% by 2010 (FEMA, 2002). Supporting firefighter learning may improve learning outcomes which have been linked to improved performance and safety (Baumann & Bonner, 2011).

Canadian and Norwegian firefighters participate in informal and formal developmental activities (Sommor & Njå, 2011; Tabor, et al., 2008). Studies examining teachers, nurses, and flight instructors found that these workers’ engagement in informal learning may be influenced by a variety of organizational contextual factors (Eraut, 2005; Lohman, 2005). The unguided nature of informal learning processes and activities gives agency to the learner who chooses the time, place and method for learning (Eraut, 2004; Lohman, 2005, Shuck, 2013). According to research findings, as much as 70% of all workplace knowledge is acquired informally; outside of organizationally-sponsored training and development programs (Ellinger, 2005; Livingstone, 2001; USDOL, 1996). This study examined how metropolitan U.S. novice career firefighters’ work culture influences the frequency that they engage in informal learning. The specific context of this study is to examine the influence of the constructs of supervisory support, psychological safety, knowledge sharing and relationship building on the frequency that novice career firefighters engage informal learning activities.

Empirical research on informal learning processes and activities, including antecedents, is limited; much of what is available remains descriptive and unavailable for broad application (Noe, Tews, & Marand, 2013). Informal workplace learning
engagement is observed in the behaviors and actions of the individual who activates informal learning activities (Lohman, 2005). This Chapter addresses the current state of informal workplace learning engagement and four variables that are theorized to interact with or influence the informal workplace learning engagement of novice firefighters. The Chapter begins with a brief introduction of how the literature was searched, sorted, and selected. The first section of Chapter 2 outlines our present understanding of informal learning theory, informal workplace learning, and informal workplace learning engagement, in the workplace. The second section presents research findings on relevant factors that interact with informal workplace learning engagement and concludes with a background of career metropolitan novice firefighters.

Approach to Conducting the Literature Review

A literature review was conducted to assess the extent of scholarly work on the topics of informal learning in the workplace, employee engagement in informal workplace learning, and organizational and contextual factors theorized to interact with or influence informal workplace learning engagement. Basic initial search terms included combinations of adult, employee, firefighter, worker, workplace, informal, learning, education, training, safety, and culture. This approach identified how these constructs were articulated in the titles and abstracts of peer-reviewed journals from both domestic and international educational journals. This step resulted in an abbreviated list of scholars, research topics, journals and search criteria that were used to narrow the search. Three primary web-based education search databases were selected and included
the Educational Resource Information Center (OhioLINK) (ERIC), Education Resource Complete, and Education Full Text.

The literature search was then performed applying the following combinations of search terms; “informal learning (or training) at work”, “informal learning (or training) in the workplace”, “employee experiential learning”, “situated learning”, “workplace learning culture”, “employee learning engagement”, “employee learning in practice”, “informal workplace learning engagement”, and “learning organization”. Filters were applied that limited searches to full-text peer-reviewed journal articles published between March 2005 and March 2015. The selected literature was examined from a Workforce Development and Education (WDE) frame encompassing literature within the adult education, educational psychology, Human Resource Development (HRD), and career and technical education fields of study. Relevant seminal research and articles representing important contributions, regardless of their publication date, were also included.

Informal Workplace Learning

For nearly three decades, researchers have been grappling to understand the workplace informal learning phenomenon; its processes, interactions, outcomes, and more recently how to leverage it for the benefit of individuals, groups and organizations (Lohman, 2005; Doornbos, et al., 2008; Marsick, 2009; Wofford, et al., 2012; Bjork, et al., 2013). It is generally accepted that informal modes of learning constitute the majority of workplace learning. In fact, one prominent researcher in the field raises the point that “more organizations than ever question the benefits of standardized training,” referring to formalized approaches to training (Marsick, 2009, page 265). Informal learning is often
described as learning that is out of view, or tacit, and situated within daily activities and it occurs to gain understanding, acquire skills or additional knowledge (Ellinger, 2005). Informal learning is grounded in adult education that provides theory for understanding a working adult’s motivation to pursue a learning opportunity, learner independence, collaborative, and experiential learning, (Bjork et al., 2013; Marsick, 2009). Malcolm Knowles is credited with first using the term ‘informal’ in the education literature in his 1950 publication titled *Informal Adult Education; a guide for administrators, leaders and teachers* (Ellinger, 2005).

**Formal Workplace Learning**

Informal learning is historically framed by researchers regarding what it is not - *formal workplace learning* (Marsick & Watkins, 2005; Eraut, 2004). Formal workplace learning has been described and defined as learning interventions that are institutionally authorized and sponsored activities where the curriculum is prescribed and facilitated (Ellinger, 2005; Lohman, 2009). Formal learning activities may be accompanied by one or more forms of recognition such as continuing education credits, certificates, or a degree (Lohman, 2009). Implicit within formal workplace learning are issues of power and agency (Eraut, 2004). In the formal workplace learning domain, individual power and agency is ascribed to, or retained by, management who determines what needs to be learned, who needs to learn it, and when, how, and where learning will be delivered (Eraut, 2004; Sawchuk, 2008). In the formal workplace learning mode, management also prescribes the curriculum, content, and context of the learning intervention (Marsick, 2009).
Not all researchers are satisfied with the manner in which formal and informal learning are distinguished within the literature. Eraut (2004) advocates for removing descriptive boundaries that create a dichotomy in the use of the terms, and instead, view them as coterminous within the larger frame of adult and workplace learning. Eraut (2004) also prefers not to contrast the two but instead think of them as occupying a relative position along a continuum, where informal and formal modes represent the polar ends. Marsick (2009) states that the two are “inextricably intertwined” but necessarily separated for conceptualization and examination (Marsick, 2009, page 265). The latter position is consistent with the findings of this literature review.

Defining Informal Workplace Learning

Variants of informal workplace learning found within the literature include, experiential learning (Kolb, 1984), non-formal learning (Kyndt, Dochy & Nijs, 2009), incidental learning (Schugurensky, 2000, Marsick & Watkins, 1990), self-directed learning (Schugurensky, 2000), tacit learning (Eraut, 2004, Schugurensky, 2000), and recently, integrative learning which extends Schugurensky’s three modes (Bennett, 2012). Experiential learning is defined as a continuous learning process derived from personal experience (Kolb, 1984). Non-formal learning is defined as encompassing formal education that occurs outside of an educational system where location is the primary determinant (Kyndt, Dochy & Nijs, 2009). According to Marsick and Watkins (1990), incidental learning occurs unconsciously, is unintentional, and is a consequence of some other activity (Marsick & Watkins, 1990). Self-directed learning occurs when an individual takes responsibility for learning intentionally and has awareness that learning is the
intended outcome (Schugurensky, 2000). Tacit learning, proposed as one of three modes of informal learning, was also proposed by Schugurensky (2000) to highlight the largely invisible nature of workplace knowledge. Recently, a fourth mode of informal learning was proposed to extend Schugurensky’s conceptualization; integrative learning, which is non-conscious and intentional (Bennett, 2012). For the purposes of this study, these variants are embodied within the construct informal learning.

Researchers have applied a variety of descriptors to differentiate and measure informal workplace learning, from formalized learning approaches by observing behaviors, activities, and outcomes. Informal workplace learning measures include informal learning processes (Watkins, 2009), informal learning activities (Wofford, et al., 2012), cognitive processes (Eraut, 2004) and social processes (Taber, et al., 2008). Informal learning is chiefly defined in the literature as learning that is unplanned, unstructured, and unbound by classrooms or training environments (Lohman, 2005). Informal learning occurs independently of authority and dependence on knowledge managers or experts (Eraut, 2004). Informal learning may be self-directed (Schugurensky, 2000). Workplace informal learning requires individual agency where employees control curriculum and learning processes are centered on the choices and decisions of the learner (Cunningham & Hillier, 2012; Hagar & Halliday, 2006; Marsick, 2009) Informal learning often occurs with others and is embedded, or situated, in the daily experiences of an individual both on and off the job (Ellinger, 2005; Wofford, et al., 2012). For the present study, informal workplace learning was adapted from Lohman’s (2005) 8 discreet informal learning activities.
Informal Workplace Learning Research

It is reported that 70% of workplace learning is the result of employee engagement in informal learning activities and processes (Ellinger, 2005; Livingstone, 1999; U.S. Department of Labor, 1996). In the most recent decade, multiple domestic and international empirical studies have been conducted examining the informal learning construct to advance theory. Early studies examined a variety of occupations including manufacturing employees, information technology professionals, teachers and human resource development professionals (Lohman, 2005; Ellinger, 2005; Lohman, 2005B; Lohman, 2009). More recent studies included police officers, flight instructors, public sector managers and supervisors, and nurses (Wolford, Ellinger & Watkins, 2012; Dornbos, Simon & Denessen, 2008; Cunningham & Hillier, 2012; Bjork, Toin & Sorenson (2013). Informal learning is generally accepted as being the principal means in which workers acquire workplace knowledge and skills.

One of the largest seminal empirical studies on informal learning among adults was conducted in North America by the New Approaches to Lifelong Learning (NALL) who focused on the informal learning practices of Canadian adults (Livingston, 2001). One aspect of the study examined work-related learning activities among four workplace classifications; managers, professionals, service workers, and industrial workers (Livingstone, 2001). This study found that Canadian adults spent five-times more time engaging informal learning activities than formal learning activities (Livingstone, 2001). Workplace-related informal learning was characterized at the time as “difficult to measure” by respondents, but very few indicated that they did not engage informal workplace learning at all (Livingstone, 2001). This important study brought to light the
prevalence of informal learning by adults and is frequently cited in domestic and international research on the subject of informal learning.

Informal workplace learning has become the focus of scholars investigating how it operates and how it may be leveraged (Noe, et al., 2013). In a more recent study, Berg and Chyung (2008) studied performance improvement professionals from the instructional and performance technology, organizational development, organizational behavioral management, and training and e-learning industries. The purpose of this empirical study was to examine the frequency of informal workplace learning engagement by training professionals who focus on the development of others. Findings included that these practitioners acquired new knowledge from informal learning activities more so than through formal approaches and activities (Berg & Chyung, 2008). This study also found that informal engagement did not differ by gender, age, or level of education which is consistent with other research findings (Berg & Chyung, 2008).

Researchers of high-reliability occupations, defined as high-risk jobs that manage risk by controlling error, have also studied the informal workplace learning processes of their workers. A recent qualitative study examined the informal learning behaviors of certified flight instructors following their Federal Aviation Administrator (FAA) certified flight instructor training (Wofford, Ellinger, and Watkins, 2012). Researchers examined the informal learning behaviors of novice flight instructors who needed to overcome training challenges encountered when instructing student pilots. The findings of this study identified learning strategies that included reflection on previous experiences as a student pilot, through collaboration with other instructors, and through trial and error or experimentation in teaching techniques which are consistent with informal learning.
activities reported by other researchers (Hoekstra, Brekelmans, Beijaard & Korthagen, 2008; Lohman, 2009)

Although no U.S studies could be identified, an empirical study of Canadian firefighters and paramedics was conducted to explore how they learned their professions. This study specifically examined how codified organizational policies and protocols were adopted and adapted into daily work practices (Taber, Plumb & Jolemore, 2008). The authors reported;

“that the deepest reaches of their expertise, has been gained, not through their intense, explicit, formal training, but through extensive, implicit, informal experience as they have participated with their coworkers on the job” (Taber, Plumb & Jolemore, 2008, p. 273).

Informal Workplace Learning Theory

The principle theory that underpins this study results from decades of work by scholars Marsick and Watkins (2007) who advanced a Re-Conceptualized Model for Enhancing Informal and Incidental Learning. Situated learning is a theoretical perspective of Brown, Collins, and Duguid (1989) who proposed that learning occurs organically as the result of performing authentic work. Marsick and Watkins (2009) acknowledge the importance of situated learning but distinguish it from their model. It is described only briefly because it’s tenets appeared in previous informal learning research of Canadian and Norwegian firefighters.
Situated learning is a construct that proposes that learning is the result of three converging influences, the context in which adults interact, tools in the form of acquired information and knowledge, and authentic social interaction (Brown, Collins & Duguid, 1989). Knowledge is generated in the minds of workers and groups of workers who engage in various formal and informal learning activities, situated in the work, social, and recreational contexts in which they operate (Brown, Collins & Duguid, 1991). The theory proposes that “knowing” resides separately from “doing” requiring authentic activity to experience and embed the knowledge or skill. Situated learning is also framed as “real-world experiences” that are socio-culturally grounded, and where content and learning processes are acted upon simultaneously (Stein, 1998; Merriam, Caffarella & Baumgartner, 2007).

Studies involving Norwegian and Canadian firefighters found that situated and authentic experiences supported the learning efforts of firefighters (Tabor et al., 2008; Sommer & Njå, 2011). Both studies found that learning resulted from or was often triggered from interaction and daily work activities such as daily equipment checks, or equipment cleaning, from actually operating at the scene of a fire. They found that firefighters valued experience, and reported that explicit knowledge could not be applied directly to emergency situations, but had to be incorporated into the work through first-hand experiences (Sommer & Njå, 2011).
In the case of Canadian firefighters, however, situated learning theory did not account for what underpinned the:

“dramatic performance of emergent, creative, and autonomous actions often required of individual emergency personnel in crisis situations.”


When faced with situations that neither their individual or collective experiences could accommodate, firefighters had to adapt, learn quickly, and apply previously unavailable actions to this new situation. Tabor et al. (2008) concluded that crisis events experienced by emergency responders required a different kind of learning that is not accounted for in this theory. This study does not address the types of instantaneous learning that occurs during firefighting work as the result of crisis situations. Situated learning is acknowledged as an important theoretical frame that supports informal learning, however, is outside the scope of this study.

Informal and Incidental Learning Model

In spite of the focus and considerable progress on the advancement of a theory of informal learning and the completion of dozens of studies on the topic, at present there is no unifying theory (Eraut, 2004; Sawchuk, 2009; Marsick, 2009). A model for enhancing informal and incidental learning, proposed by Marsick and Watkins (1990, 1997, 2001), expanded by Cseh (1998) and Callahan (1999) and reconceptualized by Marsick, Watkins, Callahan, and Volpe (2006), is the principle empirically tested model for framing the process of informal learning. This model proposes eight non-linear
process steps that operate within the boundaries of organizational context and are initiated by a work-related problem requiring learning (Marsick and Volpe, 2007). The model is initiated by a triggering event that disorients an individual from their present frame of routines and practices, requiring a novel response (Marsick, et al., 2006). The process, see Figure 2, continues through a series of process steps that include interpreting the context of the trigger, examining alternate solutions, identifying suitable learning strategies, and selecting and producing the proposed learning strategy. The consequences of the selected learning strategy are then assessed along with any unintended consequences (Marsick, et al., 2006). The learning process concludes with a revised understanding, knowledge, or skill, and a reframing of beliefs which will be activated in future situations (Wofford, et al., 2012). These informal learning phases are embedded within an organizational context and are activated through work practices and experiences (Marsick et al., 2006, Wofford, et al., 2013).

Figure 2. Informal and Incidental Learning Model

Source: Marsick et al. (2006). Used by permission of authors
Organizational context has been implicit to the model yet has been found to profoundly influence every phase of the informal learning process (Wofford, et al., 2012 Sandlin, Wright, & Clark, 2011). Organizational contextual factors account for the individual, group, and organizational social and cultural characteristics that influence how individuals will interpret and respond to the learning opportunities (Marsick & Watkins, 2001; Marsick, et al., 2006, Wofford, et al., 2012). Contemporary empirical studies found that both negative and positive contextual factors influence the process of informal learning. Examples of workplace contextual factors include workplace learning culture, availability of learning resources, physical and psychological work barriers, time constraints and work production pressures, rapid change, and relationship forming among learners. (Bjork et al., 2013; Doornbos et al., 2008; Ellinger, 2005; Hoekstra et al., 2009; Kyndt et al., 2009). Contextual factors are as complex and diverse as are the types of work environments and situations employees and researchers may encounter (Wofford, et al., 2012). In this study of firefighters, informal workplace learning engagement is essentially the activation of the informal and incidental learning model within the firefighting context.

Informal workplace learning engagement is integrated with the everyday routines encountered in the workplace and often occurs outside the awareness of the participant (Marsick, 2009; Shuck, 2011). The informal learning process begins with a triggering event (Marsick and Watkins, 2001). Ideally, triggers are best encountered when the worker is not facing a high-risk situation. In a study of pilot instructors, triggers such as a gap in a technical skill or a problem interacting with a flight student compelled the instructor to seek out and engage an informal learning activity (Wofford et al., 2012).
This trigger or “jolt” is experienced by the individual as the result of an internal or external stimulus that illuminates a gap in a knowledge or skill (Marsick & Watkins, 2001). Triggers may be the result of organic or spontaneous exposure to a work situation not previously encountered, or triggers may be induced intentionally as the result of intentional variations in work and task assignment (Bjork et al., 2013).

The informal and incidental learning model is neither linear nor sequential but rather a visual representation of the expected phases of informal learning and a means with which to define and describe each level (Marsick & Watkins, 2001; Wofford et al., 2012). Recognizing and interpreting the trigger as a learning opportunity is the second phase of the present model. Reflection is the key to the learner interpreting the trigger (Marsick, et al., 2006; Wofford, et al., 2012). The risks of misinterpreting the trigger can result in identification of an erroneous solution or strategy (Marsick & Volpe, 2012). Some triggers may not be appropriately interpreted and activate learning process, and therefore, the learner may repeat the same kinds of errors or continue functioning with the same gaps in their knowledge or skills (Marsick, 2009). Interpretation requires motivation, intentionality, and critical reflection skills (Marsick, 2009).

Once the trigger has been interpreted the individual is said to enter the next phase and examine alternatives among the possible solutions to resolve the dilemma that produced the trigger. When a learner examines alternative solutions, they are attempting to locate and apply a successful strategy from lessons learned and from their previous experiences (Marsick & Volpe, 2012). Once the learner has examined their previous experiences and has considered available alternatives, the process advances to the selection of a learning strategy (Marsick & Volpe, 2012). The next phase, the fourth
represented by Figure 1, is when the learner identifies and activates a learning strategy appropriate for the learning situation and context, this may include experimentation through trial and error, reflection on their own actions or the actions of others, talking to others within or outside the workgroup, seeking information from printed or web-based sources, among others (Marsick et al., 2006; Wofford, et al., 2012; Bjork, et al., 2013). Again, social or cultural context may interfere with the learning strategy including but not limited to a lack of social support including trust and mutual respect, a lack of time or resources to engage learning, or the lack of technical or expert resources (Marsick & Watkins, 2001; Cunningham & Hillier, 2012).

The next phase requires that the individual produce, apply, and implement the appropriate learning strategy (Marsick & Watkins, 2001; Wofford, et al., 2013). This phase in the process requires motivation, ability to interact with others, and engagement in learning (Marsick & Watkins, 2001). In many of the studies examined, this active phase of the learning process was most often recognized, observed, and reported as informal learning in action. This phase of the process is described in detail within the dependent variable discussion, informal workplace learning engagement. Assessing the consequences is the phase where the learner determines whether or not their objective has been met (Marsick & Watkins, 2001; Wofford, et al., 2012) The final phases of the informal and incidental learning processes include reflecting on any lessons learned as the result of applying and producing the results of the learning strategy and finally reframing the experience into their existing frames of reference to be used later (Marsick & Watkins, 2001).
Learning Engagement

Engagement is a psychological state where an individual dedicates the cognitive, physical, and psychological resources, or personal energies and focus, to a given task for a specific purpose (Schuck, 2011). In this study, the task of concern is learning. Engagement resides in the cognitive, affective, and psychomotor domains (Noe, et al., 2010; Rich et al., 2010; Schuck, 2011). Learning engagement requires agency on the part of the individual which then must be acted upon (Eraut, 2005; de Feijter et al., 2013). Agency extends the freedom and the ability to choose the direction, tools, and the manner with which to engage informal learning to the individual learner (Lohman, 2005). In the context of informal learning, engagement is often characterized as the action step that results from reflection following a triggering event (Eraut, 2005). That reflection may or may not motivate an individual to seek out new learning opportunities or to participate in a learning activity (Marsick and Watkins, 2001). Those that do are said to be engaged.

The literature presents a range of antecedents to informal workplace learning engagement, some of which are the result of organizational or environmental context. These include culture, work pressures, social relationships, and structure among others (Doornbos et al., 2008; Lohman, 2009; Marsick & Watkins, 2009). Engagement requires trust, psychological safety, and the ability to collaborate by building and maintaining social relationships (Eraut, 2007; Jeon & Kim, 2012). Supporting informal workplace learning engagement includes giving learners the discretion to choose among a variety of learning options and the agency to activate learning strategies (Lohman, 2005).

Engagement in the informal learning process requires workers to interact and collaborate with others and be willing to share their knowledge and experiences to contribute to the experiences of others (Marsick & Watkins, 2009). Engagement is,
therefore, dependent on the relationships that are formed and maintained among employees and the ability to communicate effectively. This is evidenced in several recent studies including among Korean managers and workers of 467 Korean companies who reported that informal workplace learning engagement was enhanced through open communications and frequent interaction between employees (Jeon & Kim, 2012). In another study involving Dutch police officers, researchers found that collaboration was significantly linked to being part of a network of relationships, which then fostered much of their participation in learning activities (Doornbos et al., 2008).

Individual worker motivation, another antecedent, also influences informal workplace learning engagement (Noe, et al., 2013). Intrinsic motivation is required to compel action and invest the necessary energy in a learning task and also contribute to the learning of others (Noe, et al., 2013). Norwegian firefighters, for instance, chose not to engage learning something new when they believed that their current knowledge and skills were sufficient for a given situation and were, therefore, resistant to pressures or triggers that were not of their discovery (Sommer & Njå, 2011). Understanding how individual agency influences the behavior of workers who choose when and how to engage a learning problem, or in many cases not to engage, is relevant to scholars examining how organizations can support informal workplace learning engagement.

Finally, engagement in informal learning has been linked to individual discretion regarding how and what learning activities to engage (Lohman, 2009). Workers not only require the agency to take action to solve a learning need but also the flexibility and independence to determine how such as gathering information from web sources, choosing to interact with others, or spending time practicing (Cunningham & Hillier,
Discretion allows individuals and groups to work at a pace of their choosing. Workers essentially control the time, place, and the tools they deem as necessary for engaging informal learning.

Informal Workplace Learning Engagement

As previously described, informal workplace learning engagement requires an investment in on the job learning experiences and activities by both the individual, their coworkers, and their managers. Individuals must possess the cognitive, physical, and psychological resources to invest in these learning occasions which are necessarily supported by coworkers and supervisors (Cunningham & Hillier, 2012; Noe, et al., 2010). For this study, informal workplace learning engagement is a measure of the frequency in which firefighters invest their personal resources in an informal learning activity to address a personal learning need. The types of informal learning activities engaged by workers can be as diverse as their occupations, the role they fill in their organizations, and the tasks they perform on a daily basis. Some informal workplace learning activities are intentional while others are unintentional (Berg, et al., 2008). These activities may occur independently or with the support of others (Doornbos, et al., 2008).

Informal learning activities fall into one of three categories; learning on one’s own and independently from others, learning from or with others, and learning that is not relational or socially dependent (Noe, Tews, & Marand, 2013). For the purposes of this study, independent informal learning activities include searching for information using published professional, trade or government materials using printed or online sources (Lohman, 2009), the use of web-based social media, reflection on one’s own actions or
the actions of others (Lohman, 2009), and experimentation through trial and error (Marsick, 2009). Activities associated with learning with others includes informal mentoring (Eraut, 2004; Cunningham & Hillier, 2013), networking (Bjork et al., 2013), discussions and feedback (Bjork, et al., 2012), and storytelling (Sommer & Njå, 2011). A subset of collaborative learning includes observing others, sometimes referred to as peripheral participation (Doornbos, et al., 2008), and consulting with an expert (Wofford et al., 2012).

Lohman (2009) studied informal workplace learning engagement of information technology (IT) managers. In this study, IT manager engagement was measured by the frequency of participation in each step of eight informal learning activities. These include searching the web, speaking with peers and others, sharing information with others, collaborating with others, reflecting on their actions, trial and error, perusing professional periodicals, and observing others (Lohman, 2009). Findings demonstrated that IT managers engaged in informal learning activities most frequently triggered when the need for them to learn something new arises. These professionals rely heavily on the internet to learn which is consistent with the routines common to daily work and IT troubleshooting. This research identified an additional set of personal characteristics that were reported to enhance engagement. Among these were

“initiative, self-efficacy, having a love of learning, interest in the profession, integrity, outgoing personality, teamwork, curiosity, and open-mindedness” (Lohman, 2009).
Variations of these antecedents appear in later studies of individual characteristics that influence informal workplace learning engagement.

Unlike technology managers, nurses tended toward collaborative learning approaches. In a clinical nursing study, informal workplace learning engagement was characterized by participation in eight informal workplace learning activities including making pre- and post-rounds with doctors, conducting shift change pass-on, congregating around the patient whiteboard, preparing medications, interacting in staff common spaces, discussing specific practices and procedures, and treating a communal patient (Bjork et al., 2013, pg. 431). In this study, informal workplace learning engagement was influenced by the leadership, or lack of leadership, provided by physicians and clinical nurse managers, variation among workers’ experiences, and acceptance and participation in a community of practice (Bjork et al., 2013). These informal occasions occurred in real time and while work was being performed and required a high level of communications and openness on the part of physicians and managers. Findings highlighted the critical importance of trust and psychological safety in these collaborative learning environments where hierarchy and experience might otherwise suppress informal learning exchanges (Bjork, 2013).

Engagement can be a total body experience. Norwegian firefighters prefer to acquire skills and knowledge through embodied experience using terms researchers described as “getting it in the hands” (Sommer & Njå, 2011). Storytelling, another tool used to engage informal learning, was also prevalent in the study of Norwegian and Canadian firefighters of their first-hand experiences (Sommer & Njå, 2011; Taber, et al., 2008). A study of professional identity framing and learning among Australian
firefighters linked embodiment of skills and knowledge, or acquisition of “fire sense,” to bodily participation in the learning processes (Lloyd & Somerville, 2006). According to these researchers “real learning” occurs when firefighter apprentices engage in authentic work situations in the physical sense, apply practices in the form of bodily activity and receive advice of other more seasoned Australian firefighters (Lloyd & Somerville, 2006).

Coupled with a motivation to leverage the benefits of workplace informal workplace learning engagement, researchers recently expanded the list of potential activities employees may engage including voluntary job rotations, cross training and assigning team responsibilities (Cunningham & Hillier, 2012). Since informal learning is considered to be embedded within the actual work, these activities serve as both triggers as well as activities where informal learning manifests. These newer examples reflect an expanding understanding of the variety of activities that constitute informal workplace learning engagement within organizations, and no matter how many more are discovered, there remains a need to understand the relationship between these informal learning activities and informal learning processes that activate them (Cunningham & Hillier, 2012).

Risks of Informal Workplace Learning Engagement

Employee engagement in informal workplace learning is not always without risk and can produce negative learning outcomes (Manuti, Pastore, Scardigno, Giancaspro & Morciano, 2015). These include failing to recognize the need to learn something new and failing to transfer the learning to the job (Manuti, Pastore, Scardigno, Giancaspro & Morciano, 2015). Failures also include the perpetuation of outdated or inappropriate
knowledge, skills, and practices, ineffective performance, or the development of inflexible work routines (Eraut, 2004; Manuti et al., 2015). A worst-case scenario of such a failure would necessarily include the possibility of injury or death of a worker as the result of experimentation through trial and error. And finally, acquiring tacit knowledge through firsthand experience may result in the development of routines which may become inflexible as the worker encounters new problems or is required to adapt to new ways of performing work (Eraut, 2004). This suggests that learning preferences may also play a part in how firefighters place value on formal learning activities giving preferences to their styles and preferences.

Employees may place greater value on tacit knowledge resulting in routines that may become inflexible and difficult for workers to modify (Eraut, 2004; Sommer & Njå, 2011). “The Achilles heel of learning from experience is sampling” referring to the importance of the number of events that an employee may or may not encounter while acquiring experience (Eraut, 2004, pg. 254). The sharp reduction in the number of actual structure fires that occur in the United States may impact the sampling size necessary to trigger learning. Eraut suggests that learning through experience requires greater effort on the learner’s part, to collect more evidence, and to be more systematic by exercising self-awareness and critical reflection. The value that Norwegian firefighters place on their learning and the learning with others while performing authentic work requires “unlearning” when something new is being proposed or introduced into their personal knowledge and skills beliefs (Sommer & Njå, 2011). The tension between having routines of practice and the need to replace what works may be responsible for the lack of adoption of more contemporary firefighting practices and approaches.
Informal Workplace Learning Support

Multiple studies have examined ways in which informal workplace learning can be supported, or facilitated, as well as how factors found within the organizational setting may inhibit informal workplace learning engagement. Support for informal workplace learning has been linked with positive and negative informal learning outcomes at the individual, group, and organizational levels (Bjork et al., 2013; Cunningham & Hillier, 2012; De Feijter, et al., 2013). Individual learning results in permanent changes in attitudes, knowledge, skills, or behaviors of an individual (De Feijter, et al., 2013). Group learning results from learning together, sharing a common knowledge and “mental model,” receiving and giving feedback, and adapting as the situation requires (De Feijter, et al., 2013). As the result of collective learning, organizations also experience a changing knowledge culture which influence policies, practices, and systems (De Feijter, et al., 2013). Multiple studies have introduced and empirically tested a variety of factors that promote or inhibit informal workplace learning engagement. Selected factors for this study are outlined here.

Informal learning support has been linked to both positive and negative learning outcomes at the individual, group, and organizational levels (Cunningham & Hillier, 2012; DeFeijter et al., 2013). Knowledge, skills, and improved performance outcomes have been empirically linked to learning support (DeFeijter et al., 2013). Informal learning outcomes are not the purpose of this study. However, firefighter safety through the prevention of injury or death is a primary motivation and because organizations are similarly motivated to improve safety outcomes (Nahrgang, at al., 2010). According to Nahrgang, et al. (2010), one way to improve safety outcomes is by supporting the
learning efforts of workers. The literature reveals a variety of reasons for researching and leveraging informal workplace learning engagement and informal learning within organizations.

Informal learning support has been associated with organizations whose managers create and value learning and promote a culture where employees can freely express their personal knowledge, skills, and even deficiencies without fear of reprisal or embarrassment (Bjork et al., 2013; Jeon & Kim, 2012). Supportive environments exist where employees can develop interpersonal relationships and interact with others socially and functionally (Jeon & Kim, 2012; Doornbos et al., 2008). And supportive environments promote freely exchanged knowledge (Connelly, Zweig, Webster, & Trougakos, 2012). It is unclear if the directly supervised and highly interactive and social novice firefighter work context supports informal learning.

Organizations and researchers turned an eye toward promoting informal learning when faced with reductions in funding for formalized training and education interventions and also when more expensive formalized approaches are seemingly not working (Cunningham & Hillier, 2012). Organizations recognize that informal learning generally costs less than formal approaches and activities like training classes, workshops, and seminars (Marsick, 2006). Informal learning has also been linked to other organizational outcomes including performance improvement, the development of expertise, change, and adaptation, and to promote continuous learning at the individual, group and organizational levels (Lohman, 2005; Manuti et al., 2015; David & Daley, 2008; Kyndt, Dochy & Nijs, 2009). Risk reduction, quality and efficiency on the
delivery of organizational services have also been empirically associated with informal learning (Eraut, 2004; Bjork, et al., 2013).

Managers can encourage informal learning within the workplace. However, informal learning may occur even when conditions are unsupportive to learning (Lohman, 2006). Livingstone writes that informal learning activities,

“have tended to be ignored or devalued by dominant authorities and researchers either because they are more difficult to measure and certify or because they are grounded in experiential knowledge, which is more relevant to subordinate social groups.” (Livingstone, 2001, pg.4).

Organizations that are unaware of the value of informal learning, or dismiss it as illegitimate, will be unable to support and leverage the development of their employees and promote learning across the organization (Le Clus, 2011). Even when the informal learning process is invoked by the individual, the individual may not have the full level of awareness to change behavior as the result of that informal learning experience.

Organizational and management support also means triggering reflection (Hoekstra & Korthagen, 2011).

Informal workplace learning support includes promoting an organizational learning climate where learning conditions may be identified, supported, or improved (Kyndt et al., 2009)

“Learning conditions are defined as conditions created in social, material, or informational environment and in the work environment itself by key figures and agents of the labour organization, and by the employees themselves so that other employees can learn (Clauwaert & Van Bree,
2008). The emphasis lies on conditions, possibilities, or occasions created to make workplace learning possible” (Kyndt, et al., 2009, p. 370).

Factors that influence informal workplace learning engagement are grouped into individual, group and organizational factors (De Feijter, et al., 2013, Skule, 2004). These influences have been shown to impede or promote participation in the types of informal learning activities engaged by firefighters (Bjork, et al., 2013; Eraut, 2004; Lohman, 2004, 2009). Individual, or personal factors such as motivation, gender and age were excluded from this study.

Informal Workplace Learning Climate

Informal workplace learning engagement can be supported by organizations whose leaders and managers support learning and create learning opportunities (Bjork et al., 2013; Cunningham & Hillier, 2012; de Feijter, et al., 2012). Key attributes of informal workplace learning engagement require a climate of where employees feel safe and operate in a climate of trust (Bjork et al., 2013; Eraut, 2007), employees have the ability to build relationships and collaborate with others (Doornbos, et al., 2008), and work in a culture that values learning (Ellinger, 2005; Marsick, 2009). Relational dynamics selected for the present study include climate of supervisory support for learning, psychological safety, knowledge sharing and relationship building. (de Feijter, et al., 2012.

Supervisory Support

It is generally accepted that supervisors and managers have considerable influence on the workplace learning environment. Leaders may be unaware of their influence or
underestimate their impact on learning engagement due to work pressures of their own, such as directing work and employees, supervising work production, and managing organization work processes (Eraut, 2004). As a result, insufficient focus and resources may be allocated to promoting and supporting employee learning. Multiple studies linked manager and supervisor commitment to organizational learning to informal workplace learning engagement (Ellinger, 2005; Lohman, 2005). Management commitment manifests itself differently based on the occupation and work being performed. Managers and supervisors can create or inhibit the creation of a learning climate that values employee knowledge exchanges and can create barriers that prevent employees from collaborating (Lohman, 2005).

Nursing supervisors created opportunities in the work environment, including creating time and space for nurses to interact and providing access to more experienced nurses which promoted informal learning exchanges (Bjork et al., 2013). This study also found that nurse managers who removed traditional hierarchical structures by allowing newer, inexperienced nurses to speak up about patient care during exchanges with physicians created opportunities for both to learn (Bjork, et al., 2013). In a recent study of teachers, Hoekstra and Korthagen (2011) identified the importance of supervisory support for teachers in giving feedback to previously unsupported teachers who had not received systematic learning support. The study found that supervisory support promoted a learning climate where teachers were able to receive feedback on their beliefs and behavior, thus inducing learning.
Psychological Safety

If learning is the result of the social and cultural environment, relationships are critical to informal workplace learning engagement (de Feijter, et al., 2013; Le Clus, 2011). An empirical study examining the influence of relationships found that individuals who “form” relationships have a positive effect on informal workplace learning engagement, and likewise those who or “disrupt” relationships negatively influence engagement (Ellinger, 2005). In a study of Dutch police officers, feelings of belongingness and connectedness to others facilitated informal learning exchanges (Doornbos, et al., 2008). Creating a collaborative learning culture is key to supporting informal learning (Ellinger & Cseh, 2007). In the context of firefighting, Norwegian and Canadian Firefighters were also found to be dependent on building and maintaining learning relationships with more experienced firefighters (Sommer & Njå, 2011).

Multiple studies have demonstrated the importance of an organizational climate where relationships are built on trust and mutual respect for supporting an employee learning culture (Cunningham and Hillier, 2013; De Feijter et al., 2013; Marsick, 2009). In a recent study of informal workplace learning engagement among hospital staff members, trust among the group was the leading factor in establishing and maintaining collaborative learning relationships (de Feijter et al., 2013). In another study of medical nursing staff, researchers found that power relationships between experienced nurses and physicians could be mediated to create a safe environment for open exchanges and learning (Bjork, et al., 2013). An exploratory study of managers found that trust and mutual respect, specifically in maintaining “confidentiality,” were expressed as important
relationship dynamics necessary to facilitate informal learning activities (Cunningham & Hillier, 2012).

An Urgency to Support Firefighter Learning

The persistence of the high number of firefighter casualties in the US, measured in both injuries and fatalities has an impact on the economic, social, and operational efficiency of a community’s fire and emergency services delivery system (FEMA: National Fire Data Center, 2002). This message was further reinforced by a retrospective study conducted in 2002 in which researchers concluded that additional “research, training, improved operations…and other factors” could appreciably reduce firefighter deaths (TriData Corporation, 2002). In 2004, the National Fallen Firefighters Foundation, a derivative of this national agenda, published 16 Firefighter Life Safety Initiatives aimed at reducing firefighter fatalities targeting aspects of the culture, supervision, and training and learning (National Fallen Firefighters Foundation, 2004). These 16 objectives fostered a national dialog and produced training interventions targeting supervisors and firefighters at trade conventions and programs conducted at the national, state and local levels (National Firefighters Foundation, 2004). Based on a 2010 USFA report, the comprehensive national agenda and subsequent interventions have generally failed to address the problem of reducing firefighter casualties (Fahy, 2010).

Career firefighter fatality and injury rates have remained consistent in spite of notable advancements in firefighter training and education and a 50% reduction in the frequency of structure fires during the most recent three decades (Fahy, 2010; Karter & Molis, 2013). To account for these paradoxical relationships, research suggests that gaps in firefighter knowledge and experience may attribute to the high casualty rate (Fahy,
Assuming firefighters engage informal learning as a dominant approach to closing knowledge and skills gaps, understanding how to support this mode of learning is a useful endeavor. And based on recent research findings, this relationship between persistent casualties increased formal training efforts, and a sharp decline in actual fires may not be as perplexing as once considered.

Preliminary Findings on Firefighter Learning

There are virtually no empirical studies available that examined the learning approaches, activities, and processes, of structural firefighters in the United States. Firefighters in the U.S. and abroad participate in a formal training “academy,” followed by participation in apprenticeships, mentoring, and observing, and participate work activities with more experienced firefighters, under direct supervision (Bauman et al., 2011; Sommer & Njå, 2011).

Two recent empirical studies examined the learning habits and approaches of career firefighters in Canada and Norway. Comparable empirical U.S studies could not be found. Canadian and Norwegian firefighters and paramedics were found to develop firefighting and paramedic skills predominantly through daily informal means while at the fire station and while operating at firefighting emergencies (Sommer & Njå, 2011; Tabor et al., 2008). The acquisition of new knowledge and skills was found to be the result of both individual and group actions, including personal hands-on experience, reflection, experimentation, sharing stories, and listening to the experiences of other firefighters and paramedics (Tabor et al., 2008; Sommer & Njå, 2011). These studies also found that learning was situated in the work and triggered by a problem that required
new or adapted knowledge or skills (Sommer and Njå, 2011; Tabor et al., 2008). Norwegian researchers found that firefighters in their country placed greater emphasis on learning by doing, or in the Norwegian context, “getting it in the hands” (Sommer & Njå, 2011).

Firefighter casualties and fatality rates, differ significantly between U.S. and Canadian firefighters. In 2013, the U.S. fire service experienced 101 line of duty deaths while 18 Canadian firefighters were lost in the line of duty. (USFA, 2014; Canadian Fallen Firefighters Association, 2015). Firefighter casualty data from Norway wasn’t available. The National Institute for Occupational Safety and Health (NIOSH) maintain a database of fatality investigation reports and provides recommendations based on findings. These reports identify performance and competency gaps that contributed to injuries and fatalities. There are multiple examples of report findings and recommendations where casualties were the result of nearly identical conditions including errors and gaps in knowledge or skills. Understanding what activates learning from these reports and the lessons they provide may contribute to efforts to reduce firefighter casualties.

Supporting Firefighter Learning

Considerable efforts have been undertaken to enhance firefighter knowledge and skills development to prevent casualties, including a host of formal safety training and operating recommendations provided by NIOSH, the National Fallen Firefighters Foundation, and the National Fire Protection Association (NFPA) (Fahy, 2010; NFPA, 2010; USFA, 2009). These recommendations operate on the premise that firefighter
safety, knowledge, and skills will improve if they participate in these prescribed training interventions, which to date, have failed to do so. They further assume that firefighters will transfer safety, knowledge, and skills, to their practices. The vast majority of the 1.1 million U.S. firefighters are not injured in the line of duty each year which demonstrates that learning to operate in these complex and dynamic environments is occurring. The studies in Canada and Norway demonstrate that the vast majority of firefighter learning occurs through informal modes of learning and not as the result of formal interventions as proposed by fire service safety advocates (Tabor et al., 2008; Sommer & Njå, 2011). The goal of this study is to understand, and where possible, support firefighter informal workplace learning engagement.
Chapter 3: Methodology

Introduction

The purpose of this study was to explore relationships among informal workplace learning engagement and selected organizational socio-relational and structural factors including supervisory support, psychological safety, knowledge sharing, and relationship building. The population of interest in this study was novice career firefighters of a single metropolitan U.S. fire department. Chapter 3 presents the methodological approach; study context, research design, the study population, the process utilized for data collection and management, and procedures for measurement and data analysis.

Research Context

This research was guided by the broad question; to what extent is novice firefighter informal workplace learning engagement influenced by supervisory and peer workplace learning support? Researchers and practitioners have taken an interest in supporting the efforts of workers who activate independent learning processes to address a personal learning need (Lohman, 2005). Recent studies have examined individual, organizational and task-related factors that promote or inhibit the informal learning engagement of workers (Noe, et al., 2013). This study examined selected socio-relational and structural factors in the context of novice career metropolitan firefighters.

The dependent variable in this study, frequency of informal workplace learning engagement, has been previously studied in other occupations and was adapted from the
workplace learning literature (Lohman, 2005). The four independent variables selected for this study, which made up the construct informal workplace learning support, were also derived from the workforce education and development literature. The independent variables include (a) supervisory support, (b) psychological safety, (c) knowledge-sharing, and (d) relationship-building (Doornbos, et al., 2008; Connelly & Kelloway, 2003; Edmondson, 1999). Theoretical and operational definitions are provided for these variables in the measures section of this Chapter. A single moderating variable, the frequency of participating in structural firefighting was also examined. This variable may influence the strength of the relationship between informal workplace learning engagement and informal learning support. A definition is provided for the moderating variable within the measures section of this Chapter.

This study was conducted in a single metropolitan Midwest U.S. Fire Department. This organization was selected for a variety of reasons including agency and citizen demographics, community fire risk and previous research findings on firefighter casualty rates. The National Fire Protection Association (NFPA) reported that U.S. Midwest cities having a population of 250,000 or more experienced the greatest number of structure fires in 2013 which correlated with the greatest number of firefighter injuries per 100 firefighting events (Karter & Molis, 2013). The selected fire department provided fire, rescue, and emergency medical services to a diverse citizen population and demographics and maintained an insurance services office (ISO) rating of Class 2. Firefighters of this organization operate under a collective bargaining agreement negotiated by the International Association of Firefighters (IAFF).
Research Design

A correlational survey research design, employing standard multiple linear regression was used to examine the relationships between variables in this study. This design was appropriate for use when exploring informal learning support climate scores with the informal workplace learning engagement scores in this study (Creswell, 2012). Statistical procedures included descriptive statistics, multiple linear regressions, graphing and plotting, and measures of the magnitude of the relationships (Creswell, 2012).

Four predictor variables were initially used in conducting a power analysis. The statistical tool, G*Power, version 3, produced a minimum sample size of 74. The a-priori sample size calculation was based on a medium effect size ($f^2 = 0.15$), alpha set at 0.05, and statistical power level set at 0.95 with four predictor variables.

The actual sample size was 54 cases. A post-hoc analysis was conducted using the same tool. However, one predictor variable was excluded from the final model resulting in 3 predictors.

Sampling

The subjects of this study were career novice firefighters of a single Midwest metropolitan fire department. Inclusion criteria included firefighters who completed basic fire academy training, met organizational probationary requirements, had been assigned to a fire station for less than six years, and were functioning independently as a permanently assigned member of a firefighting company. Exclusion criteria included firefighters who had not completed probationary requirements, were on provisional or transitional work duty or were temporarily assigned to a non-firefighting support or
administrative role. This agency had 129 firefighters at the time of the study who meet all inclusion requirements. As a result, the census of 129 firefighters were sent the recruitment materials and survey instrument.

The recruitment of participants required approval and support of the fire department administration. A formal request that summarized the study and sought formal permission to conduct the research described the research requirements and data collection procedures were presented to the Fire Chief following OSU Institutional Review Board (IRB) approval. The Fire Chief provided a letter of support and authorization to conduct the research.

Recruitment of participants included appealing to their sense of duty to improve safety outcomes by supporting research and eligibility to participate in a drawing for one of several items. Participants who opened the recruitment materials and provided contact information were entered into a drawing to receive one of five incentive items. These incentives ranged in value from $50.00 to $120.00. An electronic link to enter into the drawing was made available to participants regardless of their choice to participate. Participants were asked to provide their first and last name and a telephone contact number for use only if their name was randomly selected. The random drawing occurred following the closing of the survey and notification of recipients was completed by telephone. The awarded items included two $50.00 gift cards for Amazon, two 5.11 TMT A1 tactical flashlights that retail for $50 each, and one 5.11 LBD model duffel bag that had a retail value of $120.
Protection of Human Subjects

A recruitment email message was sent to all potential participants. The recruitment message included a statement of receipt of IRB approval, official permission to participate from the Fire Chief, a description of the study including its relevance and importance, and an explanation of provisions to ensure confidentiality and the protection of the identity of subjects. Consent and privacy language was included when the survey instrument was presented to the participants. Survey results were de-identified immediately upon downloading the data from Qualtrics.

Instrumentation and Measures

The instrument designed for the study, the Firefighter Informal Learning Support Questionnaire (FILSQ) contained thirty-four items to compute measures of six variables; the dependent variable, four independent variables, and one moderator. The four independent variables in this study were *supervisory support*, *psychological safety*, *knowledge-sharing*, and *relationship-building*. The dependent variable for this study was novice career firefighter *informal workplace learning engagement* and the moderating variable in this study was *participating in structural firefighting incidents*.

A questionnaire was developed by adapting five existing scales from previous empirical research. Each scale was comprised of three to eight indicators which were retained from their original measures. The content validity of the instrument was assessed using a panel of firefighter experts from the Columbus, Ohio region. The panel of experts suggested revisions that included terminology used by firefighters for dependent variable items suggested language revisions to several independent variable
items and suggested that personal data not be collected as part of the survey. No substantive revisions were made that would alter the reliability of the items. The reliability of the scores for the existing scales ranged from a Cronbach alpha ($\alpha$) .63, for the dependent variable informal learning engagement (see Table 3.1), and $\alpha$ from .73 to .90 for the independent variables (see Table 3.1).

**Informal Workplace Learning Engagement**

Learning engagement was defined in the literature as an individual’s personal investment of cognitive, effective, and psycho-motor resources to a particular learning task (Rich, et al., 2010, Shuck, et al., 2012). Informal workplace learning engagement was generally measured in the literature using a Likert-type scale. Participants were asked to recall and then estimate the frequency they participated in each given learning activity (Lohman, 2006; Noe, et al., 2012). In the present study, *informal workplace learning engagement* was operationally defined as the retrospective, self-reported frequency (count) of participation in one or more informal learning activities during the previous 10 work shifts. Firefighters in this agency work 24-hour shifts followed by 48 hours off duty, therefore, 10 work shifts equate to approximately one month. Informal workplace learning engagement in this study was measured using an 8-item engagement scale adapted from Lohman’s (2005) 8-item informal workplace learning engagement measure.

The proposed instrument (see Appendix A) required respondents to select a response from a 7-point Likert-type scale that best represents the number of times they recall participating in a given informal learning activity during the previous month. The
7-point scale was anchored from “never” to “constantly.” The mean of all eight items was calculated to determine the overall engagement score for each subject. Finally, it should be noted that the dependent variable was framed in the context of firefighting practices which was intended to narrow their focus and improve their recollection. A sample question is provided in Table 3.1.

Supervisory Support

Manager and supervisor commitment to organizational learning was empirically linked to informal workplace learning engagement in multiple studies (Ellinger, 2005, Lohman, 2005). Managers and supervisors can incite or inhibit a learning culture that values employee knowledge exchanges or can create barriers that prevent employees from collaborating (Lohman, 2005). An eight-item supervisory support scale was adapted from the Learning from Police Work Questionnaire (LPWQ) measure of managerial support (Doornbos, et al., 2008). A sample item includes “My officer encourages me to learn” is provided in Table 3.1 (Doornbos, et al., 2008). The instrument used in this study asked (see Appendix A) respondents to select their response from a 7-point Likert-type scale anchored by 1 = “strongly disagree” to 7 = “strongly agree.”
<table>
<thead>
<tr>
<th>Scale</th>
<th>Theory</th>
<th>Items</th>
<th>Sample item</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informal workplace learning</td>
<td>IWLE</td>
<td>8</td>
<td>How frequently do you use the following activities when you need to learn something new at work? (c) Collaborate with others</td>
<td>0.63</td>
</tr>
<tr>
<td>Supervisory Support</td>
<td>SPVS</td>
<td>8</td>
<td>My manager encourages me to learn</td>
<td>0.90</td>
</tr>
<tr>
<td>Psychological Safety</td>
<td>PSYS</td>
<td>7</td>
<td>Members of this department are able to bring up problems and tough issues</td>
<td>0.82</td>
</tr>
<tr>
<td>Knowledge Sharing</td>
<td>KNWS</td>
<td>5</td>
<td>People with expert knowledge are willing to help others in this department.</td>
<td>0.85</td>
</tr>
<tr>
<td>Relationship-Building</td>
<td>RLSB</td>
<td>3</td>
<td>I feel connected to my co-workers</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Psychological Safety

Learning requires social interactions built on personal trust (De Feijter, et al., 2013; Le Clus, 2011). Learning engagement requires trust and a sense of psychological safety among co-workers where ideas and knowledge may be freely exchanged without
fear of negative consequences (Eraut, 2004; Jeon & Kim, 2012; Shuck, 2011).

Environments that lack a climate of psychological safety and trust inhibit curiosity and organic learning (Jeon & Kim, 2012). A seven-item psychological safety scale was adapted from the 7-item measure of Edmondson (1999). A sample question includes “Firefighters on this department are able to bring up problems and tough issues” (Edmondson, 1999). The revised scale used in this study replaced the term “team” with the descriptive “department” similar to research by Carmeli and Gittell (2009) who used the term organization as a proxy. The responses to the psychological safety scale (see Appendix A) asked respondents to select a response from a 7-point Likert-type scale, 1 = “strongly disagree” to 7 = “strongly agree” that best represented their perspective on the item. Three items were reverse-coded.

Knowledge-Sharing

Knowledge sharing, the intentional act of exchanging personal knowledge with another, is foundational to informal learning interactions in studies of nurses, teachers, and technology professionals (Cunningham and Hillier, 2013; Lohman, 2005; Lohman, 2009). The importance of knowledge sharing also appeared in the Norwegian and Canadian firefighter studies. Knowledge sharing is typically bi-directional and is given freely from one individual to another (Connelly, Zweig, Webster, & Trougakos, 2012). Recently, knowledge concealing efforts in the workplace have been examined to understand the behaviors associated with withholding tacit knowledge (Connelly, et al., 2012). A five-item scale adapted from the work of Connelly & Kelloway (2003) was used to assess perceptions of organizational knowledge-sharing. Sample item included,
“people in this organization are willing to share knowledge/ideas with others” (Connelly & Kelloway, 2003). The responses to the knowledge-sharing scale (see Appendix A) asked respondents to select a response from a 7-point Likert-type scale, 1 = “strongly disagree” to 7 = “strongly agree” that best represented their perspective on the item. One item was reverse-coded.

Relationship-Building

A three-item relationship building scale was adapted from the Learning from Police Work Questionnaire (LPWQ) measure of orientation to relationship-building (Doornbos, et al., 2008). A sample item included “I feel connected to my co-workers” (Doornbos, et al., 2008). Items used for the relationship-building scale (see Appendix A) asked respondents to select a response from a 7-point Likert-type scale indicating, 1 = “strongly disagree” to 7 = “strongly agree” that best represented their perspective on the item.

Frequency of Structural Firefighting

The frequency of participating in structural firefighting was a moderating variable used in this study. Often, tacit knowledge is situated in the actual work (Eraut, 2004). The ability or inability to respond and participate in more or less firefighting activity was expected to influence informal workplace learning engagement (Eraut, 2004). This variable was defined as the number of times that a novice firefighter participated in structural firefighting activities during the 10 previous work shifts. The single item required respondents to select from a scale ranging from 1 = 0 structure fires and 7 = 16-18 structure fires.
Electronic Survey Tool

An electronic survey tool, Qualtrics, available through The Ohio State University, was used to collect the data. Consent and privacy notices accompanied both the recruitment email and the electronic survey requiring participants to consent to the terms before activating the instrument. The final data were stored on a portable drive that was secured in a locked cabinet.

Data Collection Procedures

Procedures and a schedule for administrating the survey, sending out reminders to all possible participants as a group, checking responses, and other communications and process steps were developed. The survey was open until midnight on the thirtieth day following its launch. However, the deadline was extended due to two configuration errors resulting in the survey not being available for the planned duration. Novice firefighters were provided with approximately 10 work shifts to complete the questionnaire. Reminders were sent out to participants who had not completed the questionnaire at the sixth day, at the twelfth day and at the fourteenth day. A final reminder was sent out at noon on the final day of the survey.

Data Analysis

This section outlines data cleaning and preparation, test for assumptions, and finally how the proposed research questions were statistically modeled and analyzed. The overarching research question in this study sought to examine the extent to which the variability on informal workplace learning engagement (y) is explained by the constructs
of organizational informal learning support. Informal learning support is comprised of supervisory support \((x_1)\), psychological safety \((x_2)\), knowledge-sharing \((x_3)\), and relationship-building \((x_4)\) (see Table 3.1). A proposed moderating variable, frequency of participating in a structure fire \((z)\), was also statistically modeled and analyzed. Statistical procedures included generating and examining descriptive statistics, conducting multiple linear regressions, generating and examining scatterplots and assessing the statistical effects and magnitude of the relationships of informal learning support on informal workplace learning engagement. Additionally, the frequency of participating in a structure fire was inserted into the regression model to determine if it moderated the relationship between informal learning support and informal workplace learning engagement. Data were analyzed using SPSS version 24.

Data Cleaning and Missing Data

Data obtained from Qualtrics were exported in an SPSS format and imported into SPSS. The master data were saved in a locked file to preserve the original values, and a working version of the data were created. The working version of the data were examined for missing data and checked against the original survey questionnaire to identify errors. No missing data were discovered; however, a coding error was found and corrected. A single item from the independent variable supervisory support, “my officer cares about continuing development” was miscoded and was scored on a scale from 4 = strongly disagree to 10 = strongly agree. The correct scale is 1 = strongly agree anchored with 7 = strongly disagree. The values were recoded so that strongly disagree 4 = 1 and strongly agree 10 = 7. Questionnaires included responses to all eight items of the dependent
variable, informal workplace learning engagement, so none were excluded. There were no items left blank among the items measuring the independent variables. There were two cases excluded from the study because no responses were given to any questions. It was assumed that these respondents chose not to participate after opening the questionnaire. Two additional recipients also chose not to participate and selected the “opt out” button provided on the recruitment email.

Checking Assumptions

Standard multiple linear regression requires statistical testing to satisfy assumptions of normality, linearity, homoscedasticity, multicollinearity, multivariate outliers and normality of residuals (See Table 3.2). An examination of the descriptive statistics was performed that included the means, standard deviations, minimums, maximums, kurtosis, and skewness for each measure. Descriptive data were provided in Chapter 4 for sample size, number of years of employment in this organization and apparatus assignment. The number of years of employment and apparatus assignment are intended to describe characteristics of the population and were included as variables within the regression analysis. The frequency, central tendencies and range of the eight individual engagement activities that made up informal workplace learning engagement were also reported in Chapter 4. Scatterplots of the dependent and independent variables were examined to check the assumption of linearity. The magnitude of the correlations between informal workplace learning engagement (IWLE) and each independent variable were assessed to evaluate the fitness of the model.
A preliminary regression assessed for homoscedasticity, normally distributed residuals (error), the absence of outliers and the presence of multicollinearity. Homoscedasticity was checked by plotting the informal learning support residuals against unstandardized predicted values. Multicollinearity was assessed using the correlation coefficients of the individual and combination of predictor variables. An examination of scatterplots and descriptive statistics was conducted to assess for outliers. Multiple linear regression is an iterative process where inputs including theoretical constructs and data produce statistical and graphical outputs that require critical analysis, validation and possibly revision of inputs (Chatterjee & Hadi, 2012). This iterative approach was used for this study which included correcting for assumptions if any were violated. Independent variables that did not contribute significantly to explaining the total variance (total $R^2$) were eliminated from the final model.

Multiple Regression Analysis

A standard multiple regression analysis was conducted to examine the extent to which supervisory support, psychological safety, knowledge sharing, and relationship building predict novice firefighter workplace learning engagement. This relationship is described in the multiple regression model, $Y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \ldots + \beta_kx_k + \epsilon$, where $Y$ represents the dependent variable and $x_1, \ldots, x_k$ represents the independent, or predictor variables. The parameters $\beta_0 + \beta_1x_1 + \ldots + \beta_kx_k$, where $\beta_0$ is the intercept and $\beta_1x_1 + \ldots + \beta_kx_k$ are regression coefficients, are unknown and will be estimated from the data. The model assumes that the random error, $\epsilon$, is normally and independently distributed. The multiple correlation coefficient, $r$-squared, was examined to determine the percentage of
variance accounted for by supervisory support ($x_1$), psychological safety ($x_2$), knowledge-sharing ($x_3$) and relationship-building ($x_4$). The least squares method (SPSS) was used to calculate the estimates of $b_0$, $b_1$, $b_k$ for the unknown parameters $\beta_0$, $\beta_1$, ..., $\beta_k$. Coefficients were generated for all $i$ resulting in a prediction equation $Y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + ... + \beta_4 x_{i4} + \epsilon_i$. Data analyses for each research question are outlined in Table 3.2 which includes the research question, data source, type of data, and proposed statistical tests and equation.

This study contained one continuous moderating variable – frequency of participating in structural firefighting. A hierarchical multiple regression analysis was conducted to assess the significance of the interaction effect that participating in structural firefighting ($z$) had on the relationship among the final variables comprising informal learning support ($x$) and informal workplace learning engagement ($y$). The moderated regression model demonstrated the effect that $x$ had on $y$ given a value of $z$. This model is represented by $Y = \beta_0 + \beta_1 x + \beta_2 z + \beta_3 x z$. 
Table 3.2: Data Analysis

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Data/Source</th>
<th>Type of Data</th>
<th>Statistical Tests and MLR Equation</th>
</tr>
</thead>
</table>
| What is the frequency that novice firefighters engage in informal workplace learning (IWLE) and what is the distribution of the prescribed informal learning approaches? | Firefighter Informal Learning Support Questionnaire (FILSQ) items 4-11 | Continuous – Interval | Univariate descriptive statistics and frequency tables of eight items and the sum of the eight items.  
IWLE = $\beta_0 + \beta_{SPVSi} + \beta_{PSYSi} + \beta_{KNWSi} \ldots + \beta_{RLSBi} + \epsilon_i$. |
| Does (SPPVS) supervisor support ($x_1$) predict the frequency of novice firefighter informal workplace learning engagement (IWLE)? | FILSQ items 12, 14, 17, 19, 22, 24, 27, 30 | Categorical - Ordinal | Tests of assumptions, univariate descriptive statistics, histograms, correlations, scatterplots, coefficients table and residuals statistics table.  
Conduct MLR of fitted model – correlations matrix, scatterplots, effect size $R^2$, and coefficients.  
IWLE = $\beta_0 + \beta_{SPVSi} + \beta_{PSYSi} + \beta_{KNWSi} \ldots + \beta_{RLSBi} + \epsilon_i$. |
| Does (PSYS) psychological safety ($x_2$) predict the frequency of IWLE controlling for KNWS, SPPVS, and RLSB? | FILSQ items 16, 18, 23, 28, 29, 32, 33 | Categorical - Ordinal | Tests of assumptions, univariate descriptive statistics, histograms, correlations, scatterplots, coefficients table and residuals statistics table.  
Conduct MLR of fitted model – correlations matrix, scatterplots, effect size $R^2$, and coefficients.  
IWLE = $\beta_0 + \beta_{SPVSi} + \beta_{PSYSi} + \beta_{KNWSi} \ldots + \beta_{RLSBi} + \epsilon_i$. |
| Does (KNWS) knowledge-sharing ($x_3$) predict the frequency of IWLE controlling for SPPVS, PSYS, and RLSB? | FILSQ items 13, 15, 20, 25, 26 | Categorical - Ordinal | Tests of assumptions, univariate descriptive statistics, histograms, correlations, scatterplots, coefficients table and residuals statistics table.  
Conduct MLR of fitted model – correlations matrix, scatterplots, effect size $R^2$, and coefficients.  
IWLE = $\beta_0 + \beta_{SPVSi} + \beta_{PSYSi} + \beta_{KNWSi} \ldots + \beta_{RLSBi} + \epsilon_i$. |

Continued
Table 3.2 Data Analysis Continued

<table>
<thead>
<tr>
<th>Does (RLSB) relationship-building ($x_d$) predict the frequency of IWLE controlling for KNWS, SPPVS, and PSYS?</th>
<th>FILSQ items 21,31,34</th>
<th>Categorical - Ordinal</th>
<th>Tests of assumptions, univariate descriptive statistics, histograms, correlations, scatterplots, coefficients table and residuals statistics table. Conduct MLR of fitted model – correlations matrix, scatterplots, effect size $R^2$, and coefficients. $IWLE = \beta_0 + \beta_{SPVI} + \beta_{PSYS} + \beta_{KNWS} + \ldots + \beta_{RLSB} + \epsilon_i.$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does (FSFR) participating in structural firefighting ($z$) moderate the variables SPS, PSYS, KNWS, and RLSB to predict the frequency of IWLE?</td>
<td>FILSQ item 3</td>
<td>Continuous – interval</td>
<td>Conduct moderated MLR – correlations matrix, scatterplots, effect size $R^2$, and coefficients. $IWLE = \beta_0 + \beta_{SPVI} + \beta_{FSFR} + \beta_{SPVI * FSFR}.$</td>
</tr>
</tbody>
</table>
Chapter 4: Analysis of the Data

Introduction

This Chapter reports the results of the data analysis. This study examined the broad research question “to what extent is the variability in the frequency of novice firefighter informal workplace learning engagement explained by selected workplace informal learning support variables?” The first section presents novice firefighter demographics. The second section presents the descriptive statistics for each variable. The third section presents the results of the inferential statistics used to address each research question.

Demographics

This study is directed at career metropolitan U.S. fire departments. A single metropolitan Ohio, fire department, provided access to 129 novice firefighters who met inclusion requirements. Of those recruited, 54 (41.8%) participated in the survey. Novice firefighters were defined as those having between one and six years of firefighting experience with the agency. Demographics in this study were intentionally limited to two occupational characteristics; number of years since appointment and firefighting apparatus assignment. An expert panel perceived that collecting personal characteristic information was unnecessary given the focus of the study. The panel further perceived personal characteristics as a potential barrier to recruitment and recommended exclusion.
The novice firefighter population of this study had at least two but less than five years of experience. Firefighters were appointed between May of 2011 and May of 2014 \((M = 2.67, \text{SD} = .752)\). The majority of respondents, 27 (50\%) reported having more than two years but less than three years of service. Another 18 (33.3\%) reported having more than three years but less than four years of service. Also, 9 (16.7\%) firefighters reported having more than four years but less than five years of service. Novice firefighters with less than two years or more than five years since appointment did not participate.

Firefighters also reported their primary firefighting apparatus assignment during the ten previous 24-hour work shifts. The majority of firefighters, 41 (75.9\%), reported being assigned to an engine company. Another 12 (22.2\%) reported being assigned to a ladder company and only 1 (1.9\%) reported being assigned to a paramedic ambulance. No firefighters reported assignment to a heavy rescue or as a chief’s aide. Data analysis occurred using 54 cases that included complete data. Table 4.1 shows participation based on the number of years since appointment and firefighting company assignment.

<table>
<thead>
<tr>
<th>Years</th>
<th>Percentage</th>
<th>Engine</th>
<th>Ladder</th>
<th>Ambulance</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Years</td>
<td>50</td>
<td>21</td>
<td>6</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>3 Years</td>
<td>33.3</td>
<td>14</td>
<td>3</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>4 Years</td>
<td>16.6</td>
<td>6</td>
<td>3</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Total (n)</td>
<td></td>
<td>41</td>
<td>12</td>
<td>1</td>
<td>54</td>
</tr>
</tbody>
</table>

Table 4.1 Respondent Demographics

Percentage by Assignment | 75.9\% | 22.2\% | 1.9\% | 100\%
Descriptive Statistics

There was very little research available that characterizes the nature of informal learning engagement and learning support in the U.S. fire services. In fact, this researcher could not locate a single published study that examined those contexts and variables. Descriptive statistics were generated and examined for each of the constructs of the independent variable, supervisory support, psychological safety, knowledge sharing and relationship building as well as the dependent variable, novice firefighter informal learning engagement.

Supervisory Support

Supervisory support was measured using eight items examining the presence of supervisory support by novice firefighters. Table 4.2 shows that fire officer encouragement to learn was the most important dimension of the supervisory support variable. Almost 93% of surveyed firefighters (n = 50) “agreed” or strongly agreed” that their “officer encourages them to learn.” This finding was expected and is likely a reflection of the responsibility that officers have for the development of new firefighters. There was no discernible difference between the three cohorts of firefighters on the dimension of encouragement. The item that was least observed was “my officer discusses career steps with me” with nearly 35% (n = 19) reported that they their officer did not discuss career steps. This finding was likely attributed to the behavior of an officer to focus on the present learning and development needs of novice firefighters.
Table 4.2 Supervisory Support

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>S.D</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>My officer cares about development</td>
<td>6.24</td>
<td>6.00</td>
<td>.87</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>My officer notices and values my contributions</td>
<td>6.07</td>
<td>6.00</td>
<td>.95</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>My officer encourages me to learn</td>
<td>6.46</td>
<td>7.00</td>
<td>.75</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>My officer discusses career steps with me</td>
<td>5.48</td>
<td>6.00</td>
<td>1.55</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>My officer gives me feedback on my performance</td>
<td>5.98</td>
<td>6.00</td>
<td>.94</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>My officer gives me insight into the judgment of my work</td>
<td>5.63</td>
<td>6.00</td>
<td>1.07</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>My officer encourages me to take initiative</td>
<td>6.06</td>
<td>6.00</td>
<td>1.09</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>My officer invites me to share ideas</td>
<td>5.63</td>
<td>6.00</td>
<td>1.14</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

Response Scale: 1 = strongly disagree and 7 = strongly agree
Psychological Safety

Descriptive statistics for the seven-item scale to measure the presence of psychological safety are presented in Table 4.3. Three items, “it’s difficult to ask other firefighters in this department for help,” “if a firefighter makes a mistake in this department it is often held against you,” and “firefighters in this department sometimes reject others for being different” were reverse-coded (REV). The syntax was revised to reverse the scores on these items. Scores suggested that novice firefighters perceived a supportive work environment that was open for asking questions and for not being concerned that others would intentionally undermine their learning efforts. Mistakes made by novice firefighters expressed by the item “if a firefighter makes a mistake in this department, it is often not held against you” was scored between “somewhat disagree,” and the neutral “neither agree nor disagree” (M = 3.41, SD = 1.46). This may indicate a particular pressure experienced by novice firefighters and may contribute to incentivizing learning. Upon examination of the scores by cohort, there was no discernable difference among mean scores by novice firefighters.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>S.D</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Members of this department are able to bring up problems and tough issues</td>
<td>5.28</td>
<td>6.00</td>
<td>1.25</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>It is easy to ask other firefighters of this department for help (REV)</td>
<td>5.43</td>
<td>5.00</td>
<td>1.27</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>No one on this department would deliberately act in a way that undermines my efforts</td>
<td>4.69</td>
<td>5.00</td>
<td>1.27</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>If a firefighter makes a mistake in this department, it is often not held against you (REV)</td>
<td>3.41</td>
<td>3.00</td>
<td>1.46</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Firefighters on this department rarely reject others for being different (REV)</td>
<td>3.94</td>
<td>4.00</td>
<td>1.72</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

Continued
Table 4.3 Psychological Safety Continued

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mean</th>
<th>SD</th>
<th>n</th>
<th>Lower CI</th>
<th>Upper CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is safe to take a learning risk in this department</td>
<td>4.89</td>
<td>1.49</td>
<td>2</td>
<td>4.49</td>
<td>5.29</td>
</tr>
<tr>
<td>Working with members of this department - my skills and talents are valued and utilized.</td>
<td>5.44</td>
<td>.86</td>
<td>3</td>
<td>5.03</td>
<td>5.85</td>
</tr>
</tbody>
</table>

Response Scale: 1 = strongly disagree and 7 = strongly agree

Knowledge Sharing

Descriptive statistics for the five-item scale measuring the presence of knowledge sharing by novice firefighters is presented in Table 4.4. A single item, “firefighters in this department keep their best ideas to themselves” (REV) was reverse-coded and subsequently revised. Scores suggest that knowledge sharing was present in the fire department and experienced by novice firefighters. The willingness to share knowledge with others had the highest mean score (M = 6.15, SD = .833). All three cohorts “agreed” that willingness was present. Two items scored between “neither agree nor disagree” and “somewhat agree.” “The department is good at using the knowledge of firefighters” (M = 4.91, SD = 1.36) and “firefighters do not keep their best ideas to themselves” (M = 4.98, SD = 1.27) had the lowest mean scores of all five items. This
may indicate that new firefighters may not be trusted with, or expected to contribute to organizational knowledge and idea exchanges.

Table 4.4 Knowledge Sharing (n=54)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>S.D</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firefighters in this department are willing to share knowledge and ideas with others</td>
<td>6.15</td>
<td>6.00</td>
<td>.83</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Firefighters with expert knowledge are willing to help others within this department</td>
<td>6.11</td>
<td>6.00</td>
<td>.93</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Firefighters in this department share their ideas openly</td>
<td>5.61</td>
<td>6.00</td>
<td>1.09</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>This department is good at using the knowledge and ideas of firefighters</td>
<td>4.91</td>
<td>6.00</td>
<td>1.36</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Firefighters in this department do not keep their best ideas to themselves (REV)</td>
<td>4.98</td>
<td>6.00</td>
<td>1.27</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

Response Scale: 1= strongly disagree and 7 = strongly agree

Relationship Building

Relationship building was measured using three items examining how firefighters perceive their connectedness with fellow firefighters. Table 4.5 scores indicates that
novice firefighters generally agreed that relationship building was perceived within the environment. Nearly 82% of firefighters (n = 44) “agreed” or “strongly agreed” that they were proud of the firefighters they worked with and 85% “agreed” or “strongly agreed” that they had faith in their fellow firefighters. While the overall mean score on connectedness indicated agreement (M = 5.72, SD = 1.235), nearly one-third (31.5%) indicated a range between “only somewhat agreed” and “disagreed.” The newest cohort, those having only two years on the job, expressed the lowest mean score on connectedness (M = 5.44, SD = 1.340).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>S.D</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am proud of the people that I work with</td>
<td>6.13</td>
<td>6.00</td>
<td>1.05</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>I have faith in the people that I work with</td>
<td>6.11</td>
<td>6.00</td>
<td>1.06</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>I feel connected to my coworkers</td>
<td>5.72</td>
<td>6.00</td>
<td>1.24</td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

Response Scale: 1 = strongly disagree and 7 = strongly agree

Participating in Structural Firefighting

Performing work activities has been shown to motivate informal learning (Eraut, 2004; Skule, 2004). The risks associated with operating at a structure fire and the tacit knowledge required to operate safely underpins a broader research agenda. This study
examined the fundamental means and processes in which firefighters navigate the workplace environment while acquiring knowledge and skills. Firefighters indicated that on average novices participated in two structure fires during the previous ten work shifts which constitutes approximately one month. The overall mean for the variable, participating in structural firefighting (M = 1.72, SD = .627) indicated that novice firefighters participated in 0-3 structure fires during the 10-day work period. The data revealed that 37% (n = 20) experience no firefighting activity, 53.7% (n = 29) responded to between 1-3 structure fires and 9.3% (n = 5) reported participating in 4-6 structure fires.

The relative distribution of structure fire interaction among novices based on apparatus assignment were similar. Nearly 36% (n = 15) of engine company firefighters and 41.6% (n = 5) of ladder company firefighters had not gone to a structure fire. Among the 42 engine company firefighters, 57.1% had responded to between 1 – 3 structure fires while 41.7% of ladder company novices had also responded to the same number. Only 7.14% (n = 3) of engine company and 16.6% (n = 2) of ladder company firefighters responded to between 4-6 structure fires.

Results for Research Questions

Research Question 1

To what degree are organizational informal learning support factors of supervisory support, psychological safety knowledge sharing and relationship building present in the work climate of novice firefighters?

An examination of the mean scores of the independent variables, supervisory support, psychological safety, knowledge sharing, and relationship building was
conducted. The score reflects the perceived presence of these variables within the fire department culture. The average firefighter scores for each of these variables were grouped and presented by cohorts of two years, three years, and four years in Table 4.6. Tables 4.8 presents the same data grouped by apparatus assignment. The dependent variable was scored using a 7-point Likert that ranged from 1 = none of the time to 7 = constantly. The independent variables measured the perception of the presence of each variable in a scale that ranged from 1 = strongly disagree to 7 = strongly agree. An additional variable of interest, participation in structural firefighting was measured on a scale of 1 = no fires to 7 = 16-18 fires. Note that response to participating in structural firefighting was limited to a high score of 3 which indicates participation in 4-6 structure fires. This variable was recoded in Research Question 4.

The independent variables measured the relative presence of a climate of supervisory support, psychological safety, knowledge sharing and relationship building. The average score among novice firefighters on the presence of a relationship building climate (M = 5.98, SD = .880) and the presence of supervisory support climate (M = 5.94, SD = .852) were scored highest among the independent variables. According to Table 4.7, novice firefighters generally agreed that a climate of supervisory support, psychological safety, knowledge sharing, and relationship building were present within the fire department. The lowest score was attributed to knowledge sharing where firefighters “somewhat agreed” to its presence in the department.
Table 4.6 Mean Scores on Support Climate by Years of Service

<table>
<thead>
<tr>
<th>Variable</th>
<th>Two Years</th>
<th></th>
<th></th>
<th>Three Years</th>
<th></th>
<th></th>
<th>Four Years</th>
<th></th>
<th></th>
<th>Total</th>
<th></th>
<th></th>
<th></th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean</td>
<td>SD</td>
<td>n</td>
<td>Mean</td>
<td>SD</td>
<td>n</td>
<td>Mean</td>
<td>SD</td>
<td></td>
<td>n</td>
<td>Mean</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervisory support&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27</td>
<td>5.96</td>
<td>.754</td>
<td>18</td>
<td>6.21</td>
<td>.537</td>
<td>9</td>
<td>5.38</td>
<td>1.35</td>
<td>54</td>
<td>5.94</td>
<td>.852</td>
<td>.3.1</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>Psychological safety&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27</td>
<td>4.93</td>
<td>.679</td>
<td>18</td>
<td>4.88</td>
<td>.979</td>
<td>9</td>
<td>4.68</td>
<td>1.15</td>
<td>54</td>
<td>4.87</td>
<td>.861</td>
<td>.2.7</td>
<td>6.6</td>
<td></td>
</tr>
<tr>
<td>Knowledge-sharing&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27</td>
<td>5.45</td>
<td>.836</td>
<td>18</td>
<td>5.30</td>
<td>.798</td>
<td>9</td>
<td>5.11</td>
<td>1.10</td>
<td>54</td>
<td>5.34</td>
<td>.863</td>
<td>.3.2</td>
<td>6.8</td>
<td></td>
</tr>
<tr>
<td>Relationship-building&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27</td>
<td>5.96</td>
<td>.859</td>
<td>18</td>
<td>6.24</td>
<td>.906</td>
<td>9</td>
<td>5.55</td>
<td>.800</td>
<td>54</td>
<td>5.98</td>
<td>.880</td>
<td>.3.7</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>Number of Structure&lt;sup&gt;b&lt;/sup&gt; Fires</td>
<td>27</td>
<td>1.74</td>
<td>.594</td>
<td>18</td>
<td>1.56</td>
<td>.705</td>
<td>9</td>
<td>2.00</td>
<td>.500</td>
<td>54</td>
<td>1.72</td>
<td>.627</td>
<td>.0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Learning Engagement&lt;sup&gt;c&lt;/sup&gt;</td>
<td>27</td>
<td>4.31</td>
<td>1.04</td>
<td>18</td>
<td>4.63</td>
<td>.939</td>
<td>9</td>
<td>4.25</td>
<td>.870</td>
<td>54</td>
<td>4.40</td>
<td>.978</td>
<td>.1.6</td>
<td>6.2</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Response Scale: 1 = Strongly Disagree (climate not present) to 7 = Strongly Agree (climate present)

<sup>b</sup>Response Scale: 1 = No structure fires, 2 = Attended 1-3 structure fires, 3 = Attended 4-6 structure fires

<sup>c</sup>Response Scale: 1 = Frequency none of the time to 7 = Frequency constantly
Table 4.7 Mean Scores on Support Climate by Apparatus Assignment

<table>
<thead>
<tr>
<th>Variable</th>
<th>Engine Company</th>
<th>Ladder Company</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Supervisory support(^a)</td>
<td>42</td>
<td>6.05</td>
<td>.665</td>
</tr>
<tr>
<td>Psychological safety(^a)</td>
<td>42</td>
<td>4.82</td>
<td>.902</td>
</tr>
<tr>
<td>Knowledge-sharing(^a)</td>
<td>42</td>
<td>5.35</td>
<td>.938</td>
</tr>
<tr>
<td>Relationship-building(^a)</td>
<td>42</td>
<td>6.03</td>
<td>.889</td>
</tr>
<tr>
<td>Number of Structure Fires</td>
<td>42</td>
<td>1.71</td>
<td>.596</td>
</tr>
<tr>
<td>Learning Engagement(^c)</td>
<td>42</td>
<td>4.51</td>
<td>.949</td>
</tr>
</tbody>
</table>

\(^a\)Response Scale: 1 = Strongly Disagree (climate not present) to 7 = Strongly Agree (climate present)

\(^b\)Response Scale: 1 = No structure fires, 2 = Attended 1-3 structure fires, 3 = Attended 4-6 structure fires

\(^c\)Response Scale: 1 = Frequency none of the time to 7 = Frequency constantly
Research Question 2

To what degree do novice career firefighters engage in each of the eight informal learning engagement activities?

The overall mean score for novice firefighters on engagement in all eight items was 4.4 (SD = .978). The range of combined overall scores varied between 1.63 “very rarely” to 6.25 “very often”. Further analysis of the engagement items provided insight into the types of activities that these novice firefighters activate to solve personal learning needs including their preferences among a list of choices.

Of the eight informal learning engagement items offered to novice firefighters, “reflection on their own actions and the actions of others” (M = 5.19, SD = 1.083) was ranked the highest indicating that this activity was initiated the most often. This was followed by “listening to the radio” often (M = 5.00, SD = 1.427) and sometimes practicing skills and sharing knowledge (M = 4.46, SD = 1.224). Table 4.8 demonstrates that novice firefighters rarely participated in “scanning magazines and books” (M = 3.61, SD = 1.595). The dimension “practice skills and share knowledge” had the most variance among the three cohorts. Firefighters with two years of experience reported practicing skills on their own (M = 4.44, SD = 1.311) while firefighters with three years of experience reported never practicing (M = 1.145, SD = 1.311) and members with four years tend to practice with regularity (M = 4.67, SD = 1.225). Searching the internet also varied among the cohorts. Firefighters with two years (M = 4.52, SD = 1.847) and three years (M = 4.56, SD = 1.338) reported to sometimes access the internet to learn something while firefighters with four years (M = 3.22, SD = 1.202) rarely looked to the internet for information.
Table 4.8 Informal Learning Engagement (n=54)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>S.D</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storytelling FF Operations</td>
<td>4.28</td>
<td>4.00</td>
<td>1.485</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Practice FF Skills on Own</td>
<td>4.46</td>
<td>4.00</td>
<td>1.224</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Listen to FF OPS on Radio</td>
<td>5.00</td>
<td>5.00</td>
<td>1.427</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Search the Net for FF Information</td>
<td>4.3</td>
<td>4.00</td>
<td>1.646</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Scan MAG or Books</td>
<td>3.61</td>
<td>4.00</td>
<td>1.595</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Experiment w/ New Techniques</td>
<td>4.17</td>
<td>4.00</td>
<td>1.299</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Reflect on Own Actions/Others</td>
<td>5.19</td>
<td>5.00</td>
<td>1.083</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Share FF Materials/Information</td>
<td>4.26</td>
<td>4.001</td>
<td>1.417</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

Response Scale: 1 = Never and 7 = Constantly

Research Question 3
What is the relationship between novice firefighter informal workplace learning engagement and informal learning support factors supervisory support, psychological safety knowledge sharing and relationship building?

Research Question 3 was intended to identify and exclude variables that were highly correlated before inserting them into a regression model. A Pearson Correlation Coefficient was computed to assess the relationship between the frequency of informal
learning engagement and the presence of informal learning support. The bi-variate correlation matrix in Table 4.9 describes the correlations between the dependent variable, novice firefighter informal learning engagement and the independent variables, supervisory support, psychological safety, knowledge sharing, and relationship building. A single moderator variable, frequency of structural firefighting, was included to assess its relationship with all five variables. The matrix shows the Pearson correlation coefficients ($r$) for each set of paired variables.

Based on Cohen’s (1992) guidelines there was a strong positive correlation between the independent variables knowledge sharing and psychological safety ($r = .74$, $p < .01$). A strong positive correlation was also observed between relationship building and supervisory support ($r = .56$, $p < .01$), psychological safety ($r = .60$, $p < .01$), and knowledge sharing ($r = .60$, $p < .01$). Weak positive or no correlations were found between the dependent variable and psychological safety ($r = .08$, $p < .01$), knowledge sharing ($r = .12$, $p < .01$), or relationship building ($r = .12$, $p < .01$). The coefficient for psychological safety raised concerns for multicollinearity. This concern would be addressed with a multiple regression while answering research question three. Finally, a moderate positive correlation existed between the dependent variable and supervisory support ($r = .38$, $p < .01$).
Table 4.9 Pearson Correlation Matrix (n=54)

<table>
<thead>
<tr>
<th></th>
<th>Frequency of Informal Learning Engagement</th>
<th>Supervisory Support</th>
<th>Psychological Safety</th>
<th>Knowledge Sharing</th>
<th>Relationship Building</th>
<th>Structural Firefighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of Informal Learning Engagement</td>
<td>1</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervisory Support</td>
<td>.380</td>
<td>1</td>
<td>.002*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological Safety</td>
<td>.079</td>
<td>.415</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge-Sharing</td>
<td>.115</td>
<td>.343</td>
<td>.736</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>54</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationship-Building</td>
<td>.116</td>
<td>.558</td>
<td>.596</td>
<td>.600</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>Structural Firefighting</td>
<td>.035</td>
<td>.182</td>
<td>.482</td>
<td>.445</td>
<td>.381</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
</tr>
</tbody>
</table>

*p≤.05; **p≤.01
Research Question 4

To what degree does supervisory support, psychological safety, knowledge sharing, and relationship building predict the frequency of novice firefighter informal workplace learning engagement?

A standard multiple linear regression was calculated to predict novice firefighter informal learning engagement based on the informal learning support variables supervisory support, psychological safety, knowledge sharing, and relationship building. As indicated in Table 4.10, the entry method was used to enter all variables into the regression simultaneously. The entry order was based on the expected contribution that each variable was theorized to contribute to the overall effect. Other entry methods such as stepwise were not considered as they address different research questions. Additional statistical tests were completed which satisfied all assumptions of multiple linear regression. The independent variable psychological safety was moderately to strongly correlated with the three remaining independent variables and was removed from the final model due to concerns with collinearity (VIF = 2.428). Table 4.10 identifies the variables that were entered into the regression model.

Table 4.10 Variables Entered/Removed

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables Entered</th>
<th>Variables Removed</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Supervisory Support</td>
<td>Psychological safety</td>
<td>Enter</td>
</tr>
<tr>
<td></td>
<td>Knowledge Sharing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relationship Building</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: Engagement
Due to the concern raised for multicollinearity, the four independent variables, and the dependent variable, engagement, were entered into the multiple regression. All variables, one dependent, and four descriptors, were tested to satisfy the assumptions that linear regression could be used to analyze the data. The first two assumptions require a continuous dependent variable and one or more independent variables that are either continuous or categorical data. Likert-type ordinal scales containing seven or more items may be treated as continuous data. Given this, the data were categorized as scale data in the statistical package SPSS. The results of the tests of assumptions are explained below.

The scatterplot of residuals produced a horizontal band which indicated the likely existence of a linear relationship. Partial regression plots showed a somewhat linear relationship between all independent variables and the dependent variable. The presence of homoscedasticity was determined by examining the plot of studentized residuals versus unstandardized predicted values. Multicollinearity was addressed by examining the collinearity statistics, Tolerance and VIF. The tolerance value was not less than 0.1 and the reciprocal VIF was not greater than 10. The independent variable psychological safety was moderately to strongly correlated with the three remaining independent variables and was removed from the final model due to concerns with collinearity (VIF = 2.428).

Statistics were generated to determine if a revised model satisfied the required assumptions. Residuals were reexamined and the test of independence was satisfied with a Durbin-Watson statistic of 1.792 (Table 5.1). Plots were re-examined and were found to satisfy the assumption of linearity. The plot of studentized residuals versus unstandardized predicted values satisfied the assumption of homoscedasticity. The
revised model containing three independent variables eliminated concern for multicollinearity since no correlation exceeded 0.7. The test for outliers, *high leverage points* and *highly influential points* produced no findings and satisfied the assumption. SPSS did not generate a *Casewise Diagnostics* table since the standardized residual was greater than plus or minus three standard deviations. Normality was determined and satisfied by examining the P-P Plot.

**Regression Model Results**

The final model included three independent variables. Supervisory support, knowledge sharing and relationship building statistically and significantly predicted (Table 4.12) novice firefighter informal learning engagement, \(F(3,50) = 3.175, p<.032\). Regression coefficients and standard errors can be found in Table 4.11 below.

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.400a</td>
<td>.160</td>
<td>.110</td>
<td>.92261</td>
</tr>
</tbody>
</table>

a. Predictors (Constant), Supervisory Support, Knowledge Sharing, Relationship Building
A multiple linear regression was calculated to predict the frequency of learning engagement based on perceptions of supervisory support and a climate of knowledge sharing and relationship building. Novice firefighter predicted engagement is equal to

\[ \text{Novice firefighter predicted engagement} = 2.082 + 0.524 \times (\text{Supervisory Support}) + 0.074 \times (\text{Knowledge Sharing}) - 0.197 \times (\text{Relationship Building}) \]

for each unit of increase. All three independent variables measured the perceived climate of support from a range of 1 = Strongly Disagree to 7 = Strongly Agree.

The informal learning engagement score which measured the relative frequency of engagement increases 0.524 for each one unit increase in supervisory support score, 0.074 for each one unit increase in knowledge sharing score, and decreases -0.197 for each one unit of increase in relationship building score (holding others constant). For example, an individual who scored supervisory support a 5, knowledge sharing a 3, and relationship building a 6 would be expected to have an engagement score of 3.742 (=2.082 + (0.524)5 + (0.074)3 + (-0.197)6). Although a significant regression equation was found (F (3,50) = 3.175, p<0.032), with an R² of .160, only supervisory support was a significant predictor of novice firefighter informal learning engagement (p = <.001).
Table 4.13 Summary of Regression Analysis for Predicting Engagement

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.082</td>
<td>1.050</td>
<td></td>
</tr>
<tr>
<td>Supervisory Support</td>
<td>.524*</td>
<td>.179</td>
<td>.456</td>
</tr>
<tr>
<td>Knowledge Sharing</td>
<td>.074</td>
<td>1.84</td>
<td>.065</td>
</tr>
<tr>
<td>Relationship Building</td>
<td>-.197</td>
<td>.204</td>
<td>-.178</td>
</tr>
<tr>
<td>R²</td>
<td>.160</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>3.175</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. *p<.05; B = unstandardized regression coefficient; SE = Standard error of the coefficient; β = standardized coefficient

Research Question 5

To what degree does participating in structural firefighting alter the predicted frequency of firefighter informal learning engagement when controlling for supervisory support, knowledge sharing and relationship building?

The R-square value of the best fit model identified in Research Question three was compared to the R-square value of an additional model containing the variable participating in structural firefighting. Hierarchical linear regression was conducted using a model that included participating in structural firefighting while controlling for the independent variables, supervisory support, knowledge sharing and relationship building. Before conducting the analysis, relevant assumptions were tested. An examination of the correlations revealed that no variables were highly correlated. Participation in structural firefighting was moderately correlated to knowledge sharing (r = .470) and relationship building (r = .399). The data met the assumption of independence (Durbin-Watson value = 1.781) Collinearity was not a concern as statistics were within acceptable limits (Structure fires, Tolerance = .751, VIF = 1.332).
Normality, linearity, and homoscedasticity were satisfied upon examination of residual and scatter plots.

The variable, participating in structural firefighting, was converted to a dichotomous variable before insertion into the model. Participants were categorized as either participating or not participating, in structure fires (0 = no participation, 1 = participated in 1-6 fires). The addition of the variable participating in structural firefighting resulted in no significant change in $R^2$ of .002, $F(1,49) = .095, p < .066$

Participating in structural firefighting did not contribute to the predicted frequency of novice firefighter learning engagement when controlling for supervisory support, knowledge sharing and relationship building. Table 4.14 presents the summary of the regression analysis comparing the two models.

Table 4.14 Summary of Hierarchical Regression for Variables Predicting Engagement

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th></th>
<th></th>
<th>Model 2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>β</td>
<td>B</td>
<td>SE</td>
<td>β</td>
</tr>
<tr>
<td>Constant</td>
<td>2.082</td>
<td>1.050</td>
<td>1.997</td>
<td>1.095</td>
<td>1.095</td>
<td></td>
</tr>
<tr>
<td>Supervisory support</td>
<td>.524*</td>
<td>.179</td>
<td>.456</td>
<td>.518*</td>
<td>.182</td>
<td>.452</td>
</tr>
<tr>
<td>Knowledge sharing</td>
<td>.074</td>
<td>.184</td>
<td>.065</td>
<td>.093</td>
<td>.195</td>
<td>.082</td>
</tr>
<tr>
<td>Relationship building</td>
<td>-.197</td>
<td>.456</td>
<td>-.178</td>
<td>-.185</td>
<td>.209</td>
<td>-.167</td>
</tr>
<tr>
<td>Participation in structural</td>
<td></td>
<td></td>
<td></td>
<td>-.093</td>
<td>.303</td>
<td>-.046</td>
</tr>
<tr>
<td>firefighting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>.160</td>
<td></td>
<td>.162</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F$</td>
<td>3.175</td>
<td></td>
<td>2.048</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>$\Delta R^2$</td>
<td></td>
<td></td>
<td>.002</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:*p < .05
Chapter 5: Summary, Discussion, Implications and Recommendations

Introduction

Informal learning is an important workplace learning approach used by workers to acquire tacit, or implicit, job knowledge and skills in the workplace (Marsick, 2009). Informal and formal workplace modes of learning are described as dichotomous anchors located on opposing ends of a workplace learning continuum (Eraut, 2004, Noe, et al., 2013). Informal learning is characterized by the autonomous actions of the learner who activates and engages workplace learning processes and activities under terms and conditions of their choosing (Marsick & Watkins, 2005). Reflecting on one’s actions or the actions of others and experimenting with techniques are examples of informal learning activities (Lohman, 2005; Jeon & Kim, 2011).

Scholars propose that informal learning activities are organized into one of three categories; learning on one’s own and independently from others, learning from or with others, and learning that is not relational or socially dependent (Noe, Tews, & Marand, 2013). Previous research has shown that certain workplace environmental factors can inhibit or incite triggers for individual learners to activate informal learning processes (Kyndt, Dochy, & Nijs, 2009; Noe et al., 2013). Four factors thought to influence informal learning engagement emerged from a review of the literature. This study examined the degree to which supervisory support (Doornbos, et al., 2008), psychological safety (Edmondson, 1999), knowledge sharing (Connelly & Kelloway, 2011),
2003), and relationship building (Doornbos, et al., 2008) influences informal workplace learning engagement of novice career firefighters.

The key empirical findings from this study support previous research that reported informal learning support significantly and positively increases the frequency in which workers engage informal workplace learning processes and activities. A final informal learning support model combining supervisory support, knowledge sharing and relationship building predicted variability in novice firefighter informal learning engagement. Supervisory support had the most influence on informal learning engagement among the model variables. Psychological safety was not found to influence informal learning engagement. Novice firefighters engage in the same informal learning activities previously studied among teachers, technology, and human resource professionals, however, their preferences differed. This chapter summarizes the research, presents findings and discussion, conclusions and implications for further research.

Research Design

A correlational research design, using standard multiple linear regression was used to analyze the data in this study. A single instrument, measuring six variables, comprised of 34 items, was administered electronically via email link to participants. The principle research question examined the extent to which the variability of the frequency of novice firefighter informal workplace learning engagement was explained by supervisory and peer support. The purpose was to examine the degree that this combination of factors inhibits or promotes informal learning.
The dependent variable in this study, informal workplace learning engagement, was defined as the frequency of participating in each of the eight items adapted from Lohman’s (2005) informal workplace learning scale. Independent variables included supervisory support, psychological safety, knowledge sharing and relationship building. An eight-item supervisory support scale was adapted from Doornbos, et al. (2008) to measure supervisory support in this study. A seven-item scale was adapted from Edmondson (1999) to measure the climate of novice firefighter psychological safety where a climate of trust allows knowledge to be freely exchanged. Described as the bi-directional and intentional exchanges of knowledge between individuals, knowledge sharing was measured using a five-item scale adapted from Connelly & Kelloway (2003). A three-item scale adapted from the work of Doornbos, et al. (2008) measured for the presence of relationship building among peers. The frequency of structural firefighting was predicted to moderate supervisory and peer support on informal learning engagement and was treated as a dichotomous variable.

The research questions in this study included:

1. To what degree are organizational informal learning support factors of supervisory support, psychological safety, knowledge sharing, and relationship building present in the work climate of novice firefighters?
2. To what degree do novice career firefighters engage in each of the eight informal learning engagement activities?
3. What is the relationship between novice firefighter informal workplace learning engagement and informal learning support factors supervisory support, psychological safety, knowledge sharing and relationship building?
4. To what degree does supervisory support, psychological safety, knowledge sharing, and relationship building predict the frequency of novice firefighter informal workplace learning engagement?

5. To what degree does participating in structural firefighting alter the predicted frequency of firefighter informal learning engagement when controlling for informal learning support variables selected in the final model?

Population and Sample

A population of 129 novice career firefighters from a single Midwest metropolitan fire department was surveyed. The census included firefighters who had graduated from the firefighting academy but did not have more than seven years of experience with this fire department. A total of 54 novice firefighters responded resulting in a response rate of 42%. All respondents had between two and no more than five years of experience. Only work characteristics were obtained as part of the study. The sample consisted of novice career firefighters who were assigned to either a firefighting engine company (75.9%), or a firefighting ladder company (22.2%). One firefighter reported being assigned to an ambulance (1.9%) and was subsequently grouped with engine company firefighters. This is because firefighters are generally assigned to engine companies before being assigned to an ambulance.
Instrumentation

Novice firefighters completed a three-part questionnaire. The first part included work characteristics including number of years since graduation from the firefighting academy, type of firefighting apparatus assignment and the frequency that they participated in structural firefighting during the previous ten work shifts. The second part of the questionnaire measured informal learning engagement adapted from Lohman’s (2005) eight-item informal workplace learning engagement scale. Novice firefighters rated the frequency with which they engaged in each of the informal learning activities. Sample items include “during the past 10 work shifts how often did you listen to firefighting incidents on a portable radio” and “search the internet to locate something related to firefighting operations”? Participants responded using a seven-point frequency scale, ranging from 1= “never” to 7 = “constantly.”

The third section of the questionnaire contains the 23 items measuring the four informal learning support climate factors. Eight items measure the presence of supervisory support. A sample item included “my officer cares about continuing development.” A sample measure of psychological safety included “members of this department are able to bring up problems and tough issues.” Knowledge sharing measures included “firefighters in this department share their ideas openly.” And relationship building included “I am proud of the people I work with.” Respondents used a seven-point scale to report their agreement on the presence of each type of support ranging from 1 = strongly disagree, to 7 = strongly agree.
Scale Reliability

Scale reliability for the current study was examined by generating Cronbach’s alpha for each variable. Reliability coefficients for the dependent variable and all four independent variables were above the acceptable (> .5) range (Gliem & Gliem, 2003). The 8-item dependent variable, *Informal Learning Engagement*, had a Cronbach Alpha of 0.85 indicating good to excellent internal consistency (Gliem & Gliem, 2003). The Cronbach’s alpha for the 8-item independent variable, supervisory support, showed excellent internal consistency at 0.92. The Cronbach’s alpha for the 7-item independent variable, psychological safety, was good at 0.80. The 5-items comprising the independent variable knowledge sharing yielded a Cronbach’s alpha of 0.79. Finally, the 3-items making up the independent variable, relationship building, produced a Cronbach’s alpha of 0.70.

Findings

This section presents research findings organized by the five principal research questions. The overall objective of the research was to assess the variability of the informal learning support climate of a metropolitan fire department work environment and further to determine if support influences the frequency of informal learning engagement by novice firefighters. The findings are generalizable only to novice career firefighters of the fire department where the research was conducted.
Research Question 1. To what degree are organizational informal learning support factors of supervisory support, psychological safety knowledge sharing and relationship building present in the work climate of novice firefighters?

Novice firefighters reported a strong presence of relationship building (M = 5.98, SD = .880) and company officer supervisory support (M = 5.94, SD = .852). Novice firefighters perceived only a moderate degree of psychological safety (M = 4.87, SD = .861) and knowledge sharing (M = 5.34, SD = .863) within their learning and workplace culture. Findings indicate that novice firefighters’ perceived a work climate where peers and supervisors value and encourage learning through feedback, social interaction, and information sharing. Findings also indicate that knowledge is willingly shared with novice firefighters as the result of relationship development among peers. Further, supervisors are actively and intentionally engaged in supporting the development of novice firefighters.

Research Question 2. To what degree do novice career firefighters engage in each of the eight informal learning engagement activities?

Overall, novice firefighters reported engaging only occasionally in all eight of the (M = 4.4, SD = .978) informal learning activities. The most engaged informal learning activity reported by two-thirds of novice firefighters (77.7%) was reflecting on their own actions and the actions of their peers. Firefighters indicated frequently engaging this activity (M = 5.19, SD = 1.083). The second most important learning activity for novice firefighters (71.2%) was listening to firefighting operations on a portable radio. Listening to the radio occurred frequently (M = 5.00, SD = 1.427). Scanning magazines and books
(M = 3.61, SD = 1.595) was the least utilized informal learning activity among firefighters with 42.3% reporting rarely or never engaging this activity. In terms of experimenting with new techniques (M = 4.17, SD = 1.299), 42.6% of firefighters indicated that they experimented while 22.2% reported rarely trying out new tasks. One variable stood out when examined and organized by cohort. Firefighters having either two years (M = 4.44, SD = 1.311) or four years (M = 4.67, SD = 1.225) on the job reported occasionally practicing firefighting skills while novice firefighters having between three and four years reported never practicing firefighting skills (M = 1.145, SD = 1.311).

Research Question 3. What is the relationship between novice firefighter informal workplace learning engagement and informal learning support factors supervisory support, psychological safety knowledge sharing and relationship building?

Study findings reveal statistically significant (p<.05) positive correlations between all four predictor variables. Psychological safety was found to have a moderate correlation with supervisory support (r=.415) and the moderating variable structural firefighting (r=.482). Psychological Safety has a strong correlation to knowledge sharing (r=.736), and relationship building (r=.596). Supervisory support was found to have a moderate correlation to knowledge sharing (r=.343) and a strong correlation to relationship building (r=.558). And relationship building has a strong correlation to knowledge sharing (r=.600). The findings indicate that supervisory support, psychological safety, knowledge sharing and relationship building are interrelated constructs.
Informal learning engagement has a statistically significant relationship ($p < .01$) and moderation correlation with supervisory support ($r = .380$). This finding indicates that the frequency of informal learning engagement suggests a positive relationship with supervisory support. These results, however, do not indicate causation.

Research Question 4: To what degree does supervisory support, psychological safety, knowledge sharing, and relationship building predict the frequency of novice firefighter informal workplace learning engagement?

Due to concerns with collinearity, the variable psychological safety was excluded from the final predictive informal learning support model. The relationship between the final informal learning support model and informal workplace learning engagement was statistically significant ($<.05$). Supervisory support, knowledge sharing and relationship building predicted novice firefighter informal learning engagement, ($F(3,50) = 3.175$, $p < .032$). The total variance explained by the model, $R^2$ overall was 16.0% with an adjusted $R^2$ of 11.0%, a small effect size according to Cohen (1992). These findings indicate that the variance between the support variables and engagement are not the result of chance.

Research Question 5: To what degree does participating in structural firefighting alter the predicted frequency of firefighter informal learning engagement when controlling for supervisory support, knowledge sharing, and relationship building?

The addition of the variable participating in structural firefighting resulted in no significant change in $R^2$ (.002, $F(1,49) = .095$, $p < .066$) when compared to the original
model. Participating in structural firefighting did not contribute to the predicted frequency of novice firefighter learning engagement when controlling for supervisory support, knowledge sharing and relationship building. This finding indicates that firefighter learning engagement was unaffected by participating in structural firefighting.

Discussion

The results of this study are important for several reasons. First, the data indicates a statistically significant relationship among the final informal learning support model and informal workplace learning engagement indicating that this combination of factors influences engagement. As discussed below, contextual factors have been previously predicted to influence informal learning engagement in either a positive or negative direction (Ellinger, 2005). Second, results indicate that supervisory support was positively correlated to informal learning engagement and accounted for the most predictive influence when all four predictors were entered into the regression model. These findings are important and extend our general understanding of how supervisory support, psychological safety, knowledge sharing and relationship building influence informal workplace learning engagement.

Total Variance Explained

The findings of this study accounts for 11 percent of the total variance explained by the supervisory and peer support model. Supervisory support accounted for most of the total variance. Although low, the percentage of variance explained is significant
nonetheless and is consistent with findings from other studies. For instance, a study of managers using 7 predictor variables accounted for only 15% of the overall variance (Noe, et al., 2013) and a study of Dutch police officers accounted for 20% of the frequency of work-related learning activities when 9 predictor variables were included in the final model (Doornbos, et al., 2008). Scholars have previously noted challenges with both illuminating and retrospectively recalling engagement in informal learning processes and activities. These reasons may contribute to low predictability findings in overall variance which should be taken into consideration when designing future studies investigating similar factors.

The Role of Organizational Context

Novice firefighters engage in informal learning activities to solve personal learning needs while at work. The findings of this study confirm that organizational contextual factors interact with informal learning engagement processes as proposed by Marsick, Watkins, Callahan, and Volpe (2006) in their model for enhancing informal and incidental learning. Organizational social-relational, structural-hierarchical, and work conditions are among the contextual factors that are related to informal learning processes (Marsick and Watkins, 1999). The findings of this study do not specify causation; however, supervisory and peer support was perceived by novice firefighters to be operating within the work environment. Among the examined variables, the predictive relationship of supervisory support on informal learning engagement was found to be statistically significant. This finding suggests that the frequency of informal learning engagement, an otherwise self-directed process, is influenced by factors existing within
the organizational context. This finding is consistent with relevant studies examining the relationships between informal learning processes and organizational factors (Ellinger, 2005, Doornbos, et al., 2008, Hoekstra & Korthagen, 2011, Jeon & Kim, 2012).

Novice Firefighter Informal Workplace Learning Engagement

The results of this study support previous research findings on informal workplace learning for information technology professionals and teachers (Lohman, 2005), human resource development professionals (Lohman, 2009), police officers (Doornbos, Simons & Denessen, 2008) flight instructors (Wolford, Ellinger & Watkins, 2012), public sector managers and supervisors (Cunningham & Hillier, 2012), and nurses (Bjork, Toin & Sorenson, 2013). Informal workplace learning is associated with informal learning processes (Watkins, 2009), self-directed learning activities (Wofford, et al., 2012), cognitive processes (Eraut, 2004) and social processes (Taber, et al., 2008).

According to Marsick and Watkins (2009), informal learning activities are interdependent with the processes that underpin them. As indicated by mean score responses on all eight engagement items (M = 4.4, SD = .978) and a score range of 1.63 to 6.25, novice firefighters are independently assigning and accessing cognitive and affective resources to engage informal learning activities. Listening to firefighting operations on a portable radio (M = 5.00, SD = 1.422) indicates that firefighters are prescribing, activating, and implementing informal learning processes to learn and expand their understanding and knowledge of firefighting operations.
Novice career firefighters utilize all eight informal learning activities included in this study, however, they appear to have preferences. Novice firefighters reveal a slight preference toward learning alone rather than by learning collectively. Informal learning activities may be accomplished with others or independently and without collaborating with others directly (Doornbos, et al., 2008). These eight informal learning activities were adapted from the work of Lohman (2005) and empirically validated within studies investigating teachers, human resource development professionals (Lohman, 2005) and technology professionals (Lohman, 2009). Novice firefighters reflect mostly on their actions and the actions of others (M = 5.19, SD = 1.083) and least frequently in scanning magazines and books (M = 3.61, SD = 1.595). Novice firefighters were less likely to engage in learning through trial and error (M = 4.17, SD = 1.299). Engagement scores indicate that firefighters activate social learning exchanges after attempts to resolve a learning need on their own have been attempted. Teachers on the other hand preferred talking with others (M = 4.4, SD = 0.68) and sharing materials with others (M = 4.2, SD = 0.69) indicating a tendency to first engage interactive informal learning activities (Lohman, 2005).

In this study, novice firefighters were most likely to select informal learning activities that could be performed first in solitude choosing primarily to “reflect on their actions and the actions of others,” “listen to the portable radio” and “practice skills independently” which is a variation of observing others. Descriptive study findings of Canadian and Norwegian firefighters indicated highly social preferences followed by work task experiences as preferred methods of learning (Sommer & Nja, 2011). Technology (IT) professionals, on the other hand, are more likely to initiate a search on
“the internet” on their own followed closely by asking “others” (Lohman, 2009). Technology professionals rarely “reflected on their actions” (Lohman, 2009). Teachers favored inter-relational approaches including “talking and collaborating with others” and “sharing materials” but also “reflected on their actions.” These studies were not limited to informal modes of learning, however, were reflected in the informal learning experiences reported by career novice U.S. firefighters.

The disparity among findings is of interest but are outside the scope of this study. Discrete occupational differences are likely one reason for explaining why teachers and technology professionals, who generally work independently, would be first oriented to collaborative learning activities while firefighters, who operate as part of a work team, would prefer initially to learn in solitude. It’s also possible that the precise and explicit nature of technology work, pressures to quickly solve problems, and access to technology systems and shared informational databases allows for, or even subtly promotes and rewards, greater learning efficiency through independent problem-solving tasks.

Teachers, like technology professionals, also operate independently while in the classroom. But unlike technology professionals and firefighters, do not operate under time constraints and or have similar work pressures. This context may allow teachers more flexibility, both in time and in manner, in choosing an informal learning path. Finally, the very nature of a teachers’ role is based on social interaction so it’s no surprise that their informal learning preferences favor the social engagement of others.

Firefighters also operate within a highly social framework performing nearly all tasks in conjunction with others and directed by a firefighting supervisor who is integrated into their work team. Qualitative studies of firefighters found that firefighters
prefer to learn socially, yet these findings suggest some reluctance to engage others as a first line of inquiry. A single psychological safety item, “if a firefighter makes a mistake it is often held against them”, had a mean score of 3.41 and may indicate the presence of a pressure on novice firefighters to avoid judgment and to first seek out answers to their questions before asking others for assistance. This suggests that novice firefighters are reluctant to expose gaps in their knowledge to their peers or supervisors and may be either driven to informal learning activities that can be performed in solitude or it may inhibit learning altogether.

Informal Workplace Learning Support

Supervisory Support

Supervisors can create a learning climate that may promote or inhibit the frequency of informal learning engagement of novice firefighters. Supervisory support was found to be significantly and positively correlated to informal learning engagement when all four support predictor variables were entered into the regression model. This finding indicates that firefighters perceive a work culture where supervisors value learning and provide feedback and validation. Novice firefighters indicated that they are encouraged to share their ideas and take individual initiative. This finding is consistent with previous qualitative studies of manufacturing employees (Ellinger, 2005) and novice nurses (Bjork, et al., 2013). Findings are also consistent with a study of executive Dutch police officers where managerial support was not significantly correlated with a relatively low frequency of learning engagement (Doornbos, et al., 2008).
It should be noted that although the roles of supervisors vary by occupation, support measures are relevant to informal learning engagement. For instance, Dutch executive police reported a high level of autonomy in their work whereas firefighters are interdependent in the performance of their work (Doornbos et al., 2008). Nurse supervisors tend to both interact and provide a high level of autonomy to nurses while firefighter supervisors directly participate in firefighting work and oversee the work activities of each team of firefighters (Bjork, et al., 2013). In each of the latter two cases, supervisors are present to provide immediate and relevant feedback. Regression analysis shows that only supervisory support significantly predicts informal workplace learning engagement among firefighters. The findings of this study indicate that more research on supervisory support is needed to discover the degree to which employee autonomy and frequency of interaction between supervisors and their direct reports influences engagement.

Psychological Safety

Findings show that novice firefighters perceive a high level of psychological safety within their work domain. However, psychological safety was not significantly correlated to informal workplace learning engagement. This finding suggests that the social environment is relatively judgment-free and conducive to open exchanges and idea sharing. It further suggests that firefighters feel safe to express their concerns and ideas without fear of reprisal – psychological conditions that are attributed to inhibiting learning exchanges in other settings. A subtheme found within the psychological safety measures indicates a slight concern on the part of some novice firefighters that errors and
mistakes will not be easily forgiven by their peers. It is also possible that novice firefighters are more sensitive to the perceived responses of more experienced firefighters when errors are made. This is an important observation that should be examined more closely in future studies of firefighters and other high-reliability occupations (Baumann, Gohm, & Bonner, 2011). Overall, psychological safety was not found to be a significant predictor of novice career firefighter informal workplace learning engagement. One possible explanation for this is due to its significant and moderate correlation with supervisory support and relationship building and its significantly high correlation with knowledge sharing. These findings indicate that the sense of relational trust and confidence are reflected in the remaining factors.

**Knowledge Sharing and Relationship Building**

Findings indicate that novice firefighters perceived a workplace where the socio-relational factors knowledge sharing and relationship building were present in the fire station. These factors indicate a climate where knowledge and experiences are shared openly and freely among firefighters. It also indicates that firefighters have the ability to interact socially to develop interpersonal relationships conducive to learning. Findings, however, demonstrate that neither knowledge sharing or relationship building were significant predictors of learning engagement. Both factors were found to be moderately and significantly correlated to each other in addition to psychological safety. The possible reason that these factors did not influence learning engagement is likely the result of their association with all but one predictor.
Core Work Activities

Participating in structural firefighting work activities did not moderate the relationship between informal learning support and the frequency of informal learning engagement by novice firefighters. This finding suggests that structural firefighting experience has no appreciable effect on informal learning frequency. This study provides insight into how work context factors can promote or inhibit the frequency in which novice firefighters engage in informal workplace learning activities. The relationship between the informal workplace learning support model containing supervisory support, knowledge sharing and relationship building and informal workplace learning engagement was statistically significant. Informal workplace learning support predicted the frequency that novice firefighters engage informal learning. It was peculiar to find that supervisory support accounted for nearly all of the explained variation in informal learning engagement. The findings of this study indicate that more research on supervisory and peer support is needed to discover how their contributions to the informal learning climate can impede or induce independent learning.

Conclusions

The findings of this study support several conclusions. First, supervisory support influences novice firefighter informal learning engagement. Supervisors who provide performance feedback, encourage workers to take initiative, and place value on employee knowledge and skills acquisition influence informal learning engagement. Fire department supervisors who create a supportive learning climate are associated with inciting or inhibiting the frequency that novice firefighters engaged informal learning.
The combination of supervisory support, knowledge sharing, and relationship building are useful in predicting engagement, however, relationship building and knowledge sharing contributed very little to the final model. Novice firefighters perceived a work climate where experienced firefighters readily shared knowledge and experiences. This knowledge-sharing climate was also correlated to the supportive role that supervisors play within the work group. Fire department supervisors work directly with a team of firefighters and may be unaware of the effect they have on the acquisition of tacit knowledge by their direct reports.

The second conclusion of this study pertains to the expectation that a climate where employees feel safe to take learning risks would be associated with informal learning engagement. In this study, a psychological safe climate did not influence the informal learning engagement of novice firefighters. This is likely the result of its moderate to strong correlation to the remaining three predictors, supervisory support, knowledge sharing and relationship building. Novice firefighters perceived that the fire station work environment is a safe place to ask others for help and are generally not concerned with being embarrassed as the result of knowledge gaps. This finding also suggests that novice firefighters are more influenced by the guidance and support provided by their supervisors while supervisors in this organization are also attentive to new firefighters that have been assigned to their companies. One dimension of psychological safety inferred that novice firefighters may not feel completely safe in exposing knowledge gaps or in making mistakes. This finding, although subtle, could paralyze a novice firefighter thus inhibiting their activation of informal learning processes. Psychological safety was not significantly correlated to engagement, however,
may play a role in the choice that novice firefighters pursue informal learning activities in solitude versus by interacting with others.

The third conclusion relates to the belief that performing core work tasks mediate supervisory and peer support and informal learning engagement (Eraut, 2004). Participating in structural firefighting did not alter the frequency that novice firefighters activated informal learning activities. Participating in core work tasks were expected to incite informal learning of novice firefighters who have limited authentic work experience. This finding may be the result of a novice firefighters’ unwillingness to expose any weakness in their competency to their peers when associated with a firefighting event.

Revised Conceptual Model

As a result of the findings of this research, the proposed conceptual framework presented in Chapter 1 was revised and simplified. The revised framework, Figure 3, shows that supervisory support, knowledge sharing, and relationship building are positively related to the frequency of novice firefighter informal learning engagement. The construct psychological safety was highly correlated to supervisory support, knowledge sharing and relationship building and was subsequently removed from the informal learning support model. The addition of the variable participating in structural firefighting resulted in no significant change in $R^2$ of .002, $F(1,49) = .095$, $p < .066$. 

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Participating in structural firefighting did not contribute to the predicted frequency of novice firefighter learning engagement when controlling for supervisory support, knowledge sharing and relationship building. As a result, it was eliminated from the final model. Novice firefighters reported selecting among informal learning activities that could be grouped into either learning in solitude or collaborative which is reflected in the revised framework.

Implications for Practice

These research findings contribute to the existing body of knowledge on informal learning in the workplace. This research provides insight into the informal learning engagement practices of a select population of novice metropolitan U.S. firefighters. The research also provides insight into the learning support climate of a metropolitan U.S. fire
department from the perspective of a novice firefighter. As a result of these statistically significant findings that supervisory support, knowledge sharing, and relationship building are correlated to the frequency of novice firefighter informal learning engagement, a novice firefighter informal learning support model could be constructed.

Organizations may leverage the findings that novice employees are engaging informal learning activities as a matter of practice. Fire Department training officers and administrators should place value on informal learning and support some of the informal learning activities engaged by novice firefighters. For instance, issuing portable radios may not occur in some agencies until a firefighter passes their probationary period. Issuing radios early, possibly during the academy experience, may incite informal learning. Officers who allow time and space for independent drilling and practice may also be serving the learning needs of firefighters. Organizations may also consider recognizing informal learning activities as legitimate and authentic learning that could be documented as part of a novice firefighter’s overall learning experience. Finally, promoting a climate where supervisors provide constructive feedback, value learning, and encourage novice firefighters to take initiative in their learning may stimulate the frequency in which firefighters engage informal learning activities.

The findings of this study indicate that supervisory support influences the frequency that workers engage informal workplace learning processes and activities. Supervisors may also influence peer support in the form of sharing knowledge. Fire department supervisors can promote a higher incidence of learning in two ways. The first is to create a fire station climate that encourages and values learning among all firefighters. This climate should allow the space and time for learning to occur among
peers in a way that they choose. Company officers should stimulate discussions and knowledge sharing. The second way for supervisors to support learning is to provide individual feedback to firefighters on their performance and actions. Supervisors may also encourage firefighters to take initiative when it comes to job knowledge and skills and not to wait for direction or instruction.

Implications for Future Research

This study advances existing and important research examining organizational factors that promote or inhibit informal workplace learning. The findings of this study accounts for 11 percent of the total variance explained by the supervisory and peer support model. Supervisory support accounted for most of the total variance. Variables selected for this study were taken from previous study findings and represent factors present in the organizational and work context (Marsick and Watkins, 2006). Improved recruitment and a larger population would afford greater power and predictive ability. Given the scope of the organizational context in which these predictor variables are derived, it is difficult not to imagine that a vast number are present and simply not accounted for in this study. Additional research should be undertaken to explore and examine other socio-relational support factors that may explain a larger percentage of the variance on the frequency of informal learning engagement.

Individual agency is reported as a key attribute of informal learning, where individual control of the curriculum and learning processes reflect their preferences and choices (Cunningham & Hillier, 2012; Hagar & Halliday, 2006). Formal learning proposes the opposite; that the curriculum and processes are selected on behalf of the
individual. Understanding how individuals choose among individualistic versus collective informal learning approaches has merit. Further, scholars differentiate the two modes of learning, formal versus informal, as either dichotomous or residing on a continuum anchored by the two. Given the preference of some workers to activate informal learning in isolation while others choose a collaborative approach suggests the presence of an additional point on this continuum. Further research should examine how supervisory support and tenure influence autonomy. Finally, the variable supervisory support could also be expanded to include supervisor support training climate items designed by Tracey and Tews (2005).

Learning outcomes have been linked to improved competence and safety outcomes such as the reduction of injuries. An additional area of study includes examining informal learning outcomes related to worker safety and risk management.

Final Thoughts

It is generally accepted that continuous learning is linked to reducing workplace injuries and fatalities. Informal learning is an important means of acquiring tacit knowledge by firefighters and other high-reliability workers. Increasing the frequency that workers activate and engage informal learning is of interest to researchers and practitioners alike. Scholars generally agree that worker dependence on self-directed and autonomous learning may not occur without the support of peers and supervisors within the organization. Administrators must ensure that their supervisors understand their impact on the informal leaning practices of their employees. More experienced
employees must also be willing to share their knowledge and experiences by interacting with and developing relationships with less experienced workers. The combination of supervisory support, knowledge sharing, and relationship building has a small but important relationship when novice firefighters are independently developing their firefighting knowledge and skills. This line of inquiry is critical for the advancement of adult education theory and practice.
REFERENCES


Appendix A. Firefighter Informal Learning Support Questionnaire (FILSQ)

Instructions:

Participation in this survey is voluntary. This survey is expected to take approximately 20 minutes to complete. Please answer all questions to the best of your recollection. Your responses will be kept strictly confidential. Respond to all questions before selecting the “submit”.

Section 1: About yourself and your job assignment

1. How many years have you been a firefighter at this Fire Department?
2. What type of apparatus are you primarily assigned to? Select one.
   - Engine
   - Ladder/Truck
   - Heavy Rescue
   - Medic/Squad/Ambulance
   - Chiefs Aide
   - Other
3. How many structure fires did you participate in during the past 10 work shifts?

Section 2: Informal Learning Activities

Think back over the past ten (10) work shifts and select the frequency that best represents how often you participate in each of these learning activities. The scale is ranges from “Very Rarely”, only 1 or 2 times during the previous ten shifts and “Constantly” which means 25 or more times during the previous ten shifts. Select the frequency that best

During the past 10 work shifts how frequently did you:

4. Participate in discussions or storytelling about firefighting operations?

   - Never
   - Very Rarely
   - Rarely
   - Sometimes
   - Often
   - Very Often
   - Constantly

5. Practice firefighting skills or share firefighting knowledge that was outside of department-required training?

   - Never
   - Very Rarely
   - Rarely
   - Sometimes
   - Often
   - Very Often
   - Constantly
6. Listen to firefighting incidents on a portable radio?
   o o o o o o o o
   Never   Very Rarely   Rarely   Sometimes   Often   Very Often   Constantly

7. Search the internet to locate something related to firefighting operations?
   o o o o o o o o
   Never   Very Rarely   Rarely   Sometimes   Often   Very Often   Constantly

8. Scan magazines or books to locate something related to firefighting operations?
   o o o o o o o o
   Never   Very Rarely   Rarely   Sometimes   Often   Very Often   Constantly

9. Experiment with a new firefighting technique or approach?
   o o o o o o o o
   Never   Very Rarely   Rarely   Sometimes   Often   Very Often   Constantly

10. Reflect on your own firefighting knowledge and actions or the actions of others?
    o o o o o o o o
    Never   Very Rarely   Rarely   Sometimes   Often   Very Often   Constantly

11. Share firefighting-related materials or information with others?
    o o o o o o o o
    Never   Very Rarely   Rarely   Sometimes   Often   Very Often   Constantly

Section 3: Perceptions about organization

Select the response that best reflects your perspective.

12. My officer cares about continuing development.
    o o o o o o o o
    Strongly Disagree   Disagree   Somewhat Disagree   Neither Agree nor Disagree   Somewhat Agree   Agree   Strongly Agree
13. Firefighters in this department are willing to share knowledge and ideas with others.

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<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Agree</th>
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14. My officer gives me attention.

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<th>Strongly Disagree</th>
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15. Firefighters with expert knowledge are willing to help others within this department.

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16. Members of this department are able to bring up problems and tough issues.

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17. My officer encourages me to learn.

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18. It is difficult to ask other Firefighters of this department for help (reverse-coded).

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<th>Strongly Disagree</th>
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19. My officer discusses career steps with me.

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<th>Strongly Disagree</th>
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20. Firefighters in this department share their ideas openly.

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21. I am proud of the people I work with

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22. My officer gives me feedback on my performance

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23. No one on this department would deliberately act in a way that undermines my efforts.

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24. My officer gives me insight into the judgment of my work.

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25. This department is good at using the knowledge/ideas of firefighters.

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26. Firefighters in this department keep their best ideas to themselves (reverse-coded).

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<th>Strongly Disagree</th>
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27. My officer encourages me to take initiative.

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<th>Strongly Disagree</th>
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<th>Neither Agree nor Disagree</th>
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<th>Agree</th>
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28. If a firefighter makes a mistake in this department, it is often held against you (reverse-coded).

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<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Agree</th>
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29. Firefighters on this department sometimes reject others for being different (reverse-coded).

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<tr>
<th>Strongly Disagree</th>
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<th>Somewhat Disagree</th>
<th>Neither Agree nor Disagree</th>
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30. My officer invites me to share ideas.

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<th>Strongly Disagree</th>
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<th>Somewhat Disagree</th>
<th>Neither Agree nor Disagree</th>
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31. I have faith in the people I work with.

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<th>Strongly Disagree</th>
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<th>Somewhat Disagree</th>
<th>Neither Agree nor Disagree</th>
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32. It is safe to take a learning risk in this department.

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<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
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<th>Neither Agree nor Disagree</th>
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33. Working with members of this department - my skills and talents are valued and utilized.

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34. I feel connected to my coworkers.

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