HOW WE LEARN: MEASURING LEARNING PRACTICES FOR INFORMATION TECHNOLOGY PROFESSIONALS

by

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(Under the Direction of Karen E. Watkins)

ABSTRACT

The purposes of this study were to 1) validate the Learning Practices Audit (LPA; Watkins, Harman, & Li, 2019); 2) understand the relationships between learning practices, organizational support for informal learning, and the learning organization for IT professionals; and 3) understand knowledge performance outcomes for organizations.

This quantitative study used survey data to examine the relationship between learning practices, the learning organization, and knowledge performance and organizational support for informal learning of information technology (IT) professionals. It also validated the Learning Practices Audit (Watkins, Harman, & Li, 2019) as a measurement tool. The survey included 18 questions on learning practices, six items on organizational support for informal learning, the 21-item Dimensions of the Learning Organization Questionnaire (Watkins & Marsick, 1997), and six knowledge performance measures. It was administered through MTurk (N=401) in April of 2021. Data was analyzed using structural equation modeling.

The results supported most of the research hypotheses. A learning organization had a positive effect on informal learning, organizational support for informal learning, and knowledge

performance. Similarly, organizational support for informal learning had a positive effect on informal learning and knowledge performance, but it did not mediate the relationship between the learning organization and knowledge performance. However, organizational support for informal learning did mediate the relationship between the learning organization and informal learning. And informal learning had a positive effect on knowledge performance and mediated the relationships between both the learning organization and knowledge performance and between organizational support for informal learning and knowledge performance. Finally, informal learning for IT professionals is affected by gender and age, but not by working remotely, non-profit status, having a managerial position, or level of education.

This study validated the LPA. The results provided insights about the relationship between learning practices, organizational support for informal learning, and the learning organization, and how all three constructs impact knowledge performance. The findings enhance our understanding of IT professionals as informal learners while providing direction for future areas of research; they also offer practical applications for learning and development professionals.

INDEX WORDS: Informal learning, learning organization, knowledge performance, learning and development, IT Professionals

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DEDICATION

I dedicate this dissertation to my family. To my mother Anabella Starnes, thank you for bringing me into the world and raising me to persevere. Thank you for the countless weeks you came to help me so I could pursue this dream. I could not have done it without you. To my father, Dennis Lee Starnes, thank you for gifting me with humor and a calm disposition during storms. I appreciate your genuine support for all my education. To my husband Gregor, thank you for giving me the space to pursue this passion and for being an amazing partner and co-parent. Your encouragement was instrumental to this process. To my sisters Wendy and DeeDee, you have always been the best examples of empathy and fortitude. Thank you for shaping those traits within me throughout my life. I will always look up to you both. To those closer ones, you have given me love that is ever steadfast and I treasure your friendship and look forward to celebrating this and many more milestones.

Finally, to my young daughters, Charlotte, and Caroline – I love you more than words can say. This work started before you existed and grew alongside you; thank you for accepting it as part of our lives. I hope you both grow up with kindness, perseverance, and a deep love of learning.

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1

INTRODUCTION

"The only way to win is to learn faster than anyone else." Eric Ries, author of The Lean Startup

In the Information Technology (IT) environment where technology is always evolving, professionals need to adapt to be successful (Levinthal, 1998; National Academies of Sciences, Engineering, and Medicine, 2017). The United States Department of Labor (2019) reports that there are over four million computer and information technology professionals. And the number of professionals working in IT is expected to increase faster than the number in any other field.

For the most part, IT professionals learn informally – first through internet searches, and then through social learning (Lohman, 2009). Lohman identified six environmental factors that inhibit informal workplace learning for IT professionals: lack of time; lack of proximity to colleagues' work areas; unsupportive organizational culture; inaccessibility of others; lack of equipment and technology; and lack of meeting/workspace. Lohman also identified nine personality traits that made IT professionals more likely to pursue informal learning: initiative; self-efficacy; love of learning; interest in the profession; integrity; outgoing personality; teamwork ethic; curiosity; and open-mindedness. As companies invest more in blended learning opportunities and self-directed technology platforms, IT professionals must be even more reliant upon informal learning to gain the knowledge and skill sets needed for successful performance.

IT professionals include professionals who develop, deploy, support, and or maintain technological systems, software, hardware, or applications. They can be developers, architects,

analysts, engineers, technicians, and/-or team leads (Bennett, 2009, p. 2). The average IT professional is between 32 and 38 years old, the average age for managers is 42 (Clement, 2016; Visier, 2016). Women are underrepresented in this group, making up just 25% (Coast, 2021). On that note, both ageism and sexism are proven phenomena in the hiring of IT professionals (Moss, 2019; Funk & Parker, 2020). Additionally, women in technology report a lack of support in the workplace (Gurchiek, 2018). Women in tech also experience pay discrimination and are more likely than men to leave mid-career (Moss, 2019; Funk & Parker, 2020).

IT professionals are characterized as creative and highly skilled individuals who often work remotely, face high pressure, unpredictable work hours, and have low social and psychological needs (Ahmed et al., 2017; Anjali & Anand, 2015; Wynekoop & Walz, 1998). Given these traits, it is unsurprising that IT productivity and performance were not affected by an increase in remote work resulting from the COVID-19 pandemic (Galanti et al., 2021; Tortorella et al., 2021); companies are now embracing this transformation and planning on more remote and hybrid work, post-pandemic (Bhat & Harvey, 2020).

From a practice view of learning and development, IT professionals are particularly interesting, as the pace of change in their field is so rapid compared to the pace of change in other disciplines (Rajagopal & Abraham, 2009). And scholars who have used IT professionals as a context for research on workplace learning provide helpful insight into key characteristics for learning in IT: though it is known work experience and implicit learning are crucial success factors (Drohan, 2014; Kabia, 2011; O'Horo, 2013), there is a dearth of literature on the subject (Prasad et al., 2007; Wingreen & Blanton, 2018).

While IT is a dynamic field, IT professionals' workplace learning is influenced by the same forces as other organizational learners (Lohman, 2009; Wingreen & Blanton, 2018).

However, the resulting knowledge is often disjointed from the greater discourse on learning and IT (Boyle & Strong, 2006; Drohan, 2014; Wingreen & Blanton, 2018). Articles appear only sporadically, and only in trade journals specific to certain parts of the IT profession or business. For example, a study might look at the training and development of only Software Engineering (SE), Information Systems (IS), or Enterprise Resource Planning (ERP). Though this approach has not added to the general body of knowledge, it can also be beneficial, allowing for very specific implications and providing a strong basis for future studies.

According to the 2019 Training Industry Report, measuring learning outcomes is a top priority for firms (Freifeld, 2019). From a practical perspective, governments and firms lack the structures needed to assess and promote informal learning; without this infrastructure, companies will not progress in this area despite recognizing informal learning's benefits (Skule, 2004). Indeed, companies see informal learning as a crucial component of corporate competitiveness as well as a strategic area of focus for human resource departments – but human resource development literature has only recently begun incorporating informal learning (Skule, 2004). To stay competitive, firms have an increasing interest in becoming organizations that learn continuously (Kim, 2016). This aspirational state is what Watkins and Marsick (1993) refer to as a learning organization. Becoming learning organization has become a goal for many firms (Marquadt, 2004).

And in the corporate world, becoming a learning organization is imperative: more than half the companies on the 1993 Fortune 500 were off the list by 2001 (Housel & Bell, 2001). According to Wooldridge (2006), "The best way for companies to win the talent wars is to turn themselves into learning organizations. The trouble is that few of them know how to do this" (p. 20). Organizational actions and strategies play an important role in facilitating organizational

learning – and in hindering it. Markets are increasingly volatile; firms face change constantly (Senge, 1995; Marquardt et al., 2004; Thomas & Allen, 2006). According to Kim, et al. (2015), "With the emphasis on and potential in establishing the competitive learning culture, learning organization (LO) may well be a remedy pursued by many learning and development professionals to enhance their organizational capacity and competitiveness that are required to survive" (p. 92).

Though it doesn't always use the term "learning organization," there has also been a substantial increase in literature focusing on strategic learning and organizational support for learning. This practitioner-focused body of work explores the role of the learning and development leadership. Han (2015) explains,

> As human resource development professionals' roles have shifted from transactional and operational functions to transformational and strategic roles, human resource development professionals have become strategic partners and change agents for leading organizations by promoting formal and informal learning processes within organizations. (p. 15)

This explanation builds on Ruona and Gibson's concept (2004) where organizational learning and the learning organization are key elements of learning and development's strategically proactive era. The era began in the mid-1990s and emphasizes the creation of a workforce that takes advantage of opportunities by leveraging learning (Torraco & Swanson, 1995; Ruona & Gibson, 2004).

Practitioner engagement has contributed to both the organizational learning (Dixon, 2017) and learning organization discourses (Marquardt, 1995; Senge, 1990; Watkins & Marsick, 1993). Ruona and Gibson (2004) further note, "It is possible that this focus on organizational

learning has the potential to be the hallmark of a strategically proactive human resource development that features generative learning as central in creating future strategic alternatives" (pp. 57-58). Support for learning manifested as several different practices, among them coaching (Gallucci et al., 2010) and communities of practice (Wenger, 2011).

The literature on learning for IT professionals reflects the broader, emergent trends in the organizational learning and informal learning literature. With the learner at the helm, managers and leadership play important roles in a context influenced heavily by technology and the organizational environment. The three primary measures for qualifying skills of IT professionals remain formal education, certifications, and work experience. However, the four-year degree is increasingly obsolete; certifications are becoming the relevant criteria (Mahatanankoon, 2007a, 2007b; Naveda & Seidman, 2005). In fact, certifications and completion of formal education are often used in hiring, to gauge a candidate's competency, though these criteria are not the most accurate indicators of the IT professional's ability to do their job (Baker et al., 2007; Drohan, 2014; Kabia, 2011; O'Horo, 2013).

As organizational learning scholars might expect, there is a significant positive relationship between years of IT-related work experience and self-reported job competencies for IT professionals (Drohan, 2014; Kabia, 2011; O'Horo, 2013). Workplace learning through on-the-job experience is especially important for this group (Kabia, 2011). Technology professionals feel constant pressure to implement, learn, adopt, and preach new technologies (Rajagopal & Abraham, 2009). When a new technology is rolled out at a client site or a firm, there is no guarantee of sufficient formal training for the IT professionals tasked with its implementation and operation – or of any formal training at all. Much of what the IT

professional learns and finds useful gets absorbed and operationalized in the absence of formal structures (Lohman, 2009; Kabia, 2011).

As the importance of IT professionals grows, organizations must be able to make informed decisions about this group. There is no valid, reliable instrument for learning and development professionals to isolate learning practices and support IT professionals' informal learning. There's also a lack of information on relationships between learning practices, organizational support for informal learning, the learning organization, and the outcome of organizational performance in the context of IT professionals. IT professionals as a group are understudied.

Statement of the Problem

There is, however, a direct relationship between the learning organization and organizational performance (Watkins & Kim, 2018). Organizations must become learning organizations to stay competitive (Kim, 2016). Furthermore, in addition to fostering a learning culture, organizations need to understand informal learning in order to meet the needs of IT professionals. Organizations value and seek out IT professionals but are often unable to foster learning environments for this group to thrive and innovate (Schambach & Blanton, 2002). Barriers exist despite the integral work IT professionals do for most organizations and those professionals' reliance upon informal learning to be successful. In sum, organizations must be able to measure informal learning in order to support it.

But neither the effect of the learning organization on informal learning specifically nor the efficacy of organizational support for informal learning in general have been studied in-depth. For-profit corporations are interested foremost in the return on their investment (ROI) (Freifeld, 2020); while there is a proven relationship between the learning organization and

knowledge performance, quantitative assessment measuring knowledge performance outcomes from informal learning and organizational support for informal learning are both needed in order to support IT professionals, who are primarily informal learners. Without an understanding of these relationships, learning and development professionals will lack the data necessary to inform their organization's strategic decision making. This study addresses these gaps.

Purpose of the Study and Research Hypotheses

The study used the Dimensions of the Learning Organization Questionnaire (DLOQ; Watkins and Marsick, 1997), including knowledge performance measures, along with the Learning Practices Audit (LPA; Watkins, Harman, & Li, 2019), and custom items developed to assess organizational support for informal learning. The study's purposes are threefold: 1) validate the Learning Practices Audit; 2) understand the relationships between learning practices, organizational support for informal learning, and the learning organization for IT professionals; and 3) understand the knowledge performance outcomes for organizations.

To that end, this study tested the following hypotheses:

1. The Learning Practices Audit is a reliable and valid measure for assessing learning practices for IT professionals.
2. A learning organization has a positive effect on informal learning.
3. Organizational support for informal learning has a positive effect on informal learning.
4. A learning organization has a positive effect on organizational support for informal learning.
5. A learning organization has a positive effect on knowledge performance.
6. Informal learning has a positive effect on knowledge performance.

7. Organizational support for informal learning has a positive effect on knowledge performance.
8. Organizational support for informal learning mediates the relationship between a learning organization and informal learning.
9. Organizational support for informal learning mediates the relationship between a learning organization and knowledge performance.
10. Informal learning mediates the relationship between organizational support for informal learning and knowledge performance.
11. Informal learning mediates the relationship between the learning organization and knowledge performance.
12. The role – manager or non-manager – of the respondent has a significant impact on informal learning practices.
13. Gender has a significant impact on informal learning practices.
14. Age has a significant impact on informal learning practices.
15. The type of organization – non-profit or for-profit – has a significant impact on informal learning practices.
16. Education level does not have a significant impact on informal learning practices.
17. Remote work does not have a significant impact on informal learning practices.

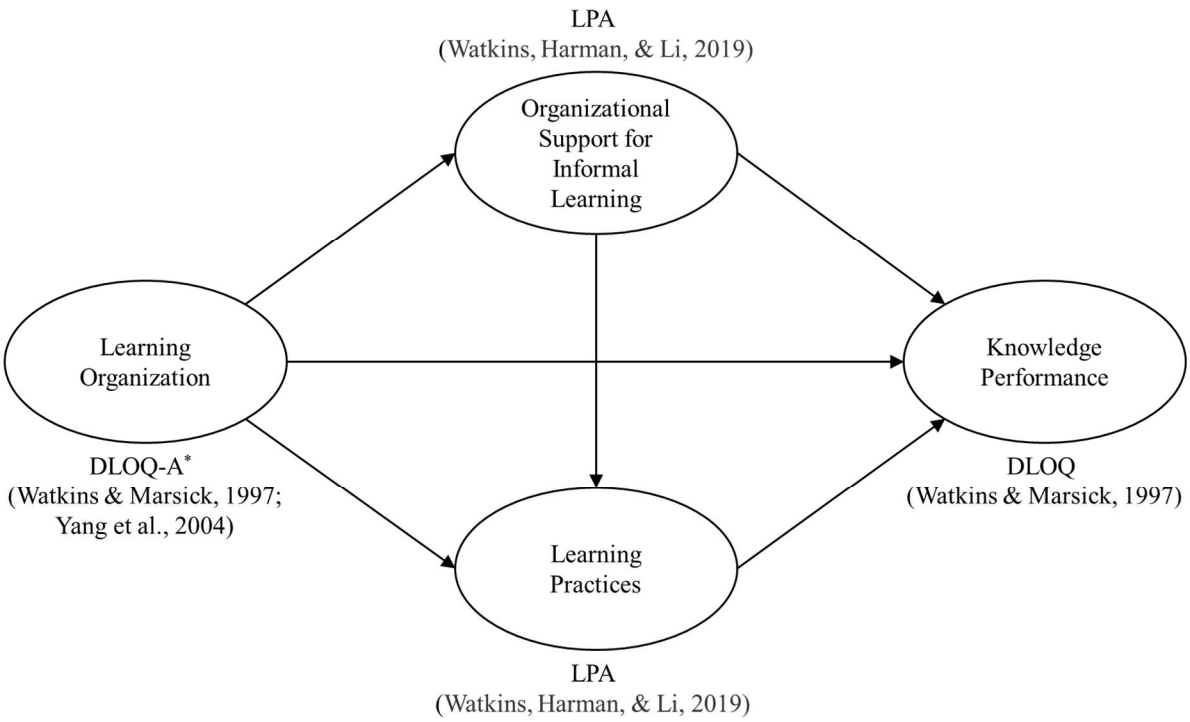
Theoretical Framework

Figure 1 depicts this study's theoretical framework, which analyzed the relationship between the learning organization, organizational support for informal learning, and learning practices for IT. The study measured the learning organization using the 21-item DLOQ, plus six

items to assess knowledge performance. Learning practices and organizational support for informal learning were measured using a revised version of the LPA.

Figure 1

Theoretical Framework



* Shortened version of DLOQ (Watkins & Marsick, 1997; Yang, et al 2004)

Significance of the Study

This study enhances our understanding of informal learning for IT professionals, as well as of the learning organization. Consequently, it expands our understanding of adult education and workplace learning. Understanding how the learning organization's presence affects learning practices and organizational support for informal learning for IT professionals will help explain how learning occurs in other complex workplace contexts.

IT professionals are responsible for a wide range of technology-related tasks, from design to implementation to customer service, which organizations use to operate and manage

information. IT domains can be as ambiguous as they are complex, and may include technical (programming, web development, database and operating system administration, networking, and infrastructure) and non-technical work (project and program management, communications, and customer service). In recent years, the scope and impact of IT activities have transformed – leaving companies increasingly reliant on IT function for successful operations. This growth has in turn elevated the need to acquire new skills constantly and quickly, leading IT professionals to embrace informal learning (Powell & Snellman, 2004).

Informal learning is relevant across a variety of industries and cultures (Callahan, 1999; Livingstone, 2001). As the current workplace evolves, so too does informal learning. Despite the subject's wide relevance, many scholars contend that informal learning is under-researched in the context of the workplace (Eraut, 2004; Marsick & Watkins, 2001). This study therefore offers organizations a means of quantifying the value of learning practices, which can lead to better-informed strategic decision making with regard to the promotion of learning for IT professionals.

Conceptual Definitions

This study used the following conceptual definitions:

IT Professional

Professionals who develop, deploy, support, and/or maintain technological systems, software, hardware, or applications. IT professionals might be developers, architects, analysts, engineers, technicians, and/or team leads (Bennett, 2009, p. 2).

Informal learning

Per Watkins & Cervero (2000), informal learning is "experiences that occur naturally as part of work" (p. 187). These experiences include on-the-job coaching, performance planning,

self-study including reading professional journals and books, and other potential activities with a learning goal (which may or may not be structured).

Organizational Support for Informal Learning

"Organizational support for informal learning" refers to a set of perceived conditions that reduce barriers to informal learning as identified by Lohman (2009). This includes the organization making time for learning, supporting learning by providing classes, offering funding, encouraging supervisors and colleagues to support learning, and making only learning resources available.

A Learning Organization

This study uses the term "learning organization" to refer to an organization "that learns continuously and transforms itself. Learning is a continuous strategically used process—integrated with and running parallel to work" (Watkins & Marsick, 1993, p. 8).

Knowledge Performance

"Knowledge performance" is the "creation and enhancement of products and services because of learning and knowledge capacity (lead indicators of intellectual capital)" (Marsick & Watkins, 2003, p. 139).

Summary

This chapter introduced the study, illustrated the theoretical framework, stated the problem and purpose, and highlighted the study's significance. The chapter closes with the conceptual definitions used throughout the study. The next chapter will provide a comprehensive review of the relevant related literature.

CHAPTER 2

REVIEW OF THE LITERATURE

The previous chapter introduced the study, illustrated the theoretical framework, stated the problem and purpose, and highlighted the significance of the study. To better provide a comprehensive review of the relevant literature, this chapter has two sections. The first section describes informal learning, with a focus on the Marsick and Watkins model. It also conceptualizes organizational support for informal learning. The second section explains the learning organization and knowledge performance.

The literature for this review was compiled based on internet search results for relevant student dissertations, scholarly articles, and books. Relevance was established based on keyword searches for *informal learning*, *organizational support*, *learning for IT professionals, learning organization*, *DLOQ*, *knowledge performance,* as well as for select demographic indicators.

Informal Learning

Since its inception, many authors have furthered the model developed by Marsick and Watkins (1990). As of 2018, more than 150 studies have used their model for informal and incidental learning (Beyerlein et al., 2017). The authors themselves also updated their model, in order to reflect emergent knowledge in the field of Adult Education and new information from examining the model in practice (Marsick et al., 2006; Watkins et al., 2014). According to Watkins et al. (2018), the evolved model emphasizes how context influences informal learning based on research by Cseh (Cseh et al., 1999; Fernandez-de-Alva, 2014; Marsick, Watkins, &

Lovin, 2009) and focuses more on social learning (Marsick & Watkins, 2015b; Nicolaides & Scully-Russ, 2018; Watkins & Marsick, 2014).

The Marsick and Watkins model, rooted in constructivism, is now a social constructivist heuristic that accepts the integral nature of the social interaction (Nicolaides & Scully-Russ, 2018; Watkins & Marsick, 2018). The common thread from Marsick, Watkins, and researchers who built upon their model (see Table 2) can be summarized in five concise points:

1. **The organization matters**. Context or environment is pivotal in determining the nature and quality of informal learning. The degree of austerity, industry, and other environmental factors, such as the opportunity for social interaction, also makes a difference (Callahan, 1999; Cseh et al., 1999; Skule, 2004; Marsick, Watkins, & Lovin, 2009; Warhurst, 2013; Watkins & Marsick, 2014).
2. **The individual matters**. Marsick and Watkins (2001) provided suggestions to organizations for encouraging informal learning, including discussing the organization's role in enabling the learner to become more self-directed. However, the onus for enablement remains on the employees themselves, along with their personal and professional characteristics (Hart, 2015; Illeris, 2004; Livingstone & Sawchuk, 2004; Sawchuk, 2008).
3. **The manager matters**. Scholars of informal learning agree that the manager and leadership and their support for learning– or lack of it – play a crucial role in how learners participate in informal learning opportunities (Ellinger & Ellinger, 2020; Enos et al., 2003; Eraut et al., 2001; Lohman, 2009; Skule, 2004). And managers and self-directed learners share some traits (Choi, 2009; Noe, Tews, & Marand, 2013).

4. **Social interaction matters**. The social aspect of informal learning is integral. Conversations and social structures, like communities of practice, are proven vehicles of informal learning (Hart, 2015; Marsick & Watkins, 2015b; Nicolaides & Scully-Russ, 2019; Scully-Russ & Boyle, 2018); and
5. **Technology matters**. Technology and how we interact with it are both changing. The technology itself, which may be the reason for learning, is capable of manifesting modern contexts for social learning (Cox, 2018; Justice & Yorks, 2018; Smith & Nicolaides, 2018; Thomas & Brown, 2011; Watkins & Marsick, 2018).

Origins of Informal Learning

Informal learning is an evolution of the discourse on formal and non-formal education (Colley et al., 2003). In 1947, UNESCO published a report on how the economies of developing countries were affected by non-formal education. Non-formal education was promoted as a flexible way to educate these countries, which lacked infrastructure and funds for public education, while incorporating traditional knowledge from the local population (Sawchuk, 2008).

The next wave of work on the topic came in the late 1960s and early 1970s. Tough (1967) focused on self-directed learning; Illich (1971) introduced the concept of de-schooling; Freire (1973), informed by power and political dynamics, wrote about the poor in Brazil learning through non-formal means.

By the 1980s, countries became interested in qualifying non-formal education gained through paid work or apprenticeship. Learning theorists categorized learning as formal, informal/non-formal, and incidental (Jarvis, 1987; Marsick & Watkins, 1990, 1999; Spear & Mocker, 1984; Watkins & Cervero, 2000). Spear and Mocker (1984) conducted qualitative interviews to test the hypothesis that organizing factors, separate from the learner, were the

catalyst for non-formal learning. The authors confirmed that context could drive learning. Following the study, the authors called for additional research on the effect of the context and the characteristics that enabled learners to learn outside formal settings. Marsick and Watkins (1990) sought to define informal, incidental learning by differentiating it from formal learning. Traditional formal learning opportunities are "provided in structured, institutionally sponsored, classroom-based activities," such as courses, seminars, and conferences. Informal learning, by contrast, refers to "experiences that occur naturally as part of work," including on-the-job coaching, performance planning, self-study (including reading professional journals and books), and other potential activities (themselves potentially structured), with a learning goal (Watkins & Cervero, 2000, p. 187). And incidental learning involves spontaneous opportunities that result from work – like, to give one example, a lessons-learned session following the completion of a project.

The Marsick and Watkins Model

Much of the literature and empirical studies are based on Marsick and Watkins' seminal 1990 work. Thirty years later, informal learning has never been more relevant (Sawchuk, 2008; Skule, 2004). Combined spending on formal and informal learning is up to $1.1 trillion dollars – $649 billion on formal learning and $413 billion on informal, according to a report published in 2015 by the Center on Education and the Workplace at Georgetown University (Carnevale et al., 2015). Part of the impetus behind Marsick and Watkins' model was, in fact, a report published by the same author, Anthony Carnevale, three decades before.

In 1984, Carnevale's economic modeling explained the growing prevalence of informal learning and its effect on economic output. Carnevale (1984) found that employers spent $210 billion dollars per year on training, $180 billion of which went to informal learning. (All

amounts are adjusted for inflation.) Carnevale also pointed out that 83% of workplace learning is informal and incidental, and only the remaining 17% is formal. Riding the wave of this information, Marsick and Watkins built out their model for informal and incidental learning with concepts from Dewey, Argyris, Schon, Lewin, Kolb, and Simon (Beyerlein et al., 2017; Marsick & Watkins, 1990; Nicolaides & Scully-Russ, 2018).

Dewey pioneered learning from experience and the idea of reflective thought as learning. Taking Dewey's (and Lewin's) work and applying it to theory manifesting in practice, Argyris and Schon (1978) developed action science and action research: a cycle of problem identification, experimentation, monitoring, and reflection. These authors asserted that learning happens under non-routine circumstances; critical reflection then creates solutions amidst ambiguity, and professionals must learn to think like their peers. Kolb (1984), who also draws on Dewey (1938) and Lewin (1951), suggested that meaning making differs from person to person. In Kolb's (1984) model, individuals can learn through concrete experience, abstract conceptualization, reflective observation, and active experimentation. Kolb, like Argyris and Schon, highlights "the importance of some kind of dialectical interaction between action and reflection, and between direct experience and its opposite" (Marsick and Watkins, 1990, p. 20).

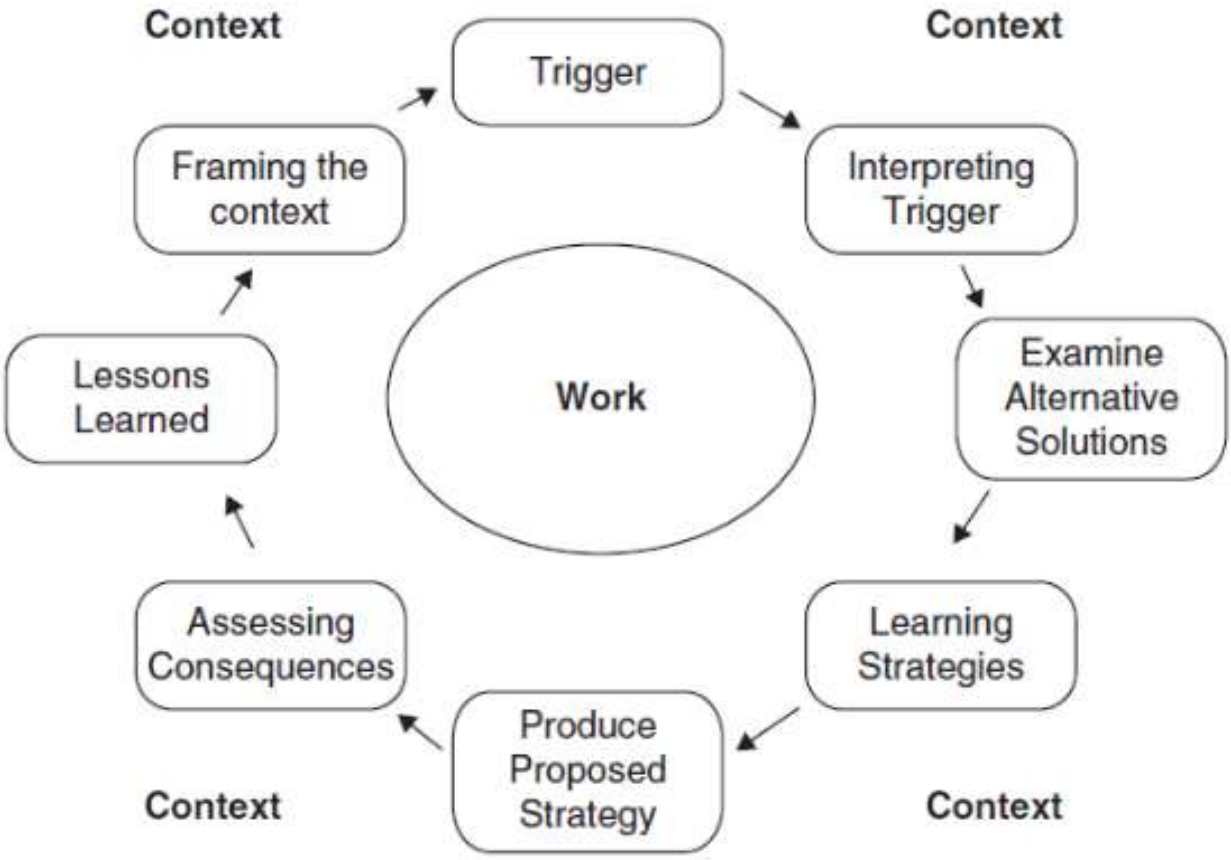
Simon's (1960) decision-making theory was the last element upon which Marsick and Watkins built their initial model. This theory asserts that decision making is affected by whether an activity is routine or non-routine. Marsick and Watkins (1990) integrated Simon's three stages of unprogrammed activity into their model: "(a) intelligence activity in which the individual searches the environment for conditions calling for a decision; (b) design activity in which the individual invents, develops, and analyzes courses of action; (c) choice activity" (p. 22).

The Marsick and Watkins model (see Figure 2), adapted from previous work, illustrates the idea that informal and incidental learning are essentially problem-solving approaches that stem from "triggers" of non-routine events or situations embedded in the everyday context of the organization – but in non-routine situations (Cseh et al., 1999; Marsick & Watkins, 2001; Watkins & Marsick, 1997). Within the context of an organization, the catalysts create the need to find a solution; a solution is developed, attempted, and then evaluated. This evaluation creates an opportunity for more informal learning through reflection. The cycle is broken into eight steps, but they are not necessarily linear or sequential (Watkins et al., 2018).

Marsick and Volpe (1999) suggest that informal learning is characterized by integration with daily routines; triggered by an internal or external jolt; not highly conscious; haphazardness and influence from chance; an inductive process of reflection and action; and linkage with the learning of others (p. 5). The emphasis on the non-routine is a departure from previous scholarship, which focused on pre-planning or organizing to enable learning in a linear structure (Spear & Mocker, 1984; Tough, 1971). In 2001, the authors updated the model to account for the perpetual nature of incidental learning (Marsick & Watkins, 2001). The learner initiates and self-directs through the unstructured environment, reflecting and reevaluating actions constantly. In this way, the model is learner driven. Beyerlein et al. (2017) further explain that with this model, organizations can "deliberately encourage such forms of learning" (p. 6).

Figure 2

*The Marsick and Watkins Model (2001) of Informal Learning**



* Diagram is from Marsick and Watkins, 1990. Used with permission.

To further illustrate their model, Marsick and Watkins (1990) analyzed six case studies through the lens of another model, drawn from the work of Dewey, Argyris, Schon, Lewin, Kolb and Simon, focusing on spontaneous, sometimes overlapping cycles of individual, experiential learning in the workplace. This learning takes place through identification of problems, interpretation of situations, attempts of solutions, and evaluation of results. The six case studies illustrate the characteristics of learners and leaders and show how informal and incidental

learning manifest differently at the individual and organizational levels. From the six cases, Marsick and Watkins (1990) identified six characteristics of informal and incidental learning:

- Learning takes place in non-routine situations (p. 76).
- Leadership and the role of facilitators are key, and can shape learning outcomes (pp. 92, 175).
- Reflectivity, creativity, and proactivity make for good learners (pp. 28-30).
- Reflection is an integral part of informal learning (pp. 97, 149).
- Tacit knowledge can be made explicit through informal learning (p. 99).
- The biography of individual experiences and assumptions both shapes meaning-making and can act as a barrier (p. 113).

The authors later synthesized their discoveries into

> three conditions [which] enhance this kind of learning: critical reflection to surface tacit knowledge and beliefs, stimulation of proactivity on the part of the learner to actively identify options and to learn new skills to implement those options or solutions, and creativity to encourage a wider range of options. (Marsick & Watkins, 2001, p. 30)

Alternate Definitions and Models for Informal Learning

In the early 2000s, authors Eraut, Livingstone, and Illeris separately and simultaneously proposed alternative definitions and models for informal learning. The authors focused on three key areas: 1) agency of the individual and influence of management, 2) the context or workplace environment, and 3) the distinction between informal and formal learning.

Eraut emphasized the importance of managers, citing earlier work that explained the tremendous effect managers have on the learning capacity of their employees (Eraut et al., 1999). Furthermore, Eraut (2004) explained that managers' informal, interpersonal role affects learning

even more significantly than their formal role, despite greater emphasis on the latter. Management training typically focuses on motivation, productivity, and performance reviews, and underemphasizes supporting the learning, allocating, and organizing of work, along with creating an environment conducive to informal learning (Eraut, 2004). As the magnitude of workplace learning became better understood, the shift from maximizing potential to enabling self-directed development became more important than ever. Eraut's assessment of both conscious and unconscious cognitive functioning addressed the role of the individual: Eraut posited that the ways in which a learner processes information (memory, reflection, discussion, planning) depends upon social and organizational contexts (Eraut, 2004; Sawchuk, 2008).

Livingstone (2005) offered a model of informal learning that was dependent on the situation. However, Livingstone's model around the roles of the learner and the teacher and the structure of the information, whether pre-established or situational. Livingstone focused on the power and control of human agency (Livingstone & Sawchuk, 2004; Sawchuk, 2008) and offered clear differentiation of the various types of learning, much like Marsick and Watkins (1990). Livingstone's definitions are detailed in the table below.

Table 1

Livingstone's Typology of Learning (adapted from Livingstone, 2005, pp. 980-981)

Type of learning	Manifestation
Formal Education	When a teacher has the authority to determine that people designated as requiring knowledge effectively learn a curriculum taken from a pre-established body of knowledge - either in the form of age-graded and bureaucratic modern school systems or elders initiating youths into traditional bodies of knowledge.
Non-formal education or further education	When learners opt to acquire further knowledge or skill by studying voluntarily with a teacher who assists their self-determined interests by using an organized curriculum, as is the case in many adult education courses and workshops.

Informal education or informal training	When teachers or mentors take responsibility for instructing others without sustained reference to an intentionally organized body of knowledge in more incidental and spontaneous learning situations, such as guiding them in acquiring job skills or community development activities.
Self-directed or collective informal learning	All other forms of intentional or tacit learning in which we engage either individually or collectively without direct reliance on a teacher or an externally organized curriculum. In the most expansive conceptions of human learning, self-directed learning may be seen as coterminous with life experience itself.

In Marsick and Watkins' model, informal learning by reflecting upon tacit knowledge was suggested as a mitigant for constraints from power and control, as "power dynamics might distort the way in which events are understood" (Marsick & Watkins, 2001, p. 31). Another key distinction is that Livingstone's work questioned the definition of "workplace." His work examined the informal labor sector as a venue for informal learning. Livingstone (2001) understood that research and discourse should not only focus on paid labor but should expand to include more aspects of life where work is performed, such as domestic labor and community service. Eraut (2004) researched several studies on informal learning conducted in workplaces and furthered the discourse by offering alternative definitions and grounding the emergence of the phenomena in organizational contexts themselves. Eraut described informal learning as a point situated on the informal end of an informal-to-formal spectrum. Incorporating the non-routine aspect of the Marsick and Watkins (1990) model, the author characterized the informal end of the continuum as "implicit, unintended, opportunistic and unstructured learning and the absence of a teacher" (Eraut, 2004, p. 250). Eraut (2004) further explained that this definition relies on Reber's (1993) conception of implicit learning, or the "acquisition of knowledge independent of conscious attempts to learn and in the absence of explicit knowledge about what

was learned" (p. 250). However, this did not imply that explicit learning and implicit learning could not take place simultaneously.

Eraut (2004) also made the distinction that informal learning is reactive rather than deliberate, according to Tough's (1971) definition, where

> there is a definite learning goal and time is set aside for acquiring new knowledge, and engagement in deliberative activities such as planning and problem solving, for which there is a clear work-based goal with learning as a probable by-product. (p. 250)

Eraut (2004) concluded that informal workplace learning is complex and dependent on context (meaning feedback and support, confidence and commitment, and challenge and value of the work) and learning factors (that is, allocation and structuring of the work, encounters and relationships with people at work, and expectations of each person's role, performance, and progress).

Perhaps the most important feature Eraut (2000) highlighted is the concept of intentionality, explaining that informal learning can be distinguished by timing and the learner's intent. In this model, informal learning can be either reactive or deliberate, depending on the learner's intent, and learning can take place in the past, present, or future. Schugurensky (2000) also calls informal learning conscious, self-directed, and intentional. And, in contrast to Livingstone (2001) as well as Marsick and Watkins (1990), Schugurensky includes incidental learning – unconscious and unintentional learning – as part of informal learning.

By contrast, the model offered by Illeris (2004) narrowed back down to the paid work arena while accepting that some individual components of informal learning do intersect with other parts of life. Illeris' model considered the emotional (what this model calls psycho-dynamic) and cognitive dimensions of three types of factors that influence informal learning:

technical-organizational, *social-cultural*, and *individual* (p. 432). The *technical-organizational* factors referred to what other scholars call "organizational context factors" and included the division of labor, degree of autonomy, and organization of opportunity for interaction. *Social-cultural* factors included workplace culture, political aspects of work, and communities of practice. The *individual* factor considered knowledge, skills, education/training, motivation, and – much the same as the Marsick and Watkins model – the biography of the individual. The Illeris model built around these factors' interaction with one another and their influence on informal learning.

Hart (2015), like Eraut, focused on practice, outlining 20 actions the organization can take to ready itself for modern workplace learning. The author recommended professionals first act for themselves and then help the organization. Hart divided the 20 actions into eight categories (new mindset; new ways of learning; new skills; professional goal setting and evidencing; daily learning workout; learning from daily work dealing with performance problems; and participating in a social, working team). While Hart provided examples, the list focused on encouraging autonomy and personal responsibility rather than overly prescriptive recommendations. This structure also recognized that formal learning is still a part of workplace learning. Hart's work further asserted that there exists another space, sometimes identified as hybrid learning, where formal and informal learning intersect. This intersection is neither exclusively formal nor informal, not solely social or incidental; it is not entirely structured, yet some structures exist.

In contrast with Livingstone's dichotomies of formal versus informal learning contexts, Hart's (2015) model of workplace learning did not use the term "informal learning." Rather, the model described informal learning as part of a dual-axis continuum across a spectrum of value

and autonomy. This description followed the conclusion, drawn by other scholars, that aspects of both formality and informality are apparent in all learning, and trying to distinguish between the two only creates more confusion (Billett, 1995, 2002; Colley, 2003; Eraut, 2004). Hart's concept showed four horizons, the least valuable and least autonomous of which was *courses* – "learning through training," or e-training. *Courses* were followed by *resources*, or "learning from information, supporting productivity and job performance." After *resources* came then *social collaboration*: "learning as part of daily working with others in teams and groups through sharing of knowledge and experiences." The final horizon, *personal learning*, was the most valuable and most autonomous. The term referred to "learning, individually, as part of daily experiences in the workplace, through self-improvement, and using the web (professional networking, keeping up to date, etc.)" (Hart, 2015).

Hart asserted that the shift in workplace learning was the result of a dramatic shift in the learners themselves. Living in a world with accessible internet meant learners had different expectations for information acquisition. Hart described this acquisition as continuous, on-demand, happening in short bursts, and social, as well as happening as part of the flow of work or on-the-go, serendipitous, and autonomous. This autonomy, Hart argued, has been the key feature of modern workplace learning since the advent of the internet. Individual learners have more agency in spending their time both personally and professionally. In this sense, the modern learner is self-managed – not necessarily working with their organization's learning authority.

Measuring Informal Learning

While informal learning in the workplace has been studied qualitatively and quantitatively, there is no single instrument or method as widely used or validated for the learning organization as the DLOQ. As Skule (2004) wrote, "Methods for measuring the

conditions that are conducive to this kind of learning are seriously underdeveloped" (p. 9). In both qualitative and quantitative research, scholars highlighted the challenges of measuring informal and incidental learning (Contu et al., 2003; Eraut, 2004; Eraut et al., 2000; Sawchuk, 2003). One major challenge is that the vocabulary of scholarship does not always translate to the general population. In particular, participants struggle with identifying informal learning versus tacit knowledge – and questions often reference and frame activities around their degree of formality, thereby skewing generalizations and creating biases from the outset (Livingstone, 2001). As Li (2021) aptly states, survey data that frames questions around "professional development and preparedness could possibly limit the learning experiences to only those associated with higher levels of intentionality and consciousness" (p. 86). Most of the qualitative studies employed case studies, interviews, and microanalysis (Colley, 2003; Sawchuk, 2008). Qualitative research on the topic also leveraged microanalysis, which usually relies on recorded slices of candid conversations from various workplace contexts. This microanalysis has yielded insights about how informal learning manifests in practice (Engestrom & Middleton, 1998; Luff et al., 2000; Sawchuk, 2008).

Many researchers have also attempted to study informal learning through quantitative survey research (Colley, 2003; Eraut, 2004; Livingstone, 2005; Sawchuk, 2003, 2008). According to Sawchuk (2008), attempts to study informal learning through surveys started with "Johnstone and Rivera's (1965) and later Penland's (1977) national surveys in the US...neither of these focused exclusively on work[;] however[,] each established the core observations and benchmarks concerning the extensive amounts of informal learning" (p. 11). Guglielmino (1977) published the Self-Directed Learning Readiness Scale (SDLRS), which uses eight factors to assess readiness for informal learning. In recent years, other attempts to study informal learning

resulted in creation of the Informal Learning Scale (Noe et al., 2013); a focus on learning channels; Kyndt et al.'s Questionnaire on Informal Workplace Learning Outcomes (2014) which emphasizes on outcomes; Froehlich, Beausaert, and Segers's (2017) social approach to work-related informal learning scale examining informal learning as feedback seeking, help seeking or information seeking behaviors; and the Informal Workplace Learning Scale (Decius et al., 2019), which outlines meaning-making activities and outcomes.

Watkins and Cervero (2000) developed the original version of the Learning Practices Audit, a survey instrument designed to assess organizational opportunities for formal, informal, and incidental learning practices. The authors first used this measurement tool to compare learning opportunities in a certified public accounting firm and a business services firm – but the instrument has not been widely used or validated. It has, however, been revised for the purposes of this study, and validated by a pilot study (Harman et al., 2021). Whereas the other measuring instruments focus on behavior, channels, and capability, the LPA is more applicable to learning and development professionals, as it evaluates learning practices based on specific learning practices. The items in this instrument use the stem "I learn from" paired with an activity. For example, "I learn from searching the internet" is one of the learning practices. The focus on the learning practice is the LPA's primary differentiator. Categorizing a learning practice as informal is based on Watkins and Cervero's (2000) criteria that informality be self-directed and pursued with a learning goal in mind (p. 187). Another key distinction is the Learning Practices Audit's simultaneous evaluation of incidental and formal learning practices, which may be useful for broader or comparative research.

Finding other empirical informal learning studies to inform this study required searches for "informal learning and the DLOQ," "informal learning for IT professionals," "organizational

support for informal learning," and "informal learning and knowledge performance." The results further required filtering for survey studies completed in workplace settings after the year 2000. In addition to searches related to the theoretical framework of the study, demographic factors were also included in the search.

These studies explore the extent and distribution of informal learning and influencing factors. Insights in empirical studies supported the trends identified in the seminal informal learning studies. The organization matters (Berg & Chyung, 2008; Nurmala, 2014; Watkins & Cervero, 2000). The individual matters (Choi, 2009; Livingstone, 2001; Lohman, 2009; Noe et al., 2013). The manager matters (Li, 2021; Harman et al., 2021; Skule, 2004). Social interaction matters (Han, 2015; Kim & Lee, 2006; Nurmala, 2014; Wilson & Hartung, 2015). Technology matters (Kim & Lee, 2006; Lohman, 2009).

The literature offers contradictory insights on the relationship between the learning organization and informal learning. Studies from Nurmala (2014) and Harman et al. (2021) indicate that there is a significant correlation between the two variables. However, data from Berg and Chyung (2008) suggest there is no significant relationship between the learning organization and informal learning. Articles related to informal learning for managers and the effects of age, education and remote work were also analyzed. Data from Harman et al. (2021) shows remote work has a positive effect on informal learning.

For age and education, the literature is inconclusive. Berg & Chyung (2008) found that age had a positive effect on informal learning, while Harman et al., (2021) found there was a negative relationship, and Noe et al. (2013) and Livingstone (2001) found age had no effect. Researchers are also divided on the effect of education – Harman et al. (2021) conclude that

education is significant, while Berg and Chyung (2008) and Livingstone (2001) found it was not.

Table 2

Summary of Relevant Informal Learning Studies

Relevance	Authors	Context (*N*)	Implications for the study
DLOQ	Nurmala (2014)	Public Health Professionals (172)	- Variables in learning opportunities, including informal learning opportunities and the dimensions of learning organization (DLOQ), are significantly correlated with each other - Learning organization is significantly correlated with informal learning
	Berg & Chyung (2008)	Human Resource Development Professionals in a mix of industries (125)	- Positive correlation between age and informal learning .05 level [r (123) = .195, p < .05] - Education did not affect informal learning - No significant correlation between informal learning engagement and the presence of learning organization characteristics
Role of Manage-ment	Choi (2009)	Korean banking sector (247)	- Formal learning affects informal learning significantly - Personal characteristics affect informal learning significantly - Work environments do not affect informal learning directly, and only have an indirect effect through formal learning - Self-experimentation is the most frequently used type of informal learning
	Noe et al. (2013)	Restaurant industry in the U.S. (180)	- Zest is a significant predictor of informal learning - Correlation between agreeableness and informal learning is significant - General mental ability related negatively to informal learning - Age and tenure were not significant predictors of informal learning

IT Professionals	Lohman (2009)	IT (143)	- Informal learning for IT professionals relies heavily on searching the internet - Six barriers in informal learning - Nine personal characteristics increase motivation to engage in informal learning
	Han (2015)	IT engineers in South Korea (432)	- Social interaction, sense of duty, trust, and enjoyment, proactive personality, and social exchange perception affect knowledge sharing positively - Economic rewards have a negative effect on knowledge sharing
Organizational Support for Informal Learning	Li (2021)	ESL instruction volunteers and paid teachers in the U.S. (77)	- Validated a version of the LPA (revised for ESL teacher/volunteer context) - Combined LPA with another instrument (GPI) - Participation in informal and incidental learning activities correlated positively with intercultural maturity - Paid instructors scored higher on LPA than volunteers - Organizational support for informal learning has a positive effect on informal learning
	Harman et al. (2021)	403 MTurk workers	- Validated the LPA - The learning organization correlated significantly to informal learning and organizational support for informal learning - Organizational support for informal learning correlated significantly to informal learning - Managers and those working in non-profits ranked higher on learning practices - Education is significant for learning practices - Age has a significant, negative relationship with informal learning - Remote work has a significant, positive relationship with informal learning
	Kim & Lee (2006)	Public-sector and private sector South Korea (322)	- Social networks, centralization, performance-based reward systems, employee usage of IT applications, and user-friendly IT systems are significant variables that affect employee knowledge-sharing

	Watkins & Cervero (2000)	Accounting and business services firms in the U.S. (3)	- Organizational context (tuition reimbursement, subscriptions to professional journals, video courses, computer-based courses, and encouraging peers to work and learn collaboratively) can drive the type of organizational support for learning
Age and Education	Living-stone (2001)	Canadian adult population (1,562)	- Engagement in informal learning activities is significantly higher than engagement in formal learning activities - Age does not affect informal learning participation - Prior education does not strongly affect informal learning
Social and Organizat-ional Context	Skule (2004)	Public-sector and private sector in Norway (1,300)	- Job-related factors influence learning intensity - Seven characteristics of the most learning intensive jobs (manager responsibilities, high degree of exposure to change and demands, manager support, reward, feedback, professional network)
	Wilson & Hartung (2015)	Executives from a mix of industries and countries (79)	- Five learning outcomes - Conversations are "high-yielding" for informal learning - Conversation-based informal learning is an understudied tool

Organizational support for informal learning: A Practical Application

Organizational support for informal learning first appeared in a pilot study by Harman et al. (2021). The authors conceived of the construct based on the organizational support literature, organizational learning literature around support, and informal learning literature, especially Lohman (2009). Lohman (2009) emphasized the challenges presented by lack of time, lack of proximity to colleagues' work areas, unsupportive organizational culture, inaccessibility of others, lack of equipment and technology, and lack of meeting/workspace. This construct was tested by Harman et al. (2021) and Li (2021) and proven valid and reliable.

Organizational support for organizational support theory was first developed by Eisenberger, Huntington, Hutchison, and Sowa (1986). These scholars explain that organizational support is based on the degree to which an employee perceives their organization's commitment to them. Two empirical studies showed that an employee's perception typically permeates all actions of the organization either negatively or positively; both absenteeism and effort are affected by perceived support, and the magnitude of these relationships increases when the employee perceives they will receive reward or recognition from the organization in return. When the expectation of reciprocity is higher, affective attachment is higher, "increasing the internalization of the organization's values and norms" (Eisenberger et al., 1986, p. 505). These researchers developed the Survey of Perceived Organizational Support, which has become a valid and distinct measure for the organizational support construct (Shore & Tetrick, 1991).

Organizational support examination specific to learning draws on literature from the psychology, management, human resources, and learning and development disciplines. There are references to organizations as supportive learning environments and to managers who support learning, but there is no single definition of what organizational support for informal learning is as a concept. According to the literature, the concept manifests in five components: activities, structures and behaviors, relationships, and the role of leadership. This differs from learning culture, which refers to "an environment that supports and encourages the collective discovery, sharing and application of knowledge…[in which individuals are] continuously developing new knowledge together and applying collective knowledge to problems and needs" (Gill, 2010, p. 5). Gill (2010) has also written on culture and how to create a learning culture in the organization. Schein (1985), as captured by Gill (2010), explains organizational culture as "the values, basic

assumptions, beliefs, expected behaviors, and norms, of an organization; the aspects of an organization that affect how people think, feel, and act" (p. 5). This pervasive element embeds in an organization through knowledge transfer, reflection, and feedback.

In the organizational learning literature, organizational support for learning comes in the form of activities, structures, behaviors, and relationships that promote learning. Activities considered organizational support include tuition reimbursement, job posting, self-assessment, job rotation, and career counseling (Pattie et al., 2006; Tansky & Cohen, 2001). Structures might include communities of practice, discretionary time for learning, and the availability and maintenance of learning tools – with particular attention given to e-learning platforms (Ahmed, 2010; Cheng et al., 2012; Chuo et al., 2011; Lee et al., 2011; Lim et al., 2007). Behaviors include open communication, active experimentation, taking the initiative, tolerance of mistakes, and openness to risk (Baskett, 1993; Chuo et al., 2011; Confessore & Kops, 1998; Joo et al., 2015; Shrivastava, 1983).

The literature also suggests that relationships are also a key form of organizational support (Hall & Mirvis, 1996). This refers not only to the relationships between coaches, mentors, and peers, but to the employee's perceived relationship with the organization (Joo et al., 2015; Jin & McDonald, 2017). The role of leadership is another component of organizational support presented in the literature (Chang & Lee, 2007; Foucher, 1996; Islam et al., 2013; Joo et al., 2010). Executives and managers play a crucial role in organizational support for learning, leading by example and aligning learning with strategic goals. Studies further showed that managers with clear development objectives had a greater organizational commitment and were more likely to promote learning for people on their team. The sum of these components inflates or deteriorates the perceived level of support from the employee perspective and affects

engagement in learning activities (Jin & McDonald, 2017; Kurtessis, et al., 2017; Salehzadeh et al., 2014).

The Learning Organization

This section starts with a brief description of the organizational learning as it relates to the learning organization. Next comes an explanation of Watkins and Marsick model of the learning organization, followed by an overview of alternate definitions and models. After that is a description of the Dimensions of the Learning Organization Questionnaire (DLOQ; Watkins and Marsick, 1997). The section then closes with a discussion of knowledge performance as a practical application of the learning organization model.

Origins of the Learning Organization

According to Sun & Scott (2003) in Kim (2016), the terms "organizational learning" and "learning organization" were synonymous until the late 20th century. In the 1990s, researchers began to differentiate between the two. Today, many scholars distinguish organizational learning as the process of organizations learning, and the learning organization as a type of organization (Tsang, 1997; Denton, 1998; Ortenblad, 2001). The two are no longer mutually exclusive or functional equals.

Many scholars have attempted to define organizational learning. Based on the literature, organizational learning can be described as the acquisition or creation of new knowledge that affects organizational behavior (Fiol & Lyles, 1985; Huber, 1991; Sinkula, 1994; Slater & Narver, 1995). Sinkula's (1994) model of organizational learning is a three-stage process of information acquisition, information dissemination, and shared interpretation. Dixon (2017) takes a more dynamic approach, defining organizational learning as the use of learning processes for continuous transformation. "The little R&D" (p. 133), as Marsick and Watkins (2003) call it,

constitutes the organic workplace learning prompted by the work itself: team members learn and transfer knowledge to others constantly, in the process creating organizational knowledge. Tsang and Zahra (2008) call organizational learning as "The discarding of old routines to make way for new ones" (p. 1437). And according to Slater and Narver (1995), in most cases, the definitions all promote the same change model: learning leads to changes in behavior, and those changes enhance business performance.

The organizational learning field is permeated by other disciplines, including organizational knowledge, knowledge management, intellectual capital, and organizational memory (Spender, 1996; Vera & Crossan, 2004). In the last thirty years, the body of work on organizational learning has expanded in terms of empirical studies and theoretical developments (Bapuji & Crossan, 2004). Many scholars, such as Huber (1991), Dodgson (1993), Crossan et al. (1995), Miller (1996), and Easterby-Smith (1997) provided literature reviews which united and structured the scholarly discourse. The 1990s in particular saw a drastic increase in the number of quantitative empirical studies on the topic, which employed experiential learning concepts within the organization as the unit of analysis (Bui & Baruch, 2012). According to Bapuji and Crossan (2004), the literature throughout the 1990s and early 2000s was dominated by three major debates, which they called theoretical, analytical, and environmental.

One area where organizational learning needs more attention is guidance on how organizations can learn more effectively (Huber, 1991), in the process becoming learning organizations, embracing continuous learning as a part of work and transformation (Watkins & Marsick, 1993, p. 8). This evolution, from organizational learning to the learning organization, is a strategic imperative, according to Kim (2016).

Watkins and Marsick Model of the Learning Organization

The model of the Dimensions of the Learning Organization (Watkins & Marsick, 1993) exemplifies most of these characteristics and integrates learning culture, the role of leadership, and strategy (Beyerlein et al., 2017). Watkins and Marsick provided an integrative concept of the learning organization based on three approaches: 1) for systems thinking, organizational generativity (Senge, 1990); 2) for a learning perspective, comprehensive aspects of learning at all organizational levels (Pedler et al., 1991); and 3) for the strategic perspective, managerial practices (Garvin, 1993; Goh, 1998) and environmental connections. Like Marquardt (1996) and Crossan et al. (1999), this model takes a holistic view of the learning organization, accounting for the *societal* (later adapted to *global*), *organizational*, *team,* and *individual* levels. The individual level accounts for continuous learning, dialogue, and inquiry, whereas the team level encompasses collaboration and team learning. The organizational level addresses empowerment and systems; finally, the societal level looks at the connection to the environment (see Figure 3). Watkins and Marsick (1993, 1999) described a learning organization with six dimensions (or *action imperatives*) across these four levels, and later expanded their model to include a seventh dimension. Marsick and Watkins (1999) provided definitions for each of the seven dimensions:

- **Create continuous learning opportunities (CL).** Learning is built into work so that people can learn on the job; opportunities for ongoing education and growth are provided.
- **Promote inquiry and dialogue (DI).** People gain productive reasoning skills to express their views; they also gain the capacity to listen and inquire into the views of others. The culture changes to support questioning, feedback, and experimentation.

- **Encourage collaboration and team learning (TL).** Work is designed for groups to access different modes of thinking. Groups are expected to learn together and work together; the culture values and rewards collaboration.
- **Create systems to capture and share learning (ES).** Both high- and low-technology systems to share learning are created and integrated with work. Access is provided, and systems are maintained.
- **Empower people toward a collective vision (EP).** People are involved in setting, owning, and implementing a joint vision. Responsibility is distributed close to decision making, further motivating to learn about that for which they are accountable.
- **Connect the organization to its environment (SC).** People are helped to see the effect of their work on the entire enterprise, scanning the environment and using information to adjust work practices. The organization is linked to its community.
- **Providing leadership for learning (PL).** Strategic leadership promotes learning at all levels of the organization. Learning is valued, and learning goals are part of the organization's strategic vision.

Figure 3

*Watkins-Marsick Model (1993) of the Learning Organization**

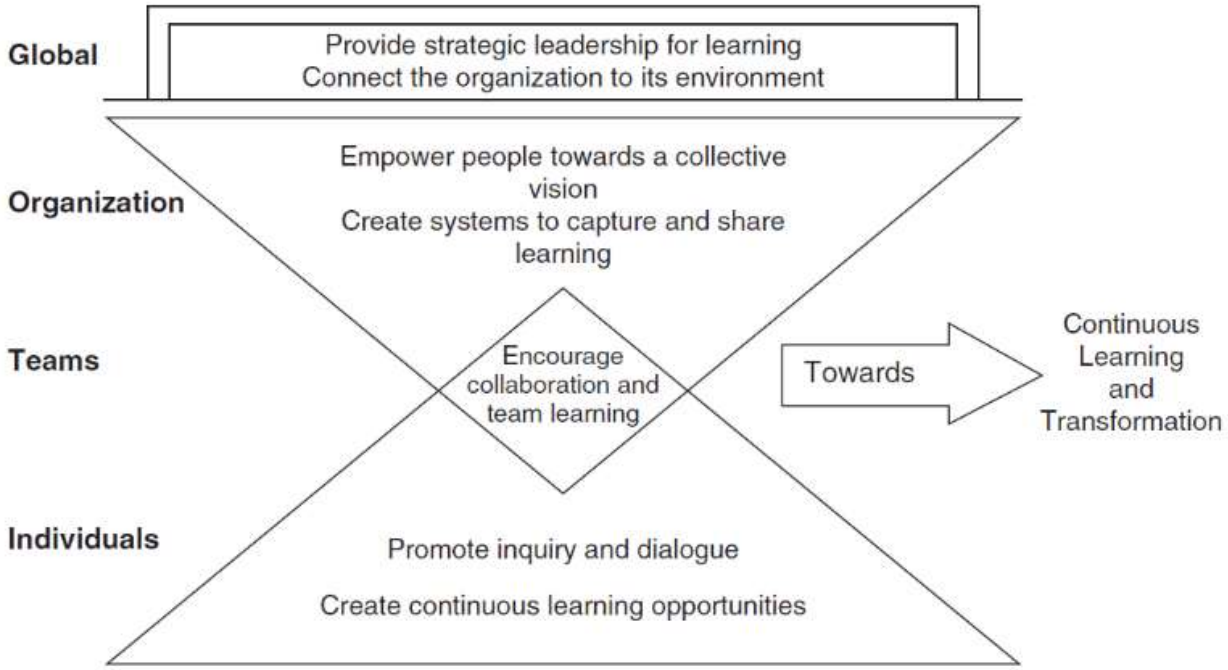


*Diagram is from Watkins & Marsick, 1997. Used with permission.

In the most basic estimation, these imperatives exhibit a pervasive commitment to learning (Gill, 2010). The imperatives are enabled by seven characteristics (see Figure 4), or what the authors referred to as the *7Cs*: Continuous, collaborative, creative, captured and codified, connected, collective, and capacity-building (Watkins & Marsick, 1993, p. 279). As cited in Watkins and O'Neil (2013), "These attributes would foster organic growth of learning organizations" (p. 135). In 1996, the authors solicited case studies of organizational learning. They chose 22 cases to publish in *In action: Creating the Learning Organization,* which exemplified the action imperatives. In consideration of increasing international influence, the authors also updated the learning level of society (Beyerlein et al., 2017), stressed the importance of leadership, and came up with three recommendations for leadership to implement (Watkins & O'Neil, 2013). Watkins and Marsick (1996) explain that "learning at the global level is thinking

globally; crossing boundaries of environmental or societal impacts, including those that affect the quality of life afforded organizational members by the organization" (p. 7). For leaders, Watkins and Marsick (1996) made the following recommendations on fostering a learning environment:

- Embed a learning infrastructure—not a training department, but a widespread means of creating, capturing, and disseminating knowledge,
- Cultivate a learning habit in people and in the culture so that a spirit of inquiry, initiative, and experimental thinking predominates,
- Regularly audit the knowledge capital in the organization and progress toward eliminating barriers to learning (pp. 282-283).

In 1999, the authors further developed the characteristics of the learning organization and offered more recommendations for practice in *Facilitating the Learning Organization*. This text also introduced the seventh action imperative – *(PL) provide strategic leadership* – under which leaders would model, champion, and support learning; and leadership would use learners strategically, for business results. In this new dimension, Marsick (1999) identified culture, strategy for learning, processes and practices for learning, and people practices as core drivers for the learning organization (pp. 208-209).

Figure 4

*Marsick and Watkins Framework of the Learning Organization**

Four levels of learning	Nature of learning	Six action imperatives	Learning outcomes (7Cs)
Individual	Change in behavior, knowledge, motivation, capacity to learn	Continuous learning opportunities Inquiry and dialogue	Continuous learning for continuous improvement
Teams	Change in a group's capacity for collaborative and synergistic work	Collaboration and team learning	Collaborative, connected, collective, creative
Organization	Change in organizational capacity for innovation and new knowledge	Systems to capture and share learning Empowering people	Connected, captured and codified, capacity–building
Society	Change in overall capacity of community and society	Connection to environment	Connected by enhancing community's capacity–building

* Diagram is from Marsick and Watkins, 1993. Used with permission.

Alternate Definitions and Models for The Learning Organization

This section outlines the various definitions of the learning organization, starting with Senge (1990) and continuing through two decades of research to Gill (2010). Following that outline, the section details the model of the dimensions of the learning organization, as this model represents the most parsimonious, comprehensive definition of "learning organization" to date (Watkins & Marsick, 1993).

The learning organization is the evolution of organizational learning, whereby the firm, with a solid foundation of core competencies, can create, integrate, and apply knowledge, and is thereby enabled to sustain a competitive advantage (Bierly et al., 2000; Thomas & Allen, 2006).

Several scholars attempted to define the phenomena of the learning organization throughout the 1990s and early 2000s. Senge (1990) described a *learning company* as

> a place where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free and where people are continually learning how to learn together. (p. 3)

Kofman and Senge (1993) highlighted the role of the individual, stating that the individual is viewed as a "legitimate being" in the learning organization (p. 16). Garvin (1993) criticized Senge's concepts as too abstract and without practical application. Garvin defined the learning organization as "an organization skilled at creating, acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge and insight" (p. 80). Similar though not-quite-synonymous definitions appeared for organizations with a *learning culture* or *learning-rich environment* (Boud & Garrick, 1999). The *learning-rich* construct, from Boud and Garrick (1999), asserted that organizations need to create environments conducive to learning. Probst and Büchel (1997) defined learning culture as an implicit phenomenon and "a system of knowledge and insights which serve as a basis for interpreting experiences and generating actions" (p. 129).

Senge's seminal work also defined the *learning company*: a company that facilitates continual learning for its members through eleven specific channels (Pedler et al., 1989). Garvin's element of transformation (1993) is also present in the earlier work of Pedler et al. (1989), which defines a *learning company* as "an organization which facilitates the learning of all of its members and continuously transforms itself" (p. 2).

Watkins and Marsick (1993) offered the most comprehensive definition of the learning organization: "one that learns and continuously transforms itself" (p. 8). The authors later added that "The learning organization is a living, breathing organism that creates the space that enables

people and systems to learn, to grow and to endure" (Marsick & Watkins, 1999, p. 210). Gephart et al. (1996) refined Watkins and Marsick 's earlier definition (1993), describing learning organizations as those with "an enhanced capacity to learn, adapt, and change" (p. 34).

The same year, Marquardt (1996) defined the learning organization in terms of an increase in capability based on an organization-wide commitment to continuous improvement. Shortly after, Goh (1998) framed the learning organization using five building blocks: teamwork and cooperation, clear understanding and support of the vision, shared leadership and participation, encouragement of experimentation, and knowledge transfer. Ortenblad (2001) called it an organization wherein deliberate activities are undertaken to achieve an aspired-to level of learning.

This conceptual evolution, spanning two decades, came to a consensus around several key characteristics. There is an element of change or continuous improvement: knowledge is transferred, shared, and consumed at the individual level, then moves to organizational levels. None of the definitions are static. And Senge (1995) also explored the adaptation component, positing that in a learning organization, adaptive learning in concert with generative learning is what enables double-loop learning. Generative learning takes place when an organization engages in critical reflection and systems thinking, questioning assumptions, and evaluating relationships (Argyris, 1977; Senge, 1990). While generative learning can lead to competitive gains, this initial advantage diminishes over time and is sustainable only through continuous improvement (Womack et al., 1990).

Capacity and capability are other key concepts (Ulrich et al., 1993; Gephart et al., 1996). Ulrich et al. (1993) used the term "learning capability" and discussed strategies for making it a priority. This refining and realigning of the learning organization also draws attention to the

integral role of leadership or management in the learning organization. Those in charge must make space for and encourage learning (Goh, 1998, 2001; Marquardt, 1996; Ulrich et al., 1993). Watkins and Marsick (1993) liken the role of the leader to that of a sculptor who is crucial in rallying people around a vision.

Finally, the learning organization is deliberate. According to Garvin (1993), there must be an emphasis on knowledge transfer. Specific actions are undertaken to achieve an end (Denton, 1998; Ortenblad, 2001).

Measuring the Learning Organization

As Kim et al. (2015) describe, organizations attempted to become learning organizations to establish or maintain their competitive advantage (p. 95). This strategy led to the formation and development of validated instruments to assess the learning organization culture. Such diagnostic tools can be important, as organizational change necessitates the diagnosis of the current state of organizational culture at the first stage of the efforts (McLean, 2006). Preskill and Torres (1998) developed "The Readiness for Organizational Learning and Evaluation Instrument" (ROLE), which has six areas of organizational learning (Culture, Leadership, Systems and Structures, Communication, Teams, and Evaluation). The Garvin et al. (2008) model looks at the environment, processes and practices, and leadership. However, the best-known instrument is the Dimensions of the Learning Organization Questionnaire (Watkins & Marsick, 1997), commonly referred to as the DLOQ. According to Kim (2016) and Thomsen & Hoest (2001), all but a few empirical studies on the learning organization use this instrument. The DLOQ grew out of the learning organization culture framework suggested by Watkins and Marsick (1993, 1996) in their book, *Sculpting the learning organization: Lessons in the art and science of systemic change*, as well as their later works. Based on the model of the dimensions of

the learning organization (Watkins & Marsick, 1993, 1996; Watkins and Marsick, 1997), the authors developed the first iterations of the DLOQ to measure the organizational environment for learning in the context of their model's dimensions and to calculate its effect on organizational performance. Subsequent scholars adapted and validated different versions of the DLOQ for different contexts, changing the length, adding constructs, and translating it into different languages.

The DLOQ has been widely used in and validated by a variety of industries, geographies, and organizational contexts (Watkins & Dirani, 2013; Song et. al, 2009). Researchers confirmed validity in more than 120 studies using exploratory or confirmatory factor analysis, correlation matrix analysis, or means comparison (Kim et al., 2015). Scholars highlight the instrument's reliability across various organizational and cultural contexts (Kim, 2016), with the majority of reported Cronbach α coefficients greater than .80 (Song et al., 2013).

To understand how the DLOQ could be employed in the prospective study on informal learning and learning organization for IT professionals, a few empirical studies were selected for review (see Table 3). To select these studies, "Dimensions of Learning Organization Questionnaire Validation" was searched in Google Scholar, and the results were filtered for research published after the year 2000. First, a list was compiled, with the intent to reflect an array of different cultural and industrial contexts. Second, the list was narrowed by looking for samples of IT Professionals or single professional groups. (Nurmala (2014) was added to the list of reviewed literature since – as is also the case with this study – Nurmala used both the DLOQ and the Watkins & Cervero audit of learning practices.) Third, studies using the DLOQ and related to gender and remote work (two variables of interest for IT professionals and

management because of those variables' general effect on informal learning) were also included in the search.

These empirical studies informed the methodology and design of the study on the informal learning of IT professionals and its relationship to the learning organization. The studies confirm that the DLOQ can be combined with other constructs to understand the phenomena of interest (Hernandez, 2003; Sta. Maria & Watkins, 2003). Consequently, the study will use the DLOQ and a revised Learning Practices Audit to assess learning practices. The published studies also model accepted methodological best practices for application in the project by using meta-analysis and means comparison for reliability. The empirical work also points to the use of CFA, standard fit tests, and Cronbach's alpha coefficient (Nurmala, 2014; Song et al., 2009).

The studies chosen for synthesis were all from different countries and cultural contexts. While the study will be done in English, and the onomasiological issues from translation and cultural differences will therefore be beyond control, the cross-cultural validation of the DLOQ enhances the instrument's validity (Ya-Hui Lien et al., 2006; Zhang et al. 2004). And several studies validated the use of the DLOQ in the both the field of technology and on a single professional group, in turn validating its application in the context of this study.

Other research which highlighted demographic influences on the DLOQ created space for investigation of these characteristics in the context of the IT professional as an informal learner. Because IT professionals have often been and will increasingly be remote workers, insights from Kashif's (2015) examination of the effect of remote work on the DLOQ are highly useful for this study. Kashif found that only strategic leadership and knowledge performance were below the comparative mean. An unpublished study from Stothard et al., (2012) shows that women ranked the dimensions higher than men. This warrants further investigation, as women in IT report

experiencing a lack of support in the workplace. IT professionals as informal learners are heavily affected by management, and, while the DLOQ's strategic leadership covers behavioral and cultural aspects, there is no consensus in the literature on how a respondent's role affects their perception of the learning organization, whether the respondent is a manager or not (Hasson et al., 2013).

DLOQ studies which analyze knowledge performance outcomes in specific professional settings were included in the search. By an overwhelming margin, they confirmed a high perception of a learning organization coupled with a high perception of knowledge performance. These results are included in the next section.

Table 3

Summary of relevant DLOQ studies

Relevance	Author(s)	Context (*N*)	Means across Dimensions						
			CL	DI	TL	ES	EP	SC	PL
Sampled IT Profess-ionals	Egan et al. (2004)	IT in the USA (245)	4.22	3.9	4.1	3.58	3.89	4.38	4.23
	Song et al. (2009)	Mix of industries (including IT) in South Korea (529)	3.68	3.7	3.65	3.61	3.55	3.75	3.76
	Ya-Hui Lien et al. (2010)	Finance/ insurance and High-tech in Taiwan (355)	3.71	3.71	3.67	3.79	3.79	3.79	3.79
	Jamali et al. (2009)	Banking and IT in Lebanon (227)	3.79	3.81	3.55	3.66	3.35	3.84	3.96
Manager Impact	Hasson et al. (2013)	Swedish Forestry							

		Company (101)							
Remote Work	Kashif (2015)	Mix of Industries (75)	4.12	4.34	4.18	3.89	3.91	4.14	4.05
Gender	Stothard et al. (2012)	Australian Army (862)	3.45	3.44	3.21	3.32	2.84	3.14	3.39
		Australian Army (199)	3.58	3.90	3.20	3.55	3.22	3.14	3.73
Informal Learning	Nurmala (2014)	Healthcare in the USA (172)	4.22	3.9	4.1	3.58	3.89	4.38	4.23
Diversity of Industry and Cultural Context	Abu-Tineh (2011)	Qatar/ university faculty (100)	3.93	3.93	3.99	3.87	3.87	3.87	3.87
	Leufvén et al. (2015)	Healthcare in Nepal (135)	3.24	3.14	3.29	3.17	3.09	3.21	3.75
	Zhang et al. (2004)	Service and Manufacturing in China (477)	3.74	3.78	3.77	3.55	3.75	4.11	4.0
	Hernandez (2003)	Manufacturing in Colombia (906)	3.94	4.16	4.01	4.09	4.21	3.96	4.27
	Sta. Maria & Watkins (2003)	Government in Malaysia (628)	4.05	4.08	3.84	3.97	3.79	3.98	4.21

Knowledge Performance: A Practical Application of the Learning Organization

Iterations of the DLOQ instrument include translations into various languages, variations in length, and the use of alternative constructs to measure organizational performance. Initial versions of the DLOQ captured organizational performance using two constructs: knowledge

performance and financial performance. Later, McHargue (2003) created the mission performance construct, followed by Kim's (2016) development of the adaptive performance construct.

Most studies on organizational performance measure based on financial performance variables (Richard et al., 2009). Financial performance as a construct is reliable and easily validated, as the data points, such as return on assets, return on equity, and return on investment are tangible – and, in the case of publicly traded companies, easy to access. The six financial performance items of the DLOQ are designed to capture the perceived "financial health and resources available for growth" (Marsick & Watkins, 2003, p. 139). This construct has also been validated in multiple studies (Kim, 2016; Davis & Daley, 2008; Ellinger et al., 2002). While some studies indicate a positive relationship between the learning organization and financial performance, as perceived by respondents, this was not the case in all studies (Kim, 2016). Additional research found that when compared to actual financial results, the relationships held, and in some cases the correlation between the learning organization and financial performance even increased (Ellinger et al., 2002; Davis & Daley, 2008).

In a study by Menezes et al. (2011) the learning organization accounted for 29% of the variance in knowledge performance. While widely known as a construct and validated as part of the DLOQ, not many studies validate knowledge performance by exploring the correlations between knowledge performance and other constructs (Kim, 2016; Davis & Daley, 2008; Hernandez, 2003). By examining knowledge performance with organizational support for informal learning and learning practices, the study addresses this gap. The construct of knowledge performance is a cornerstone of Kaplan and Norton's (2004) Balanced Score Card approach, which proved that "knowledge…creates different advantages or capabilities of the

company's employees to satisfy customer needs" (p. 202). And the DLOQ's six knowledge performance items also serve as an indication of organizational performance. Marsick and Watkins (2003) define knowledge performance as "creation and enhancement of products and services because of learning and knowledge capacity (lead indicators of intellectual capital)" (p. 139). Perceptions of customer satisfaction, new goods and services offered, continuous improvement, learning and development, and spending on technology and information processing are assessed.

Table 4

Summary of Relevant Knowledge Performance Studies

Relevance to Study	Author(s)	Purpose/Context (*N*)	Knowledge Performance Means
DLOQ Impact on Knowledge Performance	McHargue (1999)	U.S./ NPOs (264);	4.32
	Milton (2003)	International association (264)	3.79
	McCaffrey (2004)	Australian public sector (237)	3.88
	Power & Waddell (2004)	Multiple industries in Australia (62)	4.79
	Yang et al. (2004)	China/ state owned enterprises (477)	4.37
	Davis & Daley (2008)	Manufacturing and services sector in the U.S.A. (592)	4.1
	Watkins et al. (2009)	Public health workers in the U.S.A. (675)	2.95
	Menezes et al. (2011)	Electronics sector in Brazil (566)	3.4
	Kim (2016)	MTurk Workers (560)	4.05

To tailor the DLOQ to non-profits, McHargue supplemented the financial and knowledge performance with a third construct: mission performance. According to McHargue (2003), non-profit organizations typically share a set of traits that affect learning and development and can prevent becoming a learning organization. These traits include focusing more on their mission and less on internal development; limited financial resources for training and development; a budget that varies drastically year to year; a large proportion of membership made up of volunteers; seeing similar firms as competitors, which inhibits knowledge sharing; operating in a space where there is disconnect between stakeholders and outcomes; and using success metrics that are mission driven and often intangible (McHargue, 2003, p. 197-198). Other studies on non-profit organization using the mission performance construct found a significant relationship between the dimension of the learning organization and mission performance (Milton, 2003; Watkins et al. 2009; Wetherington & Daniels, 2013).

Within the last decade a third performance construct, adaptive performance, was developed, to measure how well an organization adapts. Kim (2016) developed the adaptive performance construct to measure organizational response to contextual changes over time. This conceptualization was adapted from Walker and Ruekert (1987, p. 19). Kim (2016) used six items to accompany the DLOQ, which assess how organizations respond to organizational, industry, and competitor changes; how quickly they adopt new technology; and the degree to which they pursue new opportunities. Kim (2016) found that adaptive performance mediates the positive relationship between a learning organization and financial performance, adaptive performance has a positive effect on financial performance, and knowledge performance is correlated with adaptive performance. Studies using the adaptive performance construct are

ongoing, as is the creation of additional constructs to refine the DLOQ's organizational performance measurement capabilities.

Summary

This chapter reviewed the relevant literature on the informal learning, organizational support for informal learning, the learning organization, and knowledge performance. Based on this review, it is clear that the relationship between the learning organization and informal learning for IT professionals needs to be investigated further.

The next chapter provides an overview of the measurement framework, including a summary of the measurement and knowledge gaps presented in the literature as they pertain to each hypothesis. The chapter also offers a description of the research design and the methodology used to investigate each of these research questions.

CHAPTER 3

METHODOLOGY

This chapter provides an overview of the study's methodology. First is a review of the measurement framework, followed by the design of the study. Then, details on the data collection method and pilot study from Harman et al. (2021) for the instrument are provided. The chapter concludes by explaining the data analysis approach.

This quantitative study used survey data to understand the relationship between informal learning, the learning organization, and organizational support for informal learning of information technology (IT) professionals. The study employed a revised LPA (Watkins with Harman and Li, 2020) and the DLOQ with knowledge performance measures, and was administered through MTurk. Data analysis used structural equation modeling.

Measurement Framework

The purposes of this study were to 1) validate the Learning Practices Audit, 2) understand the relationships between learning practices, organizational support for informal learning and the learning organization for IT professionals, and 3) to understand the knowledge performance outcomes for organizations. This study tested 17 hypotheses.

Hypothesized Outcomes for IT Professionals

As described in the previous chapter, Watkins and Marsick provided sound theoretical foundations for both informal learning and the learning organization, which other scholars employed to produce empirical studies that enhance the understanding of the topics. However, gaps still exist in measuring learning practices and understanding the relationships between

informal learning; organizational support for informal learning; and the learning organization and knowledge performance, particularly in the context of IT professionals. (Figure 5 illustrates hypotheses on the relationships between constructs.) Few studies address informal learning for IT professionals as a group. Several hypotheses related to the impact of demographics also emerge from the profile of the IT professional as well as the literature on informal learning and the learning organization. Despite a lack of empirical studies that encompass the full theoretical framework, this chapter presents substantial evidence in support of the following hypotheses:

Hypothesis 1: The Learning Practices Audit is a reliable and valid measure for assessing learning practices for IT professionals. This tool developed based on the literature on formal, informal, and incidental learning, which in turn categorizes activities based on an array of factors including learner intent and degree of structure. An expert panel vetted the LPA's items and constructs, deployed to pre-pilot groups, and validated the LPA in a pilot study. Therefore, the expectation is that the LPA will prove a reliable and valid measure for assessing learning practices.

Hypothesis 2: A learning organization has a positive effect on informal learning practices. This assertion is based on a plethora of theoretical and empirical evidence. The learning organization is one "that learns continuously and transforms itself. Learning is a continuous strategically used process—integrated with and running parallel to work" (Watkins & Marsick, 1993, p. 8). Using this definition, informal learning is an intrinsic outcome of the learning organization: with informal learning, the organization matters. The context is pivotal for determining the nature and quality of informal learning. This includes facets which may be promoted within learning organizations, such as the opportunity for social interaction or quality of communication (Callahan, 1999; Cseh, 1999; Skule, 2004; Marsick, Watkins, & Lovin, 2009;

Warhurst, 2013; Watkins & Marsick, 2014). Nurmala (2014) found that the presence of a perceived learning organization correlated significantly with participation in the informal learning activities. Though a study from Berg and Chyung (2008) did not find a significant correlation between informal learning engagement and the presence of learning organization characteristics, the proximity between themes from the informal learning literature and dimensions of the learning organization suggests – overwhelmingly – that the learning organization would have a positive effect on informal learning practices. Although these studies focus on informal learning and the learning organization, and not on IT professionals specifically, the findings may apply to this group.

(CL) Create continuous learning opportunities, in which learning is built into work, enabling people to learn on the job and creating opportunities for ongoing education and growth, aligns with the importance of organizational context exposed in the informal learning literature. Factors such as autonomy, social interaction, and industry all influence informal learning (Callahan, 1999; Cseh, 1999; Illeris, 2004; Marsick et al., 2009; Warhurst, 2013; Watkins & Marsick, 2014). The importance of social interaction is likewise highlighted in both the dimensions of the learning organization and the informal learning literature. *(DI) Promote inquiry and dialogue* – appears in studies on informal learning. Social interaction (and, more specifically, conversations with colleagues) has a significant, positive effect on informal learning (Han, 2015; Wilson & Hartung, 2015). Therefore, it is logical to assert that the *(DI)* dimension would also benefit informal learning. The *(TL) Encourage collaboration and team learning* dimension would be expected to have a similar effect, even across digital platforms, and is a proven means of informal learning (Marsick & Watkins, 2015b; Nicolaides & Scully-Russ, 2018; Scully-Russ & Boyle, 2018). Technology is also integral to informal learning (Cox, 2018;

Hart, 2015; Justice & Yorks, 2018; Kim & Lee, 2006; Smith & Nicolaides, 2018; Thomas & Brown, 2011; Watkins & Marsick, 2018). The learning organization considers technology in the dimension *(ES) Create systems to capture and share learning*. Evidence from the informal learning literature also suggests a close link to the *(EP) Empower people toward a collective vision* dimension, wherein people are involved in setting, owning, and implementing a joint vision; responsibility is distributed close to decision making, so that people are motivated to learn that for which they are accountable. (*PL) Providing leadership for learning* is another dimension which would likely contribute to the relationship between the learning organization and informal learning. Leadership and the manager matter in formal learning, as management and leadership advocacy for the learner – or lack thereof – is a success factor for informal learning (Ellinger & Ellinger, 2020; Enos et al., 2003; Eraut, 2004; Hart, 2015; Lohman, 2009; Skule, 2004).

Hypothesis 3: Organizational support has a positive effect on informal learning. Although organizational support for informal learning has not been widely validated as a construct and its effect on informal learning is unknown, its basis for this hypothesis is substantiated by scholarly work. This construct is based largely on the work of Lohman (2009). Lohman's (2009) study identified six environmental factors that are barriers to informal learning for IT professionals: lack of time; lack of proximity to colleagues' work areas; unsupportive organizational culture; inaccessibility of others; lack of equipment and technology; and lack of meeting/workspace. Organizational support for informal learning encompasses actions which would address each of these barriers directly.

Hypothesis 4: A learning organization has a positive effect on organizational support for informal learning. A positive relationship is expected based on how closely the dimensions align

with the actions described as organizational support for informal learning. “Encouragement to help each other learn” corresponds directs to *TL* and *DI*. “Access to online resources” and “providing time to learn” could be addressed as *CL*, in which learning is woven into work and management support could be included in *PL* strategies.

Hypothesis 5: A learning organization has a positive effect on knowledge performance. This assertation is based on the numerous supporting studies (Kim, 2016; Hernandez, 2000; Yang et al., 2004; Zhang et al., 2004; Davis & Daley, 2008; Watkins et al., 2009). Please see Table 4.

Hypothesis 6: Informal learning has a positive effect on knowledge performance. This is based on the conceptual definitions of knowledge performance and informal learning. Knowledge performance, according to Marsick & Watkins (2003), is the “creation and enhancement of products and services because of learning and knowledge capacity (lead indicators of intellectual capital)” (p. 139), and informal learning refers to “learning experiences that occur naturally as part of work” (Watkins & Cervero, 2000, p. 187). The informal learning literature highlights the importance of the individual. According to Marsick and Watkins (2001), one way for organizations to improve is by enabling the learner to become more self-directed; however, it is the responsibility of the individual to engage in informal learning, and the learner determines direction and velocity of growth (Hart, 2015; Illeris, 2004; Livingstone & Sawchuk, 2004; Sawchuk, 2008). Informal learning practices are pursued with the intent to learn and would consequently increase the number of skilled workers and the knowledge capacity of the organization.

Hypothesis 7: Organizational support for informal learning has a positive effect on knowledge performance. This hypothesis builds on the relationships posited in Hypothesis 3 and

6. Those hypotheses suggest positive relationships between organizational support for informal learning and informal learning and between informal learning and knowledge performance, respectively. Because organizational support for informal learning consists of strategies intended to mitigate barriers to informal learning, and because informal learning practices intrinsically contribute to knowledge performance, it follows that organizational support for informal learning itself could benefit knowledge performance.

Hypothesis 8: Organizational support for informal learning mediates the relationship between a learning organization and informal learning. Evidence for four mediating relationships emerged from the literature on informal learning and the learning organization. Hypothesis 8 is the logical extension of Hypothesis 3, which proposes a relationship between organizational support for informal learning and informal learning practices; and of Hypothesis 4, which asserts there is a positive relationship between the learning organization and organizational support for informal learning. Considering expected outcomes, organizational support for informal learning would mediate the relationship between a learning organization and informal learning.

Hypothesis 9: Organizational support for informal learning mediates the relationship between a learning organization and knowledge performance. This hypothesis relies on the proven relationship between the learning organization and knowledge performance stated in Hypothesis 5. The anticipated positive relationship is also tied to hypothetical relationships between the organizational support for informal learning and informal learning practices outlined in Hypothesis 3, and to the proposed relationship between organizational support for informal learning and knowledge performance stated in Hypothesis 7. While informal learning practices are expected to affect knowledge performance (Hypothesis 6), the expectation is that removing

barriers to informal learning through organizational support will result in an even more effective learning organization.

Hypothesis 10: Informal learning practices mediate the relationship between organizational support for informal learning and knowledge performance. The role of informal learning practices as a mediator is the logical extension of expected relationships rooted in the literature on informal learning and the learning organization. The construct of organizational support for informal learning is based on Lohman's 2009 findings outlining barriers to same. Organizational support is expected to increase informal learning practices by removing those barriers (Hypothesis 3).

Hypothesis 11: Informal learning mediates the relationship between the learning organization and knowledge performance. The proven relationship between the learning organization and knowledge performance and the expected relationship between the learning organization and informal learning evident in the literature both support this assertion.

Hypothesis 12: The role – manager or non-manager – of the respondent has a significant impact on informal learning practices. Many studies using the DLOQ report that managers rank higher across all the dimensions (Watkins & Kim, 2018). Informal learning literature also supports this, as research shows some personality traits of managers align with some of the personality traits of informal learners (Choi, 2009; Noe et al., 2013).

Hypothesis 13: Gender has a significant impact on informal learning practices. This assertion is based on the gender disparities that exist for IT professionals (Gurchiek, 2018; Moss, 2019; Funk & Parker, 2020). Sexism in hiring, promotion, and pay, as well as a lack of support, would all likely affect the learner.

Hypothesis 14: Age has a significant impact on informal learning practices. Empirical evidence from the informal learning literature suggests a significant relationship between age and informal learning. Berg and Chyung (2008) investigated factors that influence informal learning and found a positive correlation between age and informal learning engagement. Livingstone's (2005) study also supported this, though analysis showed age only has weak effects on levels of informal learning activity (p. 12).

Hypothesis 15: The type of organization – non-profit or for profit – has a significant impact on informal learning practices. This assertion is based on the literature from McHargue (2003) which outlines how the experience for learners differs between non-profit and for-profit organizations. The non-profit learning environment may be constrained by the strong focus on the organization's mission, having a limited and fluctuating budget for learning, volunteer-based labor, and competition with other non-profits (McHargue, 2003, p. 197-198). As these forces constrain non-profits in their evolution to learning organizations, it is logical to assume that informal learning practices might also be affected.

Hypothesis 16: Education level does not have a significant impact on informal learning practices. The IT field places less emphasis on formal education and degrees than it does on certifications and work experience (Mahatanankoon, 2007a, 2007b; Naveda & Seidman, 2005).

Hypothesis 17: Remote work does not have a significant impact on informal learning practices. IT professionals are accustomed to working remotely, and recent studies have shown that remote work does not affect performance and productivity (Galanti et al., 2021; Tortorella et al., 2021). This hypothesis also draws on Livingstone (2004), who questioned the definition of "workplace" and examined informal labor as a vehicle for informal learning. In the Marsick and Watkins model on informal and incidental learning, social interaction is an important variable;

however, studies suggest that social interaction and community building now effectively take place in virtual space (Cox, 2018; Justice & Yorks, 2018; Smith & Nicolaides, 2018; Thomas & Brown, 2011; Watkins & Marsick, 2018). Because IT professionals often work remotely (Anjali & Anand, 2015), and because of the wave of remote work brought about by the COVID-19 pandemic (Galanti et al., 2021), the "workplace" for IT professionals should not be a relevant factor for informal learning.

Figure 5

Theoretical Framework with Hypotheses

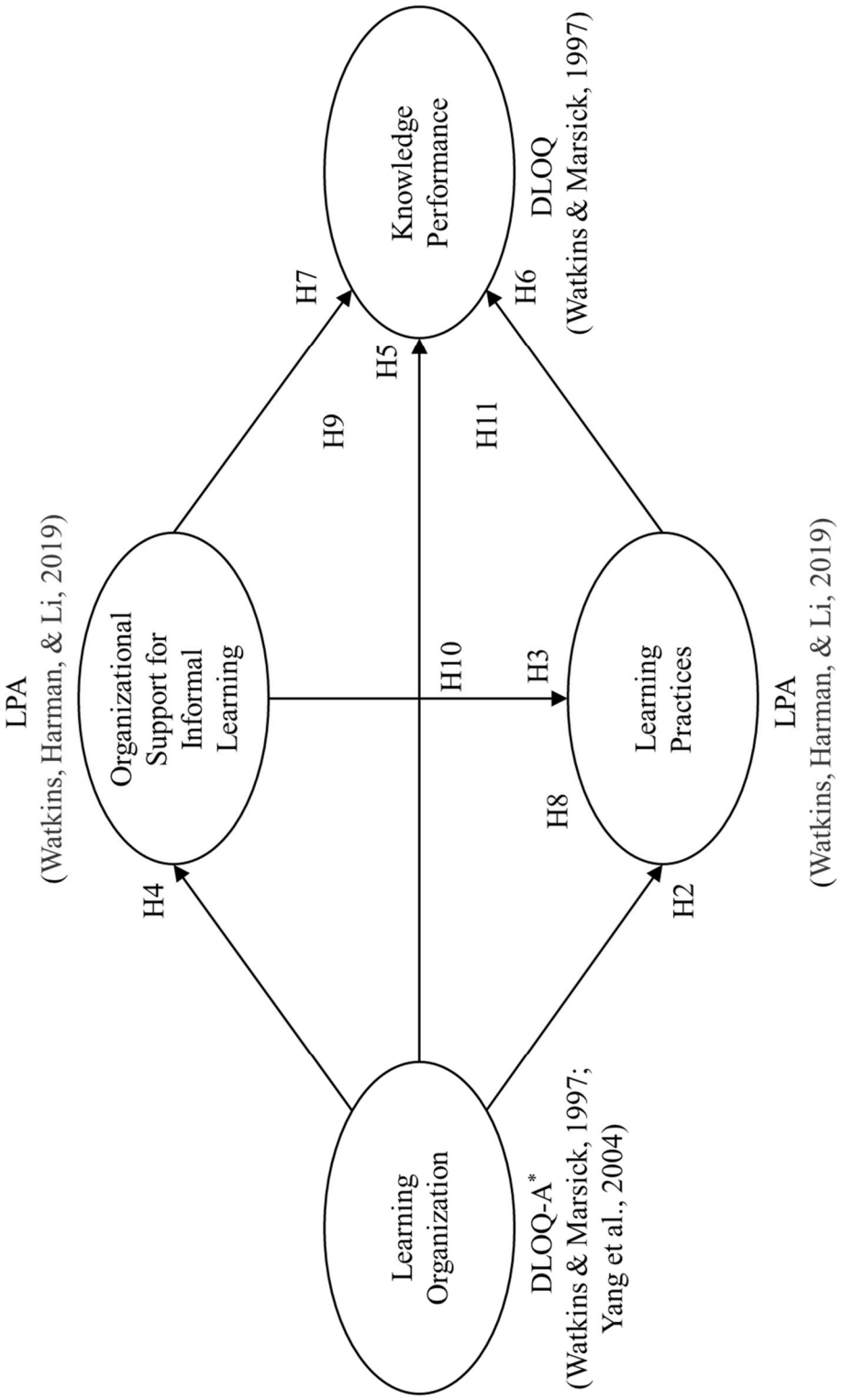


Figure 6

Measurement Framework

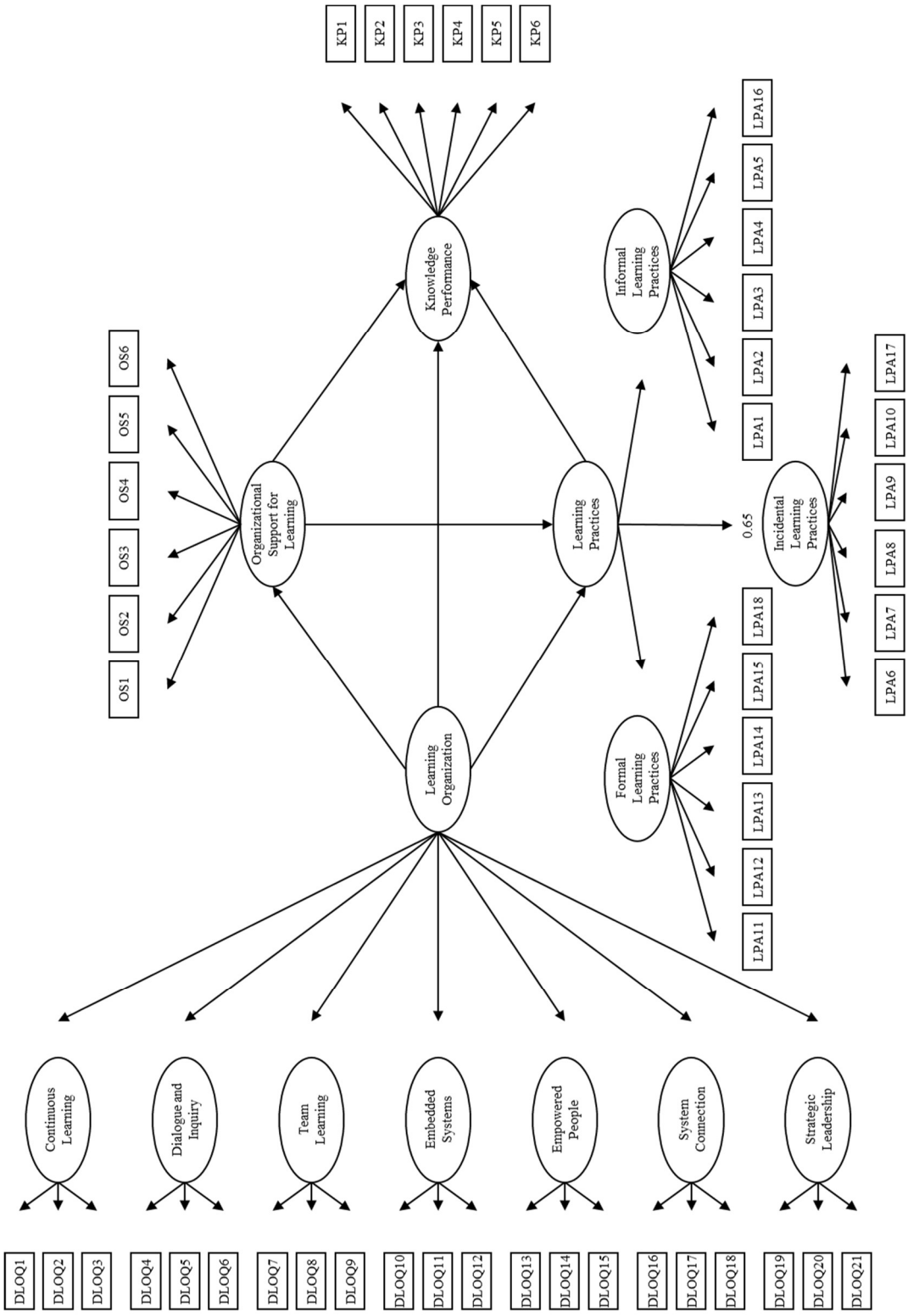


Figure 6 illustrates the measurement framework of this study, with observed variables represented in rectangles, latent variables represented in ovals, and expected causal relationships between variables drawn as solid single-headed arrows (Ho et al., 2012). The independent variable is the learning organization, as conceptualized by Watkins and Marsick (2003). A learning organization as a higher-order latent construct consists of seven dimensions: continuous learning, dialogue and inquiry, team learning, embedded systems to capture and share learning, empowered people, system connection, and strategic leadership for learning. These dimensions are first-order latent sub-constructs captured by three observed items each, for a total of 21 items. The knowledge performance and organizational support for informal learning are both first-order latent constructs, each measured through six observed variables. Learning Practices as a higher-order latent construct consists of three dimensions – formal, incidental and informal learning practices, which are first-order latent sub-constructs – captured by six items each.

Design of the Study

This quantitative study used survey data collected through MTurk. Quantitative methodology is the best fit for this research problem, as it allowed the researcher to examine the relationship between variables. According to Merriam and Simpson (1995), as cited in Kim (2016), "Quantitative research has evolved in a way to understand several factors simultaneously in order to uncover the complex nature of behavioral science" (p. 64). One benefit of using quantitative analysis is it can reveal insights about behavior and can also be used by researchers to identify concepts or address hypotheses (Creswell, 2009; Kim, 2016). When analyzed, the data in this study might point to corollary or cause-and-effect relationships, from which predictions could be made, which will fulfill the research purpose (Creswell & Creswell, 2017;

Swanson & Holton, 2005). (The methods of analysis are discussed further in the *Analysis* section.)

Another reason for selecting quantitative methods to study this phenomenon is that the group in question is large. The United States Department of Labor (2019) reports that there are over four million computer and information technology professionals in this country alone. Identifying trends and making generalizations about large populations is a major strength of quantitative methods (Swanson & Holton, 2005, p. 30).

For social science, surveys are the primary method of collecting data for statistical analysis (Sawchuk, 2008; Suchman & Jordan, 1990). This approach allows researchers to understand a sample population's views in a generalizable way (Creswell, 2009; Kim, 2016). Two existing surveys, used to measure the learning organization and informal learning, were combined into a single instrument. The method followed the Dillman et al. (2014) approach, which suggests that tailoring surveys to fit specific research purposes reduces total survey error.

Instrument

This study used a survey to inquire about the perceptions of the organizational learning culture, perceived knowledge performance and organizational support for informal learning, and the engagement in different learning practices. The survey included two existing instruments: the 21-item Dimensions of the Learning Organization Questionnaire (Watkins & Marsick, 1997), with six knowledge performance questions, commonly referred to as the *DLOQ*; and the 18-item Learning Practices Audit (Watkins, Harman, & Li, 2019), with six items to measure perceived organizational support for informal learning (Watkins, Harman, & Li, 2019), and a further six demographic questions. The following section provides an overview of each instrument.

Dimensions of the Learning Organization Questionnaire (DLOQ)

There are only a few empirical studies on the learning organization which do not use the DLOQ instrument (Kim, 2016; Thomsen & Hoest, 2001). The DLOQ grew out of the learning organization culture framework suggested by Watkins and Marsick (1993, 1996) in their book, *Sculpting the learning organization: lessons in the art and science of systemic change*, and in their later works. Based on the model of the dimensions of the learning organization (Marsick & Watkins, 2003; Watkins & Marsick, 1993, 1996), the authors developed the first iterations of the DLOQ to measure the organizational environment for learners. Later, Yang et al. (2004) refined and validated the shortened versions of the instrument.

The DLOQ is the most widely used instrument for measuring the learning organization at individual, group, and organizational levels (Beyerlein et al. 2017; Chang & Lee, 2007; Kiedrowski, 2006; Kim, 2016; Kim et al., 2015; Thomsen & Hoest, 2001) and was recently added to the APA PsychTests database (Beyerlein et al., 2017). Researchers have confirmed its validity in over 120 studies using exploratory or confirmatory factor analysis, correlation matrix analysis or means comparison (Ellinger et al., 2002; Yang, 2005; Kim, 2016; Chang & Lee, 2007; Kiedrowski, 2006; Thomsen & Hoest, 2001, Kim et al., 2015). Scholars highlight the instrument's strong reliability in multiple organizational and cultural contexts and even across different cultural contexts, such that it has been used in more than seventy published articles and their translation into multiple languages (Beyerlein et al., 2017; Kim, 2016; Marsick, 2013; Nurmala, 2014; Song et al., 2013; Watkins & Dirani, 2013). The majority of reported Cronbach α coefficients are greater than .80 (Lance et al., 2006; Song et al., 2013). The DLOQ's repeated use also provided several opportunities to further prove its reliability and validity (see Table 3)

as a tool to diagnose the learning organization (Hernandez & Watkins, 2003; Kim, 2016; Kim et al., 2015; Wang & Ahmed, 2004; Wang et al., 2007; Yang et al., 2004).

The survey uses a six-point personal construct-type scale and asks participants to respond to six items for each of the model's seven dimensions. Those seven dimensions, or *action imperatives* of the learning organization, are: *continuously creating learning opportunities (CL)*; *promoting dialogue and inquiry (DI)*; *encouraging collaboration and team learning (TL)*; *establishing systems to capture and share learning (ES)*; *empowering people around a shared vision (EP)*; *connecting the organization to its environment (SC)*; and *providing leadership for learning (PL)* (Marsick & Watkins, 1999, p. 11). For each item, participants make selections on a continuum from "almost never" to "almost always" to indicate how applicable a statement about a learning item is to their organization. The survey has been modified and revised to adapt to specific contexts and research areas (Kim, 2016; Nurmala, 2014). There is a version with 43 questions, a single dimension assessment with just seven questions, and another with 21 (Kim et al., 2015).

To keep the number of items low but maintain the specificity of the seven dimensions, this study used the 21-item version of the questionnaire. However, to reduce the number of items, the instrument for this study uses only one of the three organizational performance measures: knowledge performance. Knowledge performance was chosen over adaptive and financial performance measures for several reasons. First, knowledge performance as a construct is widely accepted as a key indicator of an organization's performance (Kaplan & Norton, 2004). The six DLOQ knowledge performance items measure perceptions of customer satisfaction, continuous improvement, learning and development, and spending on technology and information processing. This more closely aligns with the purpose of the study than adaptive

performance, which gauges how well an organization responds to changes in the external environment (Kim, 2016, p. 10). While both knowledge performance and adaptive performance have a positive effect on financial performance and mediate the effect of the learning organization (Kim, 2016), only knowledge performance items have been widely validated as part of the DLOQ. Financial performance measures were also excluded, as the DLOQ measures perceptions of financial performance – which may vary based on the role of the respondent within the organization.

The Learning Practices Audit (LPA)

In contrast to the widely utilized DLOQ, the Learning Practices Audit (LPA) is a new instrument revised by Watkins, Harman, and Li (2020). The revised instrument has 18 items on learning practices and six items on organizational support for informal learning in a Likert-type scale designed to assess organizational opportunities for formal, informal, and incidental learning practices. The tool was created and first used by Watkins and Cervero (2000), based on their research and theories on organizational informal and incidental learning. It was initially a 31-item survey used with artifact analysis and interviews for a comparative study of the learning opportunities at a Certified Public Accounting and Financial Services Firm. The audit asks respondents to indicate participation in various learning opportunities offered by their organization. This tool was used in the study to understand the degree to which the presence of a learning organization influences learners' engagement in learning practices. Per Pedhazur & Schmelkin (1991), as cited in Kim et al. (2015), "The credibility of inferences made by quantitative research depends on the nature and quality of the accumulated evidence involving the construct under consideration" (p. 107). As the LPA was significantly revised in both content and format for the purposes of the study, Harman et al. (2021) completed a pilot study as part of

their due diligence in developing the instrument. The format was updated to use a six-point Likert-type scale and the wording of the questions was changed. The stem of questions was adjusted to "I learn from" to shift the focus of the statements to participation. The six organizational supports for informal learning items were redesigned to address barriers to informal learning as identified in the literature (Lohman, 2009).

The pilot study was completed in the spring of 2020 (Harman et al., 2021). The survey consisted of 52 questions and was administered through MTurk. The 52 questions in turn consisted of the LPA's 28 items; the DLOQ's seven items (DLOQ, Watkins & Marsick, 1997); six questions assessing knowledge performance; six items measuring organizational support for informal learning; and a further five demographic questions covering age, whether the participant is a manager or non-manager, whether they work for a non-profit or for-profit organization, their education, and the percentage of time they work remotely. Respondents were full-time employees; each received $1.00 after completing the survey. Researchers collected 427 responses, and, after data screening, analyzed a total of 403 responses. Harman et al. completed multiple rounds of EFA and CFA to eliminate questions and finalize which items would be assigned to which factors. The final structure, with 18 items met the thresholds for the RMSEA, CFI and X^2 /df fit indices and for Cronbach's alpha measuring internal consistency. This validation informed the content and format included in the survey for the study of IT Professionals.

The data from the pilot study (Harman et al., 2021, pp. 15-16) indicated the learning organization is significantly correlated to informal learning (.451, $p < .001$) and to organizational support for informal learning (.722, $p < .001$). Evidence also suggested organizational support for informal learning is significantly correlated to the informal learning (.451, $p < .001$). In the

pilot data, managers ranked higher on the learning practices – formal, F1 ($t = 4.378$, $p < .001$), incidental, F2 ($t = 2.791$, $p < .001$), and informal learning practices, F3 ($t = 3.078$, $p < .001$). Those working in non-profit organizations ranked incidental learning practices, F2 higher than those in for-profit organizations – F2 ($t = -2.712$, $p < .05$). Education was significant for formal learning, F1 ($p < .05$), accounting for 13.4% of the variance. Age, and remote work were significant for learning practices. Age had a significant, negative relationship with informal learning ($p < .001$) and remote work had a significant, positive relationship with informal learning, F3 ($p < .05$).

Target Population and Sample

The study mitigated the risk of coverage, sampling, nonresponse, and measurement error with consideration to the following when selecting a target population. The study used purposive criterion sampling. This type of sampling allows the researcher to focus on the population of interest (Patton, 1990; Swanson & Holton, 2005) – more specifically, the target population of IT professionals. This population warrants study due to a set of unique characteristics. IT is a male-dominated field (Coast, 2021) and may include an array of roles (Bennett, 2009). It is highly skilled group with acute learning needs due to rapid changes in technology (Rajagopal & Abraham, 2009).

Limiting the respondent pool to the target population, based on the research questions, will optimize data quality and applicability (Dillman et al., 2014). Due to the nature of IT and current economic conditions, there was no criteria to restrict respondents to a particular location or employment type (full-time versus part-time), as IT professionals likely work remotely or on a contract basis (Galanti, et al., 2021; Bhat & Harvey, 2020). To secure a representative sample, MTurk generated the sample frame based on the qualification criteria that the respondent must

work in an IT job function. In MTurk, the requirement limited distribution of the survey to only those respondents who met the qualifying criteria. Workers voluntarily self-reported demographic data to enhance the accessibility to human intelligence tasks (HITs) based on qualifications or criteria required by the requesters. If a worker no longer wished to have their data used to filter HITs, they could opt out. Once requesters set the qualifications, the HIT is only accessible to those workers who met the criteria. Providing this additional data was not mandatory for registration as a worker; however, if a worker chose to participate, they needed to answer the questions truthfully and accurately per the Amazon Mechanical Turk Participation Agreement.

Using Cochran's equation $n_0 = \frac{Z^2pq}{e^2}$ suggested by Dillman et al. (2014), the minimum sample size of 384 was calculated based on a 95% confidence level, a confidence interval of 5, the US Department of Labor's 2017 report of a population of approximately 4,000,000 (p. 78). This sample size also considered that some of the responses would not be used, after screening the data for outliers, inattentiveness, and missing responses.

Data Profile

The survey was followed by six demographic questions. According to Kline (2016), it is critical to "select measures with strong psychometric properties and report these characteristics in written summaries…because the product of the measures is what is analyzed" (p. 88). Based on points of interest raised in the literature, respondents were asked to provide their age, gender, whether they are a manager or non-manager, whether they work for a for-profit or non-profit, the percentage of time they work remotely, and highest degree of education. These questions were selected to further inform the literature on informal learning for IT professionals (see Table 5). T-tests and regression analyses examined which demographics affected informal learning,

perceptions of perceptions of organizational support for informal learning, and the learning organization and knowledge performance.

Table 5

Outline of Demographic and Criteria Questions

Demographic Question	Rationale from the Literature	Citation
Job Function – Information Technology equal to true	This allows the researcher to focus on the population of interest: IT professionals.	Cheung et al. (2017)
What is your age?	Studies on informal learning suggest that older professionals may engage in more self-directed learning than their younger peers. This provides an opportunity to investigate in the context of IT professionals.	Berg & Chyung (2008)
To which gender identity do you most identify?	It will be interesting to the researcher, as a female IT professional, to see what the learning landscape is like for women. Women are underrepresented and face challenges in the field of IT.	Coast (2021); Gurchiek (2018); Moss (2019); Funk & Parker (2020)
What is your current position? (Manager or non-manager)	Based on the informal learning and learning organization literature, managers play a key role in fostering informal learning, yet the DLOQ literature offers conclusive information on how perceptions may differ depending on whether respondents are a manager or non-manager.	Ellinger & Ellinger (2020); Enos et al. (2003); Eraut (2004); Lohman (2009); Skule (2004); Hasson et al. (2013)
What type of organization do you work for? (For-profit or non-profit)	Studies have proved that learning organizations affect the performance of non-profit organizations. However, their budget and learning practices are very different from for-profit organizations. There is a non-profit version of the DLOQ which uses mission performance rather than knowledge and financial performance.	McHargue (2003)

What percentage of time do you work remotely?	In the Marsick and Watkins model on informal and incidental learning, social interaction is an important variable. While the COVID-19 pandemic dramatically increased the number of professionals working remotely, there may be some insights to be gained from this variable.	Galanti, et al. (2021); Bhat & Harvey (2020)
What is the highest degree you have earned?	According to the literature, the qualification for IT professionals is based more on certifications than four-year degrees. This measure can test that for this context.	Mahatanankoon (2007a, 2007b); Naveda & Seidman (2005)

A total of 401 responses was used for this analysis. The demographic distributions are shown in Table 6. Most respondents work in small to medium for-profit organizations. Women accounted for 30.42% of the sample, which is just over the 25% representation level reported for women working in tech in the U.S. (Coast, 2021). Respondents in the 31-40 age range accounted for 40.65% of the sample, which trends with the national average of 32-38 for IT professionals (Clement, 2016; Visier, 2016). 77.3% reported having an associate degree or higher. On average, respondents reported working remotely 63.48% of the time. Managers accounted for 43.14% of the sample.

Table 6

Demographic Distributions

Variable		n	%	Variable		n	%
Org.	For profit	349	87.03%	Education	IT Certifications	55	13.72%
Type	Nonprofit	52	12.97%		G.E.D.	3	0.75%
					HS Diploma	33	8.23%
Role	Manager	173	43.14%		AS	19	4.74%
	Non-M	222	55.36%		BA/S	174	43.39%
					MA	103	25.69%
Age	19~30	145	36.16%		PhD	6	1.50%
	31~40	163	40.65%				
	41~50	61	15.21%	Remote	Never	20	4.99%
	51~60	25	6.23%	Hours	1%~19%	41	10.22%

	61~70	6	1.50%	20%~39%	37	9.23%
	71~80	1	0.25%	40%~59%	58	14.46%
	Average	35.09		60%~79%	67	16.71%
				80%~99%	72	17.96%
Gender	Female	122	30.42%	Always	106	26.43%
	Male	277	69.08%	Average	63.48%	
	Non-binary	2	0.50%			

Data Collection

The study collected 500 responses to a 58-question survey (not including the qualifying question) through the Amazon Mechanical Turk (MTurk) between April 5th and April 25th, 2021. MTurk is Amazon's crowdsourcing marketplace, where workers can complete "human intelligence tasks," or HITs (MTurk, www.mturk.com), including surveys. The platform was created and is managed by Amazon as a virtual labor market wherein those seeking labor resources and offering compensation (called *Requesters*) are matched with those seeking work and seeking compensation (called *Workers*). Amazon vets the workers for eligibility based on age, social security number, and skillset. The platform also allows Requesters to set qualifications for workers to their HITs. To qualify for this study, respondents must have previously self-identified in MTurk as working in an IT function. After using selection criteria to narrow the respondents to the target population, responses were collected on a first-come, first-serve basis until 500 were secured. This HIT was tied to a Qualtrics survey. The survey was set to force responses to every item and to generate a random code upon completion of the survey. This code was then entered into MTurk to permit the $1.00 compensation offered to participants. Completion of the survey took an average of 12.

MTurk is a proven method for survey administration and is increasingly popular among researchers (Buhrmester et al., 2011; Cheung et al., 2016; Goodman et al., 2013; Paolacci et al.,

2010, 2014). Multiple studies have addressed concerns about reliability, data quality, participation, and samples. Many studies have likewise tested and supported the reliability of MTurk data using means comparisons and reliability tests: reliability test-retest scores were within acceptable and good ranges, and alphas were largely similar to traditional samples (Buhrmester et al., 2011; Johnson & Borden, 2012). There are several other similar electronic data pools. However, when compared with those, MTurk had higher reliability, and participants demonstrated better attention (Follmer et al., 2017). The samples accessible through MTurk are diverse – more so than undergraduate populations – and large samples can be collected very quickly (Paolacci et al., 2010). As with surveys that use more traditional data collection methods, participation can be affected by the compensation offered and the length of the survey (Buhrmester et al., 2011; Follmer et al., 2017). However, for construct validation and model testing of the sort used in this study, MTurk is an appropriate sample to use.

Data Preparation

The survey responses were vetted based on basic utility criteria, and took into account responses with missing values, outliers, multicollinearity, and normality. The samples that fit the utility criteria were analyzed to understand and develop broader trends by looking at the means of the responses, using factor analysis, structural equation modeling (SEM), and meta-analysis. SPSS 27 and IBM Amos 27 software facilitated meaningful analysis and interpretation (Pedhazur & McPeek, 1997; Kline, 2016). The survey forced responses on every item in order to reduce inattentiveness. String responses were eliminated, as were any entries which took fewer than three minutes to complete. After eliminating those responses, the data were screened for outliers, multicollinearity, and normality, using the technique outlined by Mat Roni (2014). After screening the data, a total of 401 responses were used for analysis.

Data Analysis

The study presents 17 hypotheses on the relationship between informal learning, organizational support for informal learning, the learning organization, and knowledge performance. This section details the study's methods of analysis.

Factor analysis

This study leveraged both EFA and CFA, the primary forms of factor analysis. Considering that the revised LPA has only been validated in one pilot study (Harman et al., 2021), exploratory factor analysis (EFA) was used first, to understand the relationships between the variables using principal components and factoring with varimax rotation. The Kaiser Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity were performed.

After using EFA to identify the factors and corresponding items, the data were compared to the data from the pilot study. Two items were subsequently moved to different factors to reflect the factors defined in the pilot study. Based on the literature, these recategorizations were theoretically more logical.

CFA was employed to understand whether the factors fit the data. The analysis used commonly accepted fit tests, as suggested by Kline (2016): comparative fit index (CFI); normed fit index (NFI); root mean square error of approximation (RMSEA); (Standardized) root mean square residual (SRMR); and chi-square/degrees of freedom ratio, as well as Pearson's R, to understand the strength of any correlation that appeared (Bollen, 1989; Swanson & Holton, 2005). Based on the results from factor analyses, SEM was used to address the research questions. SEM provides an understanding of the model parameters, the logical implications of the model, and how well the data support the model (Kline, 2016). The CFA validated the constructs for the SEM.

Structural Equation Modeling (SEM)

SEM offers the predictive power of regression coupled with the insight to latent variables through factor analysis. In the field of organizational research, multiple regression is used widely in an explanatory capacity (Swanson & Holton, 2005). SEM was the appropriate method of analysis because it addresses the phenomena of interest: the informal learning of IT professionals and its relationship to the learning organization.

The standard recommended diagnostic analysis was run as part of the analysis, including tests for violations of regression assumptions (linearity; homoscedasticity; normality; and independence of the residuals), multicollinearity, and influential observations (Swanson & Holton, 2005). SEM was used to understand whether the presence of the learning organization is a predictor of informal learning practices, organizational support for informal learning, and knowledge performance. The process relied on the theoretical foundations of the Watkins and Marsick (1993, 1996, 1997) learning organization, their model of informal and incidental learning (Marsick & Watkins, 1990), and empirical work based on these concepts. Following the structural equation modeling, the results were used in a meta-analysis of the means by comparing with published results from other studies, as captured in Watkins and Dirani (2013), Kim (2016), and the pilot study (Harman et al., 2021).

Validity and Reliability

Factor analysis addressed convergent validity and discriminant validity. Validity was tested using the average variance extracted (AVE), calculated by Fornell and Larcker (1981), which indicates convergent validity. Discriminant validity was assessed using the heterotrait-monotrait (HTMT) ratio (Henseler et al., 2015).

Reliability is the degree of consistency in findings. Han (2015) describes reliability as the "extent that research findings can be repeated with the same results" (p. 85). The study used Cronbach's alpha coefficient to test reliability, as it overcomes many of the downsides and limitations of the other tests (Bollen, 1989, p. 215). Jöreskog's rho coefficient was also used to test composite reliability (C.R.).

Hypothesis Testing

Hypothesis 1: The Learning Practices Audit is a reliable and valid measure for assessing learning practices for IT professionals was tested using structural equation modeling (SEM) and regression though IBM Amos 27 Graphics software. As previously stated, the SEM model fit was assessed using the X^2/df ratio, NFI, CFI, RMSEA, and SRMR fit indices. Reliability and validity were tested using factor analysis and other indicators generated using the SEM output. Cronbach's alpha tests assessed reliability. AVE was calculated to evaluate convergent validity using the formula AVE= $\Sigma \text{Ķ}^2$ / n. Composite reliability (C.R.) was tested using Jöreskog's rho coefficient. The HTMT ratio evaluated discriminant validity.

The relationships proposed in Hypotheses 2-7 were tested using correlation analysis and SEM. Though the correlation analysis, created using IBM SPSS 27, may have indicated a relationship, SEM analysis allowed deeper insight into the causal relationships.

The mediating relationships in Hypotheses 8-11 were tested using the output from the SEM and the four-step approach outlined by Baron & Kenny (1986). The indirect effects were tested thoroughly, using *c-c'* (Imai et al., 2010) and *ab*/*c*, when $c \geq \pm 0.2$ (Kenny, 2021).

Hypotheses 12-18 were analyzed using regression analysis of the demographic data collected.

Summary

This explained the study's measurement framework and methodology: its data collection, preparation, and analysis. The next chapter presents the results of the factor analysis, correlations, validity and reliability, along with the SEM results and demographic analysis results.

CHAPTER 4

RESULTS

This chapter begins with a presentation of the factor analysis, followed by the descriptive statistical analysis. The chapter then gives the structural equation model and corresponding research hypotheses.

Factor Analysis

While the LPA (Watkins, Harman, & Li, 2019) was proved valid and reliable in a pilot study, an exploratory factor analysis was completed with this data set for additional due diligence. The factor structure used for this study mirrors the final factor structure generated through the pilot.

Learning Practices

Exploratory factor analysis. An exploratory factor analysis (EFA) based on the LPA was performed. (See Table 7 for the resulting EFA.) While an EFA's primary function is to inform item reduction by detecting factors among groups of uncorrelated variables, no items were eliminated, nor were items moved to the factors presented in the EFA. This was done consciously, to ensure the final model matches the model validated in the pilot study. Principal components, factoring with Varimax rotation on the 18 items, was performed. The Kaiser Meyer-Olkin Measure of Sampling Adequacy (KMO = .904) and Bartlett's Test of Sphericity (Approx. Chi-square = 2923.37; df = 153; $p < .001$) indicate that the variables are suitable for factor analysis. A KMO value greater than or equal to .6 is adequate; however, the closer to 1.0, the better (Williams et al., 2010).

Table 7

Exploratory Factor Analysis Results

	Rotated Factor Loading		
	Factor 1: Formal	Factor 2: Incidental	Factor 3: Informal
1. I learn from social media.	.508		
11. I learn from reading books.	.598		
12. I learn from attending conferences.	.833		
13. I learn from training programs.	.795		
14. I learn from taking classes.	.734		
15. I learn from networking in my field.	.715		
18. I learn from mentors or coaches.	.731		
7. I learn from doing challenging tasks.		.781	
8. I learn from trying new things.		.772	
9. I learn from reflecting on what worked.		.646	
10. I learn from mistakes.		.649	
16. I learn from studying on my own.		.523	
17. I learn from new tasks or jobs.		.743	
2. I learn from help menus or help tools.			.519
3. I learn from searching the internet.			.750
4. I learn from online communities in my field like blogs, forums, etc.			.651
5. I learn from videos [e.g., tutorials, You-tube].			.739
6. I learn from the examples of others.	-	-	-
Cronbach's alpha	.865	.818	.734
Eigenvalue	6.50	2.28	1.29

As this analysis was only to confirm the final list of items generated in the pilot EFA (Harman et al., 2021), three factors were extracted, and no items were excluded. The analysis revealed a three-factor solution, very close to the desired model, which accounts for 55.60% of the variance. (Table 7 is a summary of the items and rotated factor loadings.)

The first factor is formal learning practices, and accounts for 36.13% of the variance. It contains items which are more likely structured and institutionally sponsored: the learner consciously engages in these activities with a learning goal in mind. It has a high internal

consistency, with Cronbach's alpha = .865. The second factor, incidental learning practices, accounts for 12.43% of the variance. It refers to items that occur spontaneously as part of work: the learner is not necessarily conscious of these activities and does not pursue them for a specific learning goal. The third factor, informal learning practices, explains 7.05% of the variance. Items in this factor are self-directed and task-focused activities resulting from work: the learner engages with a specific learning goal in mind and is conscious of the learning as it is taking place.

Confirmatory factor analysis. To conform to the structure of the instrument validated in the pilot study (Harman et al., 2021), one item was removed from F1 and moved to F3, one item from F2 was moved to F3, and one item that did not load on any factor was added to F2. The CFA for the learning practices and for the learning organization second-order variables was performed using the structure depicted in Figures 7 and 8. The results of the CFA showed low internal consistency for the learning practices using the data set from this study. The CFA for the DLOQ showed good fit between the model and the data.

Figure 7

Confirmatory Factor Analysis Model – Learning Practices

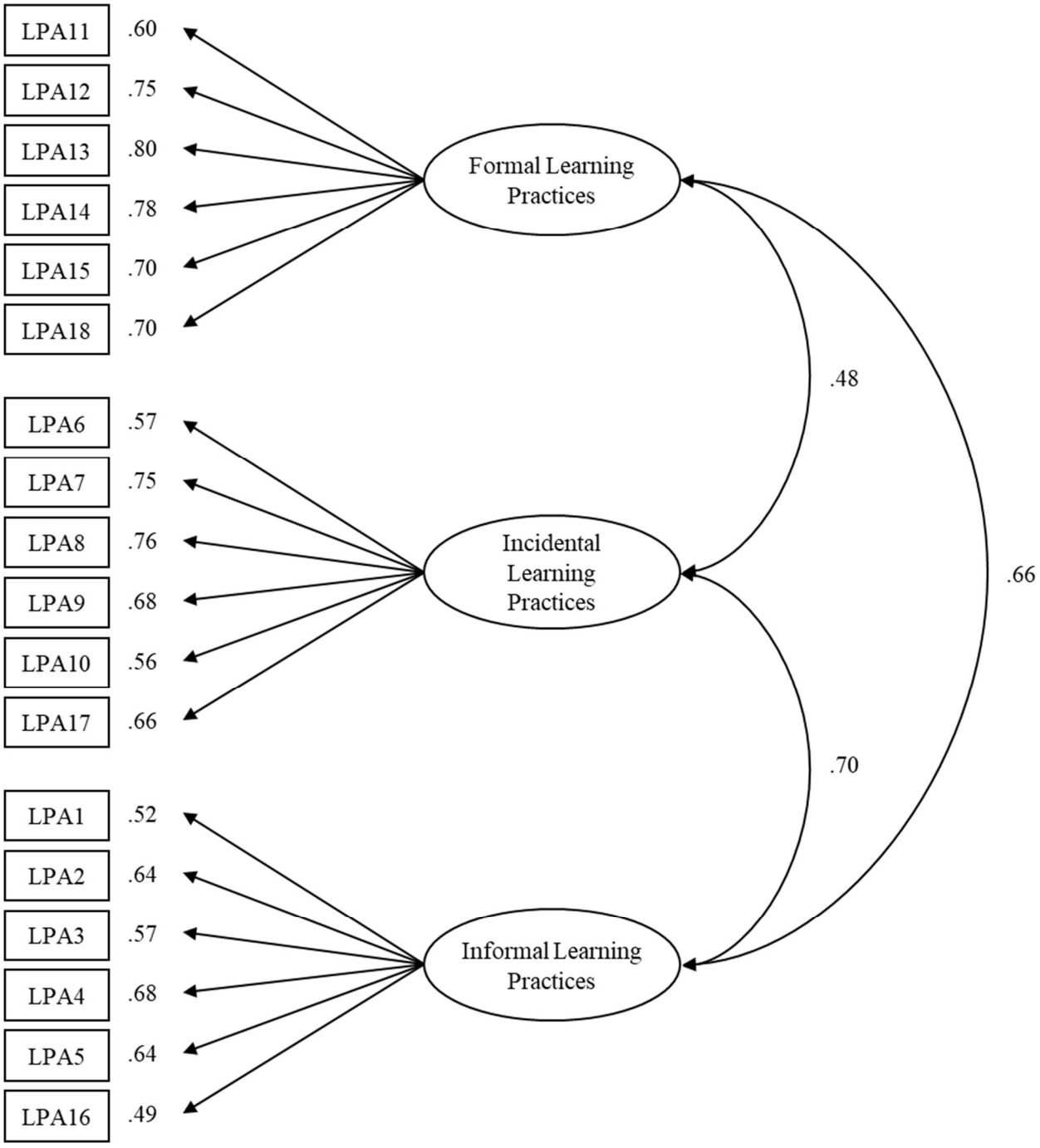
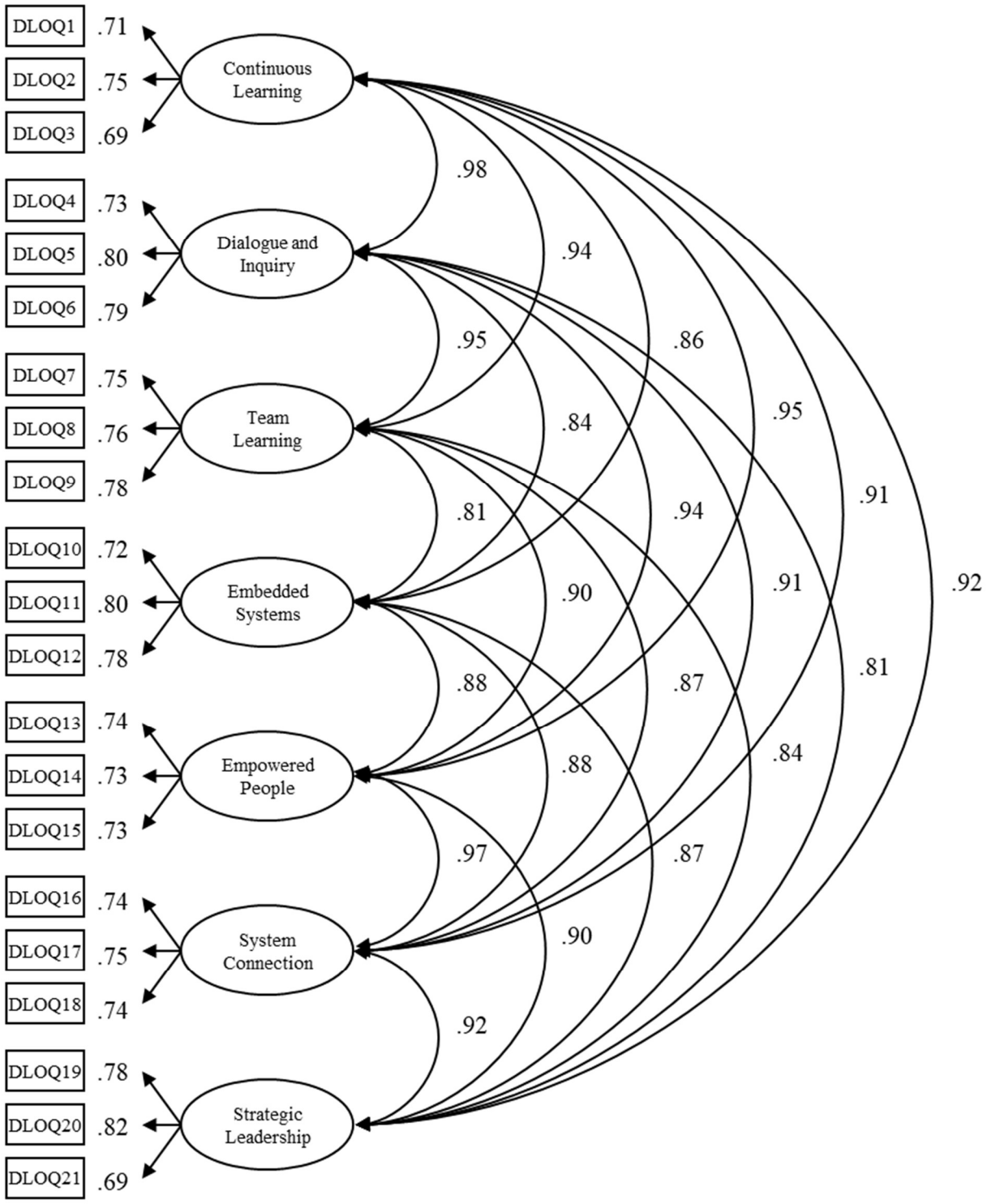


Figure 8

Confirmatory Factor Analysis Model – DLOQ



In addition to measuring the significance using chi-square, the chi-square (X^2)/degrees of freedom (*df*) ratio, Normed-fit index (NFI), comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square (SRMR) evaluated the fit of the model, as recommended by Kline (2016). The determination of fitness for the model, as shown in Table 8, is based on standard benchmarks for each fit index: NFI and CFI values should be greater than or equal to .90 (Schumacker and Lomax (2010); RMR should be close to .09 or lower (Hu & Bentler 1999, p. 27); RMSEA should be less than .08 (Browne & Cudeck, 1992); and a X^2/df ratio should be less than 5 (Marsh & Hocevar, 1985)**.** (Table 9 shows the standard benchmarks.)

Table 8

CFA Model Fit Indicators

Test	X^2/df	NFI	CFI	RMSEA	p-value	SRMR
LPA Results	3.65	.838	.876	.081	< .001	.0754
DLOQ Results	1.61	.948	.980	.039	< .001	.039

Table 9

Evaluation Criteria for Model Fit

Criteria	Cut-off	Authors
Chi-square (X^2)/degrees of freedom (*df*) ratio	< 5.0	Marsh & Hocevar (1985)
Normed-fit index (NFI)	≥ 0.90	Schumacker and Lomax (2010)
Comparative fit index (CFI)	≥ 0.90	Schumacker and Lomax (2010)
RMSEA	≤ 0.080	Browne and Cudeck (1992)
Significance	≤ 0.05	Fisher (1926)
SRMR	≤ 0.90	Hu & Bentler (1999)

Correlations between Constructs

To further understand the relationship between learning practices, organizational support for informal learning, and the learning organization, a correlation analysis was performed.

Relationships with values between 0.9 and 1.0 are considered very highly correlated; values between 0.7 and 0.9 indicate high correlation; 0.5 to 0.7 are moderately correlated; 0.3 to 0.5 indicate low correlation; and values less than 0.3 have little if any correlation (Benesty et al., 2009). (The results of the correlation analysis appear in Table 10.) Except for the relationship between incidental learning and embedded systems, the analysis showed that all variables were positive and significantly correlated with Pearson's r coefficients ranging from .301 to .767, indicating moderate to highly correlated relationships. Incidental learning and embedded systems had a low but significant correlation, with a coefficient of .260 ($p < .001$). The learning organization (DLOQ) had the strongest correlation with knowledge performance at .767 ($p < .001$) and with organizational support for informal learning at .744 ($p < .001$). Organizational support for informal learning and incidental learning had the weakest correlation at .311 ($p < .001$), suggesting that incidental learning does not benefit from these strategies. With a coefficient of .740 ($p < .001$), organizational support for informal learning has the highest correlation with continuous learning out of the seven dimensions of the learning organization. And, of the seven dimensions, knowledge performance has the highest correlation with strategic leadership, at .707 ($p < .001$).

Table 10

Correlations Between Variables

	IF	IC	FL	OS	KP	CL	DI	TL	ES	EP	SC	PL	LO	LP
IF	–													
IC	.574**	–												
FL	.565**	.441**	–											
OS	.311**	*.301***	**.479****	–										
KP	.430**	*.334***	.528**	**.598****	–									
CL	*.369***	.404**	.518**	**.740****	.647**	–								

DI *.337*** .344*** .453*** .601*** .627*** **.775***

TL .396*** *.390*** .453*** .622*** .631*** .728*** **.768***

ES .367*** *.260*** .528*** .621*** **.689*** .673*** .684*** .651***

EP *.345*** .360*** .459*** .632*** .664*** .734*** **.747*** .707*** .694***

SC *.349*** .357*** .449*** .633*** .686*** .701*** .733*** .695*** .697*** **.755***

PL *.404*** .420*** .535*** .680*** .707*** .718*** .669*** .686*** .703*** .715*** **.740***

LO .421*** *.411*** .556*** .744*** **.767*** .874*** .881*** .859*** .844*** .878*** .879*** .862***

LP .841*** .789*** .846*** *.454*** .532*** .531*** .466*** .504*** .481*** .478*** .473*** .558*** **.571***

Note. ** $p < .001$ (two-tailed). IF=Informal Learning Practices; IC=Incidental Learning Practices; FL=Formal Learning Practices; OS=Organization Support for Informal Learning; KP=Knowledge Performance; CL=Continuous Learning; DI=Dialogue and Inquiry; TL=Team Learning; ES=Embedded System; EP=Empowered People; SC=System Connection; SL=Strategic Leadership; LO=Learning Organization (composite of 7 dimensions); LP=Learning Practices (composite of 3 learning practices). The lowest coefficients are italicized; the largest coefficients, excluding the components of the composite variables (grayed out), are shown in bold. Variables are grayed out on the row of their respective composite variable.

Reliability and Validity

Hypothesis 1: The Learning Practices Audit is a reliable and valid measure for assessing learning practices for IT professionals was supported by the data. Although the CFA for the learning practices did not meet the threshold for a good fit, several other tests did confirm reliability. (See Table 11.) Cronbach's alpha values assessed the internal consistency of each factor (Gliem & Gliem, 2003). According to Taber (2018), values for Cronbach's alpha of .6 or greater indicate reliability. Formal learning practices, incidental learning practices, informal learning practices, organizational support for informal learning, and the learning organization and knowledge performance alphas all exceeded this threshold, with alphas ranging from .752 to

.956. Reliability tests for the latent variables of the LPA and learning organization yielded Cronbach's alpha values of .755 and .945.

Confirmatory factor analysis, discussed in earlier sections, indicates a near-sufficient level of fitness for the LPA. AVE was calculated to evaluate convergent validity, using the formula AVE= $\Sigma K^2 / n$. According to Fornell & Larker (1981), values above .50 indicate acceptable convergent validity. All values met this threshold except for the dimensions of the learning organization and informal learning, which had a value of .352. The DLOQ as a construct had an AVE of .713 – well above the required threshold. Composite reliability (C.R.) was tested using the Jöreskog's rho coefficient. Values greater than .70 demonstrate composite reliability (Chin, 1998); all values met this threshold. The HTMT ratio evaluated discriminant validity for the learning practices, organizational support for informal learning, the learning organization, and knowledge performance. According to Henseler et al., (2015), values lower than .90 indicate discriminant validity. The values for the DLOQ and the other construct variables were between .47 and .84, indicating discriminant validity. The ratios for organizational support for informal learning, formal, incidental, informal learning, and knowledge performance also indicated discriminant validity, with values ranging from 0.37 to 0.7.

Table 11

Reliability Indicators

Instrument	Factor	Items	Alpha	AVE	C.R.
Learning	LPA	18	.755	.525	.803
Practices Audit	Formal learning	6	.866	.525	.868
	Incidental learning	6	.821	.446	.827
	Informal learning	6	.752	.352	.762
	Org. Support for Learning	6	.864	.526	.870
Dimensions of	DLOQ	21	.945	.713	.946
	Continuous Learning	3	.758	.385	.761

Learning Organization Questionnaire	Dialogue and Inquiry	3	.817	.449	.818
	Team Learning	3	.806	.437	.807
	Embedded Systems	3	.809	.441	.808
	Empowered People	3	.774	.403	.774
	System Connection	3	.784	.414	.786
	Strategic Leadership	3	.803	.439	.808
	Knowledge Performance	6	.874	.536	.874

Structural Equation Modeling

The model presents acceptable fit indices: X^2 /df = 3.025, $p < .001$, NFI = .900, CFI = .930, SRMR = .0454, and RMSEA = .071 (see Table 12). The structural equation model's regression coefficients addressed Research Hypotheses 2-7 (see Table 13), and the mediation analysis of the structural equation model was used to address Hypotheses 8-11 (see Figure 9 and Table 14).

Figure 9

Structural Equation Model

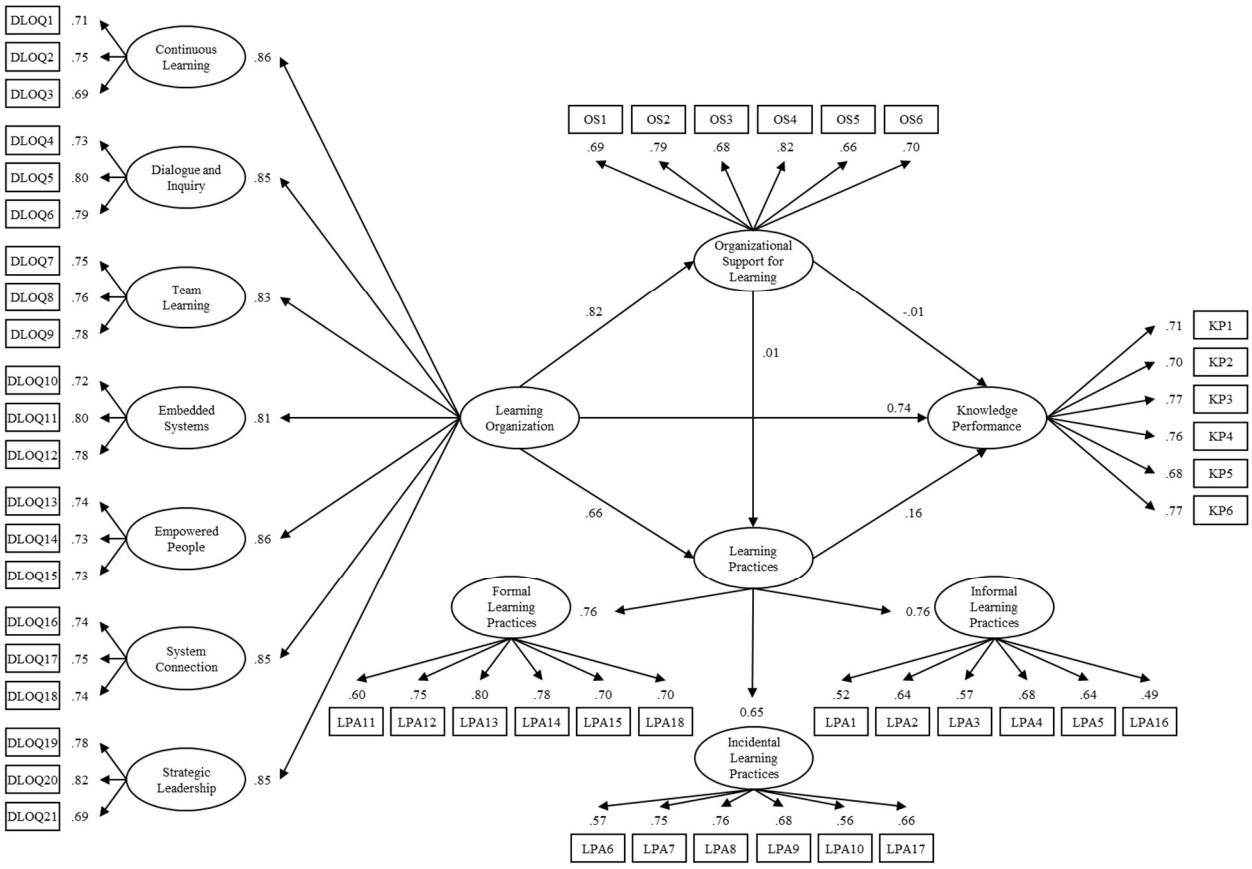


Table 12

SEM Fit Indicators

Test	X^2/df	NFI	CFI	RMSEA	p-value	SRMR
Result	3.03	.900	.930	.071	.001	.0454

Hypothesis 2: A learning organization has a positive effect on informal learning practices was supported by regression analysis supported. *Hypothesis 3: Organizational support for informal learning has a positive effect on informal learning* was also supported by the data. Informal learning practices increase by .360 ($p < .001$) for every unit increase in organizational support for informal learning.

Hypothesis 4: A learning organization has a positive relationship on organizational support for informal learning was also supported. Analysis found the learning organization has a positive effect on knowledge performance; therefore, *Hypothesis 5: A learning organization has a positive effect on knowledge performance* was supported as well. Analysis revealed that for every unit increase in the learning organization, informal learning practices increase by .479, incidental learning practices increase by .453, organizational support for informal learning increases by .818, and knowledge performance increases by .841 (all significant at the $p < .001$ level).

Hypothesis 6: Informal and learning practices have a positive effect on knowledge performance was also supported by the data. Knowledge performance increases by .516 with every one-unit increase in informal learning and increases by .376 ($p < .001$ level) with every one-unit increase in incidental learning ($p < .001$ level).

Hypothesis 7: Organizational support for informal learning has a positive effect on knowledge performance was supported by the data. Data revealed that knowledge performance increases by a .686 ($p < .001$) for every one-unit increase in organizational support for informal learning.

Table 13

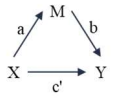
Regression Analysis

Independent Variable	Dependent Variable	Std. Coefficient
Learning organization	Informal learning	.479**
Learning organization	Incidental learning	.453**
Learning organization	Formal learning	.601**
Learning organization	Learning Practices	.656**
Learning organization	Org. support for informal learning	.818**
Learning organization	Knowledge performance	.841**
Formal learning	Knowledge performance	.597**
Informal learning	Knowledge performance	.516**

Incidental learning	Knowledge performance	.376**
Org. support for informal learning	Formal learning	.551**
Org. support for informal learning	Informal learning	.360**
Org. support for informal learning	Incidental learning	.331**
Org. support for informal learning	Learning Practices	.528**
Org. support for informal learning	Knowledge performance	.686**

** $p < .001$

Hypotheses 8-11 address the mediating relationships between the constructs. (See Table 14.) Mediating relationships were analyzed based on the four-step approach (Baron & Kenny, 1986; Judd & Kenny, 1981; James & Brett, 1984). In this approach, the relationships are modeled as 

and 

, where *X* is the causal variable, *Y* is the outcome variable, path *c* is the total effect, *M* is the intervening variable (which may or may not have a mediating effect), *c'* is the direct effect, and the product of *ab* is the indirect effect. Calculate *c*, establishing correlation between *X* and *Y*. Then, show correlation between *X* and *M*. Next, calculate *c'*, establishing correlation between *X* with *M* and *Y*. If both *c* and *c'* are statistically significant, and if *c'* equals zero, the mediation is perfect; and, if $c' < c$ but is still greater than zero in absolute terms, there is partial mediation (Baron & Kenny, 1986). If *c* is opposite in sign to the product of *ab*, the mediation is inconsistent, and the intervening variable may be suppressing the causal variable (Baron & Kenny, 1986). Effect size is considered small if the indirect effect is 0.01, medium at 0.09, and large at 0.25 (Kenny & Judd, 2014). The indirect effects were evaluated further, using two additional tests: *c-c'* as the indirect effect (Imai et al., 2010) and $ab/c \geq 0.08$, applied only when $c \geq \pm 0.2$ (Kenny, 2021). The additional tests supported the findings of the initial method in all cases except for *Hypothesis 8: Organizational support for informal learning mediates the relationship between a learning organization and informal learning practices*. In this case, *c* was less than ± 0.2, and the test was not applied.

Organizational support for informal learning as a mediator

Hypothesis 8: Organizational support for informal learning mediates the relationship between a learning organization and informal learning practices was supported by the data. The standardized direct effect was 0.162 and the indirect effect was -0.017 ($p < .001$). This indicates a small effect size – as did the *c-c'* test, which also had a value of -0.017. The second test, *ab*/*c*, could not be applied, as the value of c was not greater than or equal to ± 0.2. In this case, the product of *ab* had a different sign than *c*, indicating inconsistent mediation.

Hypothesis 9: Organizational support for informal learning mediates the relationship between a learning organization and knowledge performance was not supported by the data. While the four-step approach initially suggested partial mediation, the product of *ab* had a different sign than *c*, suggesting an inconsistent relationship. The standardized direct effect was 0.847 and the indirect effect was -0.006 ($p < .001$). Neither this value nor the *c-c'* test's value, also -0.006, meets the minimum threshold for small effect size. The second test, *ab*/*c*, was equal to -0.007, which does not meet the threshold of ≥ 0.08. Because the three measures of indirect effect failed, it can be determined that organizational support for informal learning does not mediate the relationship between the learning organization and knowledge performance, and the hypothesis is therefore unsupported.

Informal learning as a mediator

Hypothesis 10: Informal learning mediates the relationship between organizational support for informal learning and knowledge performance was supported by the data. The four-step approach indicated a partial mediation. The standardized direct effect was 0.673 and the indirect effect was 0.112 ($p < .001$). This indicates a medium effect size. However, the test *c-c'*

was 0.013, which indicates a small effect size. The second test, *ab*/*c*, was equal to 0.164, surpassing the threshold of ≥ 0.08.

Hypothesis 11: Informal learning mediates the relationship between the learning organization and knowledge performance was also supported by the data. The four-step approach indicated informal learning is a partial mediator between the learning organization and knowledge performance, with standardized direct effects of 0.76 and an indirect effect of 0.073 ($p < .001$). The *c-c'* test yielded 0.073 as well; both results indicate a small effect size. The *ab/c* test was 0.087, which supports the relationship.

Table 14

Mediation Analysis

Model	Type	Direct Effect	Indirect Effect	c – c' Test	ab/c Test	Effect Size
DLOQ → OS → KP**	Inconsistent	0.847	-0.006	-0.006	-0.007	N/A
DLOQ → OS → F-LP**	Partial	0.465	0.138	0.138	0.228	Medium
DLOQ → OS → IF-LP**	Inconsistent	0.162	-0.017	-0.017	N/A	Small
DLOQ → OS → IC-LP**	Inconsistent	0.552	-0.098	-0.098	-0.215	Medium
OS → IF-LP → KP**	Partial	0.673	0.112	0.013	0.164	Medium
DLOQ → IF-LP → KP**	Partial	0.767	0.073	0.073	0.087	Small
OS → IC-LP → KP**	Partial	0.727	0.064	-0.042	0.094	Small
DLOQ → IC-LP → KP**	Inconsistent	0.842	-0.002	-0.002	-0.002	N/A
OS → F-LP → KP**	Partial	0.511	0.174	0.175	0.254	Medium
DLOQ → F-LP → KP**	Partial	0.753	0.087	0.088	0.104	Small

** $p < .001$

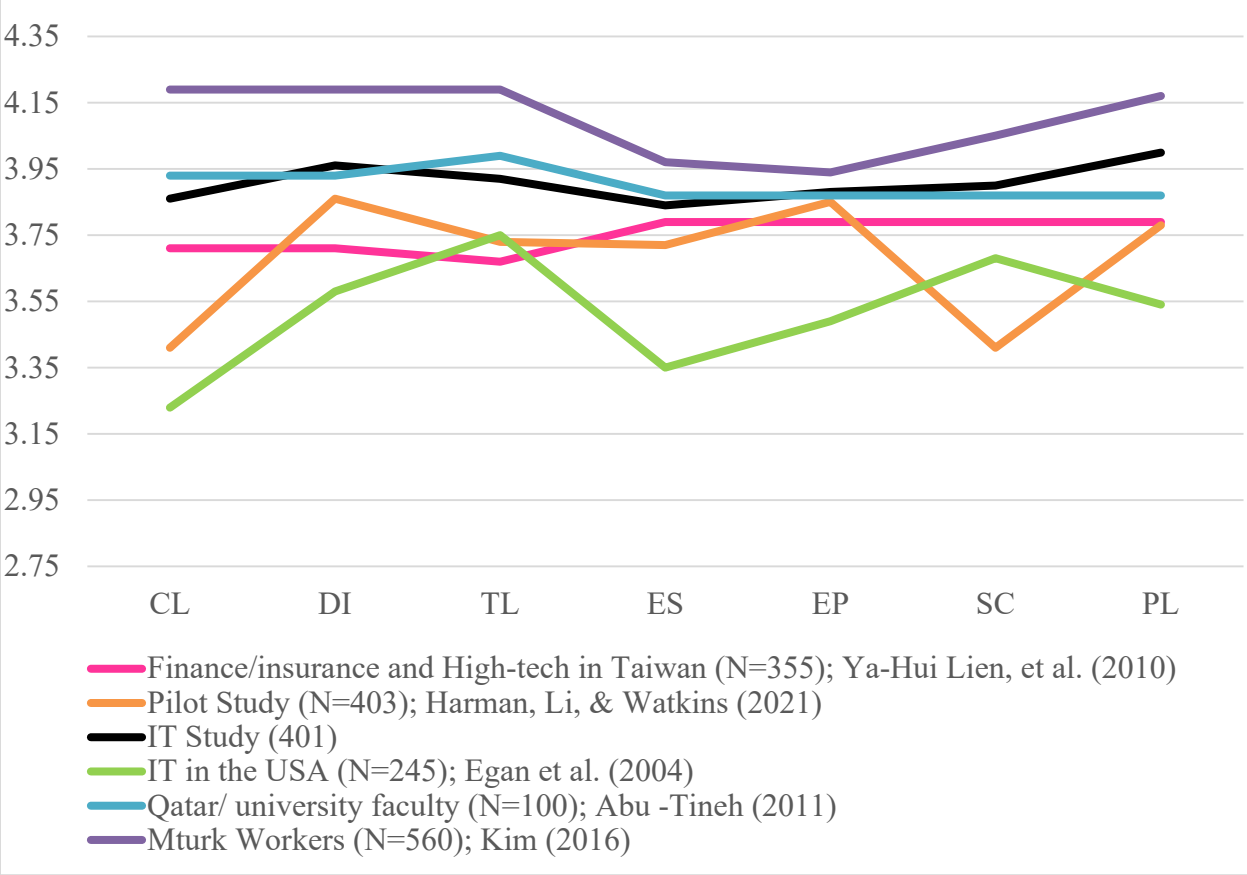
Sample Means and Variance Based on Demographics

Figure 10 compares means from this study to other studies using DLOQ. The scores for IT professionals who participated in this study do not mirror the results from other studies using MTurk, which indicates that the MTurk sample with the criteria of IT function constitutes a distinct group. The means captured most closely follow those of the faculty of Qatar University

and Finance/Insurance and High-tech workers in Taiwan. These results are very different from those of U.S.-based IT workers, which may be due in part to the fact that the data for this study was not restricted to the U.S.

Figure 10

DLOQ Means from Select Studies



CL=Continuous Learning; DI=Dialogue and Inquiry; TL=Team Learning; ES=Embedded System; EP=Empowered People; SC=System Connection; SL=Strategic Leadership; LO=Learning Organization (composite of 7 dimensions); LP=Learning Practices (composite of 3 dimensions).

Table 15 shows the values collected from the pilot study from Harman et al. (2021) as compared to this study. IT professionals in this study rank higher across every variable than the

sample used in the pilot. The pattern is similar, through respondents from the pilot group scored much lower for Continuous Learning (CL) and System Connection (SC) than the IT professionals compared to the other dimensions.

Table 15

Comparison of means

	Sample Size	Means												
		FL	IC	IF	LP	OS	CL	DI	TL	ES	EP	SC	PL	KP
Pilot Study	403	3.54	4.41	3.83	3.93	4.09	3.41	3.86	3.73	3.72	3.85	3.41	3.78	3.67
IT Study	401	3.71	4.36	4.24	4.10	4.31	3.86	3.96	3.92	3.84	3.88	3.9	4.0	3.98

IF=Informal Learning Practices; IC=Incidental Learning Practices; FL=Formal Learning Practices; OS=Organization Support for Informal Learning; KP=Knowledge Performance; CL=Continuous Learning; DI=Dialogue and Inquiry; TL=Team Learning; ES=Embedded System; EP=Empowered People; SC=System Connection; SL=Strategic Leadership; LP=Learning Practices (composite of 3 dimensions).

T-tests and regressions were performed to understand whether select demographics predicted respondents' participation in learning practices, perceptions of organizational support for informal learning, the learning organization, and knowledge performance. Participants provided demographic data on whether they are a manager or non-manager, gender, age, whether they are working for a non-profit or for-profit company, the highest degree of education they have attained, and the percentage of time spent working remotely. Results are detailed in Table 16 below.

Table 16

Regression and t-test Analysis on Demographics

	IF	IC	FL	LP	OS	KP	LO
Role	0.05	-2.36*	2.78*	-0.466	1.94	1.76	-1.60
Gender	2.51*	1.10	3.20**	-2.92*	2.59*	2.07*	-3.42**
Age	-4.09**	-0.67	-5.40**	-4.263**	-3.66**	-4.44**	-4.05**
Org. Type	1.28	-0.20	2.50*	-0.079	2.34*	3.86**	-2.84*
Education	0.17	-0.63	1.55	0.565	1.69	1.81	1.15
Remote Hours	-1.64	0.88	-4.68**	-2.463*	-2.50*	-2.35*	-2.96*

** $p < .001$ * $p < .05$

Hypothesis 12: The role – manager or non-manager – of the respondent has a significant impact on informal learning practices was not supported. Respondent role – whether they are a manager or a non-manager – has a significant impact on both incidental and formal learning practices but was not significant for informal learning practices. Additionally, managers scored higher across all variables except incidental learning.

Hypothesis 13: Gender has a significant impact on informal learning practices was supported. Gender accounts for 12.5% of the variance for informal learning ($t= -2.10$, $p < .05$) and has a significant impact on informal and formal learning practices, as well as on perceived organizational support for informal learning, the learning organization, and knowledge performance.

Hypothesis 14: Age has a significant impact on informal learning practices was also supported. Apart from incidental learning, age had a significant, negative impact on all variables. Age explained 20.1% of the variance for informal learning ($t = -4.09$, $p < .001$); 26% of the variance for formal learning practices ($t = -5.40$, $p < .001$); 18% of the variance for perceived organizational support for informal learning ($t = -3.66$, $p < .001$); 21.7% of the variance for

knowledge performance (t = -4.44, $p < .001$); and 19.5% of the variance for the DLOQ (t = -3.97, $p < .001$).

Hypothesis 15: The type of organization – non-profit or for profit – has a significant impact on informal learning practices was not supported. Organization type was significant for formal learning practices, organizational support for informal learning, knowledge performance, and the learning organization, but not for informal learning practices.

Hypothesis 16: Education level does not have a significant impact on informal learning practices was supported. Education was not significant for any variable.

Hypothesis 17: Remote work does not have an effect on informal learning practices was also supported. The percentage of time spent working remotely did not have a significant effect on informal or incidental learning. The number of hours worked remotely did, however, have a significant, negative effect on formal learning practices (t = -4.68, $p < .001$); organizational support for informal learning practices (t = -2.50, $p < .05$); knowledge performance (t = -2.35, $p < .05$); and the learning organization (t = -2.96, $p < .05$).

Summary

This chapter presents the results of the factor analysis and addresses the research hypothesis through SEM analysis. The EFA and CFA prove that the learning practices audit is a valid and reliable measure for learning practices. While the SEM results supported positive correlations between all the variables, the strongest relationships emerged between the learning organization and organizational support for informal learning. The strong correlation between the learning organization and knowledge performance was also confirmed. Analysis of the demographic factors revealed the influence of age and gender on informal learning practices for

IT professionals. The percentage of hours spent working remotely and the level of education has no significant effect, whether the professional is a manager or non-manager.

Mediation analysis revealed that organizational support for informal learning is inconsistent as a mediator. The data showed informal learning partially mediates the relationship between the learning organization and knowledge performance and the relationship between organizational support for informal learning and knowledge performance. Incidental learning partially mediates the relationship between the organizational support for informal learning and knowledge performance but shows inconsistent mediation between the learning organization and knowledge performance.

CHAPTER 5

CONCLUSION

This chapter provides a summary of the findings of this study, discusses both the theoretical and practical implications of the study for IT professionals, presents the limitations of the study, and suggests related areas for future research.

Summary of Findings

The purposes of this study were to 1) validate the Learning Practices Audit; 2) understand the relationships between learning practices, organizational support for informal learning and the learning organization for IT professionals; and 3) understand the knowledge performance outcomes for organizations. Results of the tests of hypotheses are shown in Table 17:

Table 17

Hypothesis Results

Research hypotheses	Analysis	Table Reference	Results
Hypothesis 1. The Learning Practices Audit is a reliable and valid measure for assessing learning practices for IT professionals.	Factor analysis and t-test		Supported
Hypothesis 2. A learning organization has a positive effect on informal learning.	SEM		Supported
Hypothesis 3. Organizational support for informal learning has a positive effect on informal learning.	SEM		Supported
Hypothesis 4. A learning organization has a positive effect on organizational support for informal learning.	SEM		Supported

Hypothesis 5. A learning organization has a positive effect on knowledge performance.	SEM	Supported
Hypothesis 6. Informal learning has a positive effect on knowledge performance.	SEM	Supported
Hypothesis 7. Organizational support for informal learning has a positive effect on knowledge performance.	SEM	Supported
Hypothesis 8. Organizational support for informal learning mediates the relationship between a learning organization and informal learning.	SEM	Supported
Hypothesis 9. Organizational support for informal learning mediates the relationship between a learning organization and knowledge performance.	SEM	Not Supported
Hypothesis 10. Informal learning mediates the relationship between organizational support for informal learning and knowledge performance.	SEM	Supported
Hypothesis 11. Informal learning mediates the relationship between the learning organization and knowledge performance.	SEM	Supported
Hypothesis 12. The role – manager or non-manager – of the respondent has a significant impact on informal learning practices.	Regression	Not supported
Hypothesis 13. Gender has a significant impact on informal learning practices.	Regression	Supported
Hypothesis 14. Age has a significant impact on informal learning practices.	Regression	Supported

Hypothesis 15. The type of organization – non-profit or for profit – has a significant impact on informal learning practices.	Regression	Not supported
Hypothesis 16. Education level does not have a significant impact on informal learning practices.	Regression	Supported
Hypothesis 17. Remote work does not have a significant impact on informal learning practices.	Regression	Supported

Discussion of Findings

This section discusses the findings of the study in the context of the literature previously presented.

Instrument Validation

The LPA is a valid measure for assessing learning practices in this model. The internal consistency presented in the CFA was slightly under acceptable fitness thresholds; however, learning practices as a construct met the criteria when placed in the model. When conceptualizing formal, incidental, and informal learning practices, Watkins, Harman, and Li (2020) found that the practices could be categorized as any of the three-practice types, depending on context. Learner intent and level of consciousness, as well as organizational setting, could influence the categorization.

Likewise, when consulting with the expert panel, researchers found that incidental learning practices could be imbedded in formal and informal settings. These considerations not only confirm the idea that learning exists across a formal, informal continuum, rather than as dichotomies; they also add dimensions of organizational context and learner intent (Eraut, 2000; Li, 2021; Livingstone, 2001; Schugurensky; 2000). For instance, a workplace learner pursuing an

online learning course independently and proactively in order to solve a problem at work would be categorized as informal learning. Now, suppose the same workplace learner pursues the same online learning course because they were instructed to do so by the organization. Is that now considered formal learning? Does the answer change if the learner needs the course to be promoted, but the organization is not funding it? And if the learner later reflects on the course and realizes they learned something unexpected during the course, is that now incidental learning?

Understanding the Relationships between IF, OS, KP, and LO for IT

Based on the findings, the learning organization does have a positive effect on informal learning practices. This supports the findings from Nurmala (2014) but contradicts the finding from Berg and Chyung (2008). But this may be due to misalignment of measurement, as neither of the aforementioned studies used the same items to assess informal learning.

The regression and correlation analysis shows that organizational support for informal learning has a significant, positive effect on informal learning. This is not surprising, as the construct of organizational support for informal learning was designed to specifically address barriers *to* informal learning, as identified by Lohman (2009). What is surprising is that organizational support actually has a greater correlation with and accounts for more of the variance of formal learning than informal learning. While not the focus of this study, as informal learning is the leading means of learning for IT professionals, this relationship is worth noting.

This study confirms that the learning organization has a positive effect on organizational support for informal learning. Several of the dimensions encompass the strategies that comprise organizational support for learning. And organizational support for informal learning has the highest correlations with *continuous learning (CL)* and *strategic leadership (PL)*.

This study confirms the learning organization has a positive effect on knowledge performance. The confirmation supports findings from other scholars, including Kim, 2016; Hernandez, 2000; Yang et al., 2004; Zhang et al., 2004; Davis & Daley, 2008; Watkins et al., 2009.

Informal learning has a positive effect on knowledge performance. This finding reiterates the importance of the learner, which is emphasized in the informal learning literature (Hart, 2015; Illeris, 2004; Livingstone & Sawchuk, 2004; Sawchuk, 2008). Marsick and Watkins (2001) suggest that one way for organizations to improve is to nurture self-directed learners. Knowledge performance is the tangible measure of improvement. It follows, then, that organizational support for learning, which was conceived as a means of promoting informal learning, would also affect a positive impact on knowledge performance.

The mediating relationships proposed in Hypotheses 9-11 are the logical extensions of the causal relationships posited in the first seven hypotheses. The study found that informal learning mediates the relationship between organizational support for informal learning and knowledge performance. This aligns with organizational support for informal learning's positive impact on informal learning and with informal learning's positive impact on knowledge performance. By addressing the barriers to informal learning through targeted organizational support, gains in knowledge performance can be even greater.

This study also found that informal learning mediates the relationship between the learning organization and knowledge performance. The finding compliments evidence also generated through this study on the positive impact informal learning has on knowledge performance. And the finding reiterates evidence in the literature showing the learning

organization's positive impact on knowledge performance (Kim, 2016; Hernandez, 2000; Yang et al., 2004; Zhang et al., 2004; Davis & Daley, 2008; Watkins et al., 2009).

Perhaps the most intriguing result of the mediation analysis is that organizational support for informal learning does not mediate the relationship between a learning organization and knowledge performance. As a construct, organizational support for learning encompasses strategies that align closely with structures present in the learning organization, and shows a significant, positive impact on knowledge performance. This finding suggests that although targeted strategies are important, the presence of a learning culture is a more influential driver of knowledge performance.

The Learner Profile for IT Professionals

Of the demographics captured in the study, only gender and age had a statistically significant impact on learning for IT professionals. Neither the IT professional's role (manager or non-manager), their education, whether they work for a non-profit, nor the percentage of time they work remotely had a statistically significant impact on informal learning. Many studies across several areas of academic research, from management to psychology, have explored managerial personality traits. Some of these traits overlap with the traits of self-directed learners – hence the expectation that being a manager would have some impact on informal learning (Choi, 2009; Noe et al., 2013). This was not the case, though the mean score from respondents who reported being managers was higher than that of non-managers across every variable except incidental learning. This may be attributed to greater institutional knowledge and awareness of learning and development programs. Additionally, new managers are typically subject to mandatory trainings targeted for this role.

Gender is a statistically significant predictor of informal learning, accounting for 12.5% of the variance ($t= -2.10$, $p < .05$). On average, women scored higher across all variables compared to males who participated in the study. Gender affecting learning practices and perceptions of learning culture and knowledge performance is not surprising, considering the literature (Stothard et al., 2012), and given that workplace experience in IT differs so dramatically for men and women (Coast, 2021; Funk & Parker, 2020; Gurchiek, 2018; Moss, 2019).

The dramatically higher scores might be explained by an examination of other contextual factors. Women experience more barriers to entry in IT, and, while the pay gap in IT is smaller than in other fields (Moss, 2019), women are acutely aware of being paid less than men for the same work. In workplaces in general, women report fewer interactions with leadership compared to men, which also stunts growth and development. The higher reported engagement in learning practices may be a manifestation of trying to break the glass ceiling. And not wanting to be perceived as unqualified in an environment where there are already so many barriers to entry may be a catalyst driving informal learning.

Contrary to expectations from the literature, the type of organization – non-profit or for profit – did not have a significant effect on informal learning practices. McHargue (2013) suggests that the learning environment is different in non-profit organizations. In the case of IT professionals, it could be that, because the work does not change, workplace learning does not change; or that working remotely distances them from the culture of the non-profit. However, these assumptions would do a slight disservice to the informal learning scholars who have proven that organizational context has an impact on informal learning (Callahan, 1999; Cseh,

1999; Skule, 2004; Marsick, Watkins, & Lovin, 2009; Warhurst, 2013; Watkins & Marsick, 2014).

Organization type was statistically significant for formal learning, organizational support for informal learning, and perceptions of the knowledge performance and the learning organization. Though not the focus of the study, it should be noted that organization type was also statistically significant for formal learning, organizational support for informal learning, and perceptions of knowledge performance and the learning organization.

Education level does not have a significant impact on informal learning practices. In fact, level of education is not a significant predictor for any of the variables. This confirms the trend of emphasizing work experience over formal education (Mahatanankoon, 2007a, 2007b; Naveda & Seidman, 2005). It also supports the findings from Livingstone (2001), Harman, Li, and Watkins (2021) and Berg & Chyung (2008).

Remote work does not have a significant impact on informal learning practices. This is great news for IT professionals for whom remote work was common even before the COVID-19 pandemic. In most cases, productivity was not impacted, and many companies are committed to moving to remote or hybrid models permanently. This finding contradicts the logical implication of Lohman's (2009) work, which includes lack of proximity, inaccessibility of others, and lack of a meeting space or workplace as barriers to informal learning for IT professionals specifically. Although informal learning is influenced by social interaction (Hart, 2015; Marsick & Watkins, 2015b; Nicolaides & Scully-Russ, 2018; Scully-Russ & Boyle, 2018), this social interaction does not need to be in-person. As Nicolaides and Scully-Russ, (2018) point out, technology provides a means of connection.

Significance to Learning and Development

This study addresses four gaps in the learning and development literature. First, establishing a baseline is a critical first step in enabling change. There are only a handful of instruments to measure informal learning, none of which focus on the learning practices or activities from the learner perspective. The development and validation of the LPA gives scholars and practitioners a new, reliable way to assess an organization's current state of learning.

Second, few studies focus on the learning organization and informal learning (Nurmala, 2014). This study explores that relationship and integrates the learning practices and organizational support for informal learning as new constructs.

Third, this study validates knowledge performance as a construct and explores its relationship to other constructs – something that was lacking even in the widely cited DLOQ literature (Kim, 2016; Davis & Daley, 2008; Hernandez, 2000*).*

Fourth, the few studies that do examine informal learning and the learning organization do not examine the relationship between these constructs in the context of IT professionals, who have several unique characteristics as informal learners. Most other studies focus on subgroups within IT, whereas the subject pool for this study was broader, making the insights applicable to the general IT function.

Limitations of the Study

The study may be limited by contextual factors, the instruments used, the data collection methods, and the conceptualization of the learning practices construct. First, the study cannot control for contextual factors related to organization or industry, as it focuses on IT professionals but does not specify the type of organization or industry in which those IT professionals are

employed. This is not expected to affect generalizability, however, because the sample size is large, and the respondents are unlikely to work for the same organization.

Second are limitations based on the instruments themselves. Despite the DLOQs wide use, Marsick and Watkins (2003) do recognize its constraints, including its self-reported data, that responses to the performance questions often limited to managers, and that the tool is at best only a proxy for performance results. From an analysis perspective, researchers must be aware that "the dimensions are highly intercorrelated. This multicollinearity makes statistical analyses more difficult, yet since the constructs operationalized with this instrument are all dimensions of a learning culture, it is intuitively reasonable for the dimensions to be interrelated" (Watkins & O'Neil, 2013). CFA addressed this limitation.

Additionally, Kim et al. (2015) critique the DLOQ on the basis that not enough studies using the DLOQ test construct validity via factor analysis. The authors reviewed 35 published studies using the DLOQ; of those, only 39% used some sort of factor analysis to test construct validity. However, according to Yang (2005),

> EFA (exploratory factor analysis) is used to explore underlying factors when there is little or no prior theoretical guideline for a domain of interest, and CFA (confirmatory factor analysis) is used to confirm or disconfirm a hypothesized factor structure of interest. (p. 194)

Validity can be achieved when an instrument is grounded directly in theory (Nunnally & Bernstein, 1994; Strickland, 2001). This would exclude the DLOQ from exploratory factor analysis in the view of many researchers, as the instrument has a firm theoretical foundation (Marsick & Watkins, 1999; Watkins & Marsick, 1993).

Unlike the DLOQ, the LPA has not been widely used, and therefore validity and reliability have not been proven multiple times over. The pilot study from Harman et al. (2021) was used to validate the items, and the authors practiced due diligence before launching the pilot survey in MTurk. Due diligence included revising the questions, vetting the questions with an expert panel, preliminary coding, and administering the survey to groups of doctoral students at two large research universities.

Third, the study may be constrained by its use of MTurk. There is a discourse in academic literature questioning the reliability, data quality, and generalizability of research data collected through MTurk (Bergvall-Kareborn & Howcroft, 2015; Cheung et al., 2017; Paolacci et al., 2010, 2014; Woo et al., 2015). There are tools and actions for researchers to circumvent and mitigate these methodological concerns (Woo et al., 2015). The study considered those possibilities, as detailed by Cheung et al. (2017). To avoid subject inattentiveness, which threatens internal and construct validity, data were thoroughly screened prior to analysis, and respondents were required to answer all questions and only allowed one submission. Selection bias and range restriction were addressed using a qualifying question (see *Target Population and Sample* section).

MTurk has also been criticized as convenience sampling (Cheung et al., 2017; Woo et al., 2015). Convenience sampling offers the least-generalizable findings of any sampling strategy, and yet it is still the most common type of sampling (Swanson & Holton, 2005). For the study, this risk was mitigated by using a qualifying question.

Fourth and finally, this study is limited by a theoretical concern regarding the concept of learning practices. The primary constraint is that informal learning as a construct is fluid and may not even be recognized as learning by learning and development professionals or by the

learner (Li, 2021). While the model, inclusive of other constructs, performed well, the CFA did not. And while other studies using the learning practices constructs showed acceptable internal consistency, the data collected on IT professionals for this study revealed fitness indices that were below acceptable thresholds. AVE, C.R., HTMT and Cronbach's alpha values were also tested, and many proved acceptable.

Direction for Future Research

Further research based on the findings of this study could deepen our understanding of the learning landscape for IT professionals. Three areas for future research would include examination of informal learning and IT trends, deeper exploration of gender in IT and learning, and an expanded analysis of this data to answer additional research questions.

Two trends in IT that remain unexamined in the context of informal learning are agile methodologies and company-sponsored innovation centers. Because these trends are highly visible within organizations, and face compounded pressure, the environment may present unique contextual factors that affect informal learning.

Examination of the intersectionality of race, gender, marginalized groups, and informal learning in the technology space also warrants further research. Diversity and inclusion are imperative in IT. From an organizational development perspective, it is well known that diverse teams produce better products, are more innovative, and make better decisions. As technology evolves and touches every facet of everyday life, solving the diversity problem in tech grows ever more urgent. From AI that generates sexist tweets to facial recognition software more likely to recognize a man's voice, lack of diversity creates space for inherent design and execution flaws in technological innovations.

Women are not the only underrepresented group in tech: this issue extends to race and gender identity as well. Only two of 401 respondents self-identified as non-binary. These two individuals had dramatically lower scores across all variables except informal and incidental learning and knowledge performance. While this is not enough data to be generalizable, the learning experience for marginalized groups, such as religious and ethnic minorities and the LGBTQ community, should be investigated further. Incidental learning and informal learning, though affected by the social context, can take place independently. Are minority groups marginalized in learning, too?

The data generated by this study can be used to study other topics as well. First, moderation could be explored. This study looked at mediation but did not analyze its data in terms of moderation. This analysis would be helpful for expanding the understanding of how mediating variables behave and could provide additional insights about the relationships between informal learning, organizational support for informal learning, and the learning organization and the impact knowledge performance. Second, incidental learning practices and formal learning practices deserve closer examination. The data collection included both, and, while these were presented in the results and findings chapters, they were not the focus of this study.

Finally, these data could be used in a time study on how the workforce was impacted by the global pandemic. In the U.S., many mark the start the COVID-19 pandemic as mid-March of 2020. This was the catalyst for what many organizations are calling the new normal, a way of working and living characterized by social distancing and remote work. The data for the pilot which preceded this study was collected in April of 2020, with many still adjusting to the new normal. And the data for this study were collected in April of 2021, a full year after what was the start of the fully remote work model for many IT professionals. By analyzing the two data sets

together, research questions could be addressed as a time-study and explore the effect of the COVID-19 pandemic on this period. Such an inquiry might not only produce additional insights for remote work but could also uncover transformational learning aspects that have yet to emerge. Additionally, deploying the LPA in the Spring of 2022 might illuminate how the shift to remote work and return to work have affected learners. As some companies call workers back into the office, or others become entirely virtual, understanding the influence of remote work on informal learning is crucial.

Conclusion

This section discusses the key outcomes from this study and their application for practitioners. Changes to the measuring informal learning are discussed first. Next, the effect of understanding the relationship between the learning organization and learning practices is explained. This is followed by highlighting the key insights about IT professionals as learners.

Measuring Informal Learning

In addition to validating an instrument that can be used to establish a baseline, this study also presents new constructs. Organizational support for informal learning and the learning practices are built on the empirical studies and models of informal learning literature. This study examined the validity of the constructs and their relationships to one another, the learning organization, and, most importantly, knowledge performance. Moving forward, these new constructs can be refined and combined with other constructs to further inform the literature. Observing the behavior of organizational support for informal learning in the SEM model, it is possible to conclude that action targeted to address barriers is not as effective at promoting learning practices as having a learning culture. Furthermore, barriers to one form of learning are not necessarily barriers to other forms. The validation process for the learning practices construct

suggests that the strict dichotomy between formal, informal, and incidental learning should be loosened, and made more inclusive of context and learner intent. These elements' impact the categorization of learning practices can be studied and expand the understanding workplace learning.

Learning Culture and Informal Learning

This study empowers the learning and development practitioner to further support not just self-directed learning, but a learning culture. By aligning learning practices with knowledge performance, learning and development can more transparently prove learning's return on investment for the organization. The confirmation that informal learning influences knowledge performance adds a crucial tool to the arsenal of strategies learning and development professionals have at their disposal. Knowledge performance is a major component of the balanced score card approach and a proven predictor of financial performance, yet few studies investigate the relationship between knowledge performance and other constructs outside of the DLOQ (Kim, 2016; Davis & Daley, 2008; Hernandez, 2000).

In addition to further confirming the relationship between the learning organization and knowledge performance, this study also examined the relationship between knowledge performance and organizational support for informal learning, as well as the learning practices. The significant, positive impact of organizational support for informal learning, informal learning practices, incidental learning practices, and formal learning practices adds depth to the literature on knowledge performance. This evidence can be used to inform decision making regarding informal learning practices. In the strategically proactive era, where learning and development professionals are now change agents for organizations, fostering a learning culture should be a priority (Han, 2015; Ruona & Gibson, 2004; Torraco & Swanson, 1995).

Furthermore, the positive relationship between the learning organization and informal learning, as proven in this study, confirms the importance of the learning culture in fostering an environment where the individual, self-directed learner can thrive. It also provides further evidence for the informal literature that the organizational context is a critical component of learning informally (Callahan, 1999; Cseh, 1999; Marsick et al., 2009; Warhurst, 2013; Watkins & Marsick, 2014). Correlation analysis gives deeper insight to the relationship proven in the regression analysis. The individual dimensions and the learning organization construct both have low, but significant correlations with informal learning. *Strategic Leadership (PL)* had the strongest correlation with informal learning, which supports the literature's broader finding that leadership and management are key influencers in informal learning (Ellinger & Ellinger, 2020; Enos et al., 2003; Eraut, 2004; Hart, 2015; Lohman, 2009; Skule, 2004). IT professionals are characterized as having lower social needs (Ahmed et al., 2017; Anjali & Anand, 2015; Wynekoop & Walz, 1998). In parallel, social learning and proximity are factors in informal learning (Hart, 2015; Marsick & Watkins, 2015b; Nicolaides & Scully-Russ, 2018; Scully-Russ & Boyle, 2018). This contrast is mirrored in the relationship between *Dialogue and Inquiry (DI)* and informal learning, which had the lowest correlation compared to the other dimensions, and in the relationship between *Team Learning (TL)* and informal learning, which was the second-highest comparatively.

As the global economy continues its digital transformation, the number of IT professionals in organizations will continue to grow. Strategic planning for learning and development can leverage this study's insights to focus the learning culture on informal and incidental learning by emphasizing those dimensions with the biggest impact. Based on this

study, learning and development professionals should focus on providing strategic leadership for learners and promoting team learning for IT professionals.

Learning and the IT Professional

Evidence in this study deepens our understanding of how IT professionals learn, but also raises questions about learning practices. Of the learning practices where IT Professionals have a conscious learning goal, informal learning is the preferred format. The data from this study, however, suggest that the IT professional learns more as an incidental learner. The means for the sample across the incidental learning practices was 4.36, while the means for informal and formal learning practices were 4.24 and 3.71, respectively. Little evidence for this nuance appeared in the literature on IT professionals, but it is accepted that while IT professionals are primarily informal learners (Lohman, 2009), the group also relies on work experience and implicit learning (Drohan, 2014; Kabia, 2011; O'Horo, 2013). As this pattern was the same for the MTurk workers who responded to the pilot study survey and for the group of graduate students who vetted the items, the broader implication may be that incidental learning, as an unconscious activity, impacts the learner differently than learning practices with an explicit learning goal. Is it more impactful, more memorable, or more useful in some way? Does it tap into another part of human intelligence?

Broader Application

The demographic insights contribute to the knowledge base of IT professionals as learners. The information on remote work and gender are especially relevant for IT professionals. However, although this was a targeted sample population, the diversity of the sample afforded using MTurk for data collection and the consistency of means when compared to other studies using the DLOQ suggest the insights may apply to other populations.

IT is the United States' fastest growing professional field (United States Department of Labor, 2019). IT professionals are increasingly critical to the operations and strategic initiatives of their organizations. Because IT professionals learn primarily through informal and incidental learning, it is also critical to deepen our understanding of how this learning manifests in practice. The development and validation of an instrument for assessing learning practices enables organizations to understand their current state of learning – it grants them a baseline to enable change (McLean, 2006). The link between competitive advantage and knowledge performance as exposed by Kaplan and Norton (2004) and the increasing importance of informal learning make a deeper understanding of this relationship vital for learning and development (Han, 2015; Marsick & Watkins, 1994; 2001; Watkins & Marsick, 1993). This study offered a deeper understanding of how a learning culture influences organizational performance.

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