Explorations in the Learning Sciences,
Instructional Systems and Performance Technologies

Minhong Wang

E-Learning in the Workplace

A Performance-Oriented Approach Beyond Technology

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To my husband David and our daughter Lucy

Foreword

This volume provides readers with an in-depth treatment of e-learning in the workplace. The analysis is from the overlapping perspectives of performance technology, instructional design, and organizational learning. The analysis provides many valuable insights into the efficacy of e-learning in work settings. Perhaps more importantly is a contribution that could and should add value to all e-learning contexts. Many of the advocates of technology-enhanced learning in educational contexts emphasize the collaborative possibilities provided by e-learning. However, learners in schools and colleges are not as naturally motivated to collaborate as those in work settings who are required to collaborate on a daily basis in the performance of normal job duties and responsibilities. From a performance perspective, one insight to be gained from this volume that extends beyond e-learning in the workplace is that collaboration for the sake of collaboration or because technology makes collaboration easy is not necessarily an effective instructional strategy. People need a compelling reason to make use of the collaborative potential of e-learning.

In the first chapter, five issues about e-learning in the workplace are identified, based on extensive reviews of the research literature. These issues are stated here in terms not directly linked to the workplace because they seem applicable to all e-learning contexts: (1) dynamic feedback in an e-learning environment is important; (2) generic content not directly linked to actual tasks is not likely to be effective; (3) alignment of e-learning resources and activities with goals and objectives is likely to be effective; (4) introducing e-learning without appropriate preparation, training, and ongoing support is problematic; and (5) ongoing evaluation and refinement are important considerations. These issues, derived from research on e-learning in the workplace, seem applicable to all settings. One difference is perhaps that human resource departments in an enterprise are perhaps more capable of responding to these concerns than are many educators in schools and colleges.

A second insight to be gained from this volume is that e-learning might be best considered as a complement to traditional training (or education) rather than as a replacement. The author addresses a number of reasons why this is the case. First, each context has advantages and disadvantages. While much learning can be accomplished effectively and efficiently in an anytime/anyplace context, some learning is

perhaps more effectively conducted in an actual face-to-face setting wherein an actual complex task or procedure can be demonstrated and then attempted with immediate, detailed, and constructive feedback provided and perhaps critiqued by others. Secondly, getting to know in person those with whom one must collaborate to achieve desired outcomes is usual when subsequent tasks are to be performed in an e-learning context.

A third insight involves complex and dynamic systems. Dr. Wang describes a typical e-learning workplace as example of such a system with many interacting interrelated components, and focusing on just one aspect of the system (such as technology) can overlook many important factors that will impact system performance. Nearly all educational systems are complex and dynamic, and all too often the internal feedback mechanisms and relationships among system components are overlooked in decision-making. To address this particular challenge, Dr. Wang focuses on key performance indicators (KPIs) and their use in monitoring and improving e-learning in the workplace. A case study of the use and impact of KPIs on workplace e-learning is presented along with a framework for other such studies. The discussion extends beyond a focus on individual learners and social networking to include an organizational perspective, a unit perspective, and a position perspective. Such an analysis could be extended beyond a business context to an educational context to include an institutional perspective, a department perspective, and a course perspective with appropriate KPIs developed for each level being considered.

The discussion in this volume is supported with detailed empirical analysis and strong theoretical foundations. There are, in addition, extensive references which will prove useful to many readers. This volume is an example of scholarship at work in support of improving what organizations do and how people work.

One final thought is perhaps worth adding. KPIs are familiar to many in the business sector as well as to those concerned with military training, but they are less well known to those in the education sector. It is clear that military training needs to be effective because lives are at risk. Business training needs to be effective because the health and survival of the organization is at risk. Should more emphasis be placed on KPIs in the education sector because minds are at risk?

Denton, TX, USA J. Michael Spector

Preface

With the rapid advancement of digital technology and the rise of digital workforce, e-learning has been widely recognized as an important approach to formal and informal learning in the workplace. By affording just-in-time training and rapid dissemination of knowledge, e-learning breaks the traditional aspects of geographical, managerial, and organizational structures in training and development. It has made a substantial impact on enabling self-directed lifelong learning, promoting social interaction and open innovation, and supporting organizational learning and knowledge assets management, all of which are crucial to employee development and organizational performance.

While many organizations have recognized the need to promote e-learning for training and development, the research and development efforts associated with the application of new technologies for improving workplace learning and performance have grown more complex and challenging. Technology-dominated approaches have made e-learning initiatives less effective in motivating employees and improving individual and organizational performance. There is a clear need to enhance workplace e-learning by integrating pedagogical, social, managerial, and technological perspectives. Substantial research is needed to explore how organizational systems, structures, and policies as well as learning theories and instructional strategies can be incorporated into e-learning initiatives with a view to creating an effective and manageable system for e-learning in the workplace.

Learning in workplace contexts goes beyond individual and social levels in that an organization is expected to learn and adapt to dynamic environments. Developing the ability of the employees and the organization itself to acquire new knowledge and skills has become a core strategy for gaining competitive advantages. In addition to knowledge acquisition and transfer, the capacity to create new knowledge and manage organizational knowledge assets for sustainable development represents the opportunity for building lasting success. Workplace learning is a complex system involving multiple stakeholders, many interrelated components, and dynamic and nonlinear relationships among the components. Managing a complex system of workplace learning requires the shift from optimizing specific outcomes

to aligning diverse goals and discerning leverage points in mutual causal processes for persistent improvement.

This book attempts to provide a coherent review and analysis of workplace e-learning research and development and present a theory-driven design, implementation, and analysis of a performance-oriented, technology-enabled approach to improving e-learning in the workplace. The book is written based on the output of my research on workplace learning and e-learning. Issues about workplace learning and its theoretical foundations; emerging technologies for workplace learning; challenges of e-learning in the workplace; learning at individual, social, and organizational levels; learning driven by individual and organizational goals; aligning learning goals with performance measures; performance-oriented workplace e-learning; and factors influencing the acceptance of performance-oriented e-learning are investigated throughout the book.

The main contributions of the book include the following:

- Meta-analytic review of workplace e-learning research and development
- Understanding workplace e-learning from individual, social, and organizational perspectives
- Understanding and managing workplace e-learning as a complex dynamic system
- Designing a performance-oriented framework for workplace e-learning
- Implementing performance-oriented workplace e-learning using the KPI-based approach and technology
- Analyzing the factors influencing employees' acceptance of performance-oriented e-learning

The book features a performance-oriented approach to improving workplace e-learning by (a) establishing workplace learning on measurable performance goals, (b) aligning individual needs and organizational goals in setting the performance measures, and (c) using clearly specified measurable performance goals to facilitate self-directed individual learning, promote and direct social learning, and guide organizational knowledge assets management for sustainable performance.

The principal audience for this book comprises those who are interested in workplace learning and e-learning from both research and development perspectives. This book will be of interest to those working in human resource development roles and those who are interested in enhancing technology-supported training and development such as training managers, instructors, learning and development advisors, and policy makers. Also, this book is of particular relevance to those whose tertiary studies or research interests are directed toward workplace learning, organizational learning, e-learning design and analysis, human resource development, adult learning, and knowledge workers in the digital age. To meet the needs of a broad audience, illustrations and examples are used to communicate theoretical fundamentals, conceptual frameworks, implementation methods, and empirical findings. Overall, the presentation aims to make the complexity of workplace learning and e-learning, performance-oriented approaches and technologies, and the underlying rationale

and principles accessible to various academic and professional communities interested in learning and development in organizational environments.

Acknowledgments

This book is a summary of my research projects on workplace learning and e-learning conducted at the Laboratory for Knowledge Management & E-Learning of the University of Hong Kong. I want to express my thanks to the employees and managers of the participating companies as well as the research assistants and postgraduates who participated in the projects. The projects were supported by the General Research Fund from the Research Grants Council of Hong Kong and the Seed Funding for Applied Research of the University of Hong Kong. This book is dedicated to my husband David and our daughter Lucy, without whom the projects would not be completed and this book could never have been written.

Hong Kong, China Minhong (Maggie) Wang

Contents

About the Author

Minhong (Maggie) Wang is the director of the Laboratory for Knowledge Management & E-Learning and an associate professor with the Faculty of Education at the University of Hong Kong. Her areas of expertise include knowledge management, e-learning design and analysis, workplace learning, higher education, problem-solving and scaffolding, cognitive visualization, STEM education, medical education, and expertise development. She was a visiting scholar at the Harvard Graduate School of Education, University of Cambridge, and MIT Sloan School of Management. She is the editor-in-chief of *Knowledge Management & E-Learning: An International Journal*.

Chapter 1
Introduction

Context

Over the past few decades, organizations have faced a variety of challenges including globalization, economic dynamics, industrial transformations, and more recently demographic changes in population structures. These changes, together with the exponential growth of information and technology, have forced organizations to search for new ways to improve their competitive advantage, among which the development of knowledge workers or digital workforce within high-tech, knowledge-based societies has received increased attentions. To be successful, employees in the workplace have to learn effectively and continuously to cope with the changes; meanwhile, an organization itself should be able to learn and adapt to dynamic environment. In this context, research and practice on learning in organizational environment have received wider attention, with a view to helping employees acquire new knowledge and skills and allowing organizations to achieve continuous transformation and reinforce competitive advantage.

Workplace learning refers to learning or training activities undertaken in workplace contexts with the aim to improve individual and organizational performance (Boud & Garrick, 1999; Craig, 1996). While learning in the educational system has focused on formal and planned educational activities, learning in the workplace is mostly informal by building on practical tasks and work situations (Tynjälä, 2008). While school learning tends to be abstract and decontextualized, workplace learning occurs in the context of use and application and is often closely integrated with work practices (Brown & Duguid, 1991). Moreover, learning is more collaborative in workplace settings, where social interaction and knowledge sharing among coworkers is an important part of the learning practice.

Workplace learning is underpinned by multiple theories such as adult learning, self-directed learning, experiential learning, and communities of practice. Moreover, workplace learning is related to organizational learning, which investigates how an

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organization continuously and effectively learns and adapts to the environment; it concerns both the ways individuals learn in organizational contexts and the ways in which organizations can be said to learn as organizations (Argote, 1999; Easterby-Smith, Araujo, & Burgoyne, 1999). Further, learning in organizational context is related to knowledge management, which investigates the process of creating, transferring, and retention of organizational knowledge assets for sustainable development and open innovation (Rosenberg, 2012; Wang, 2015).

e-Learning in the Workplace

In recent decades, learning in the workplace has been increasingly supported by rapid advances in information and communication technology, which has brought fundamental changes to the ways people access information and knowledge and interact with others. e-Learning, i.e., learning conducted via electronic media, typically on the Internet, has been increasingly adopted in workplace settings (Rosenberg, 2006; Welsh, Wanberg, Brown, & Simmering, 2003). *e-Learning* can be defined as the use of computer and network technology, primarily over an intranet or an Internet, to deliver information and instruction to individuals (Welsh et al., 2003). It focuses on the use of computer and network technologies to create a rich learning environment involving a wide range of information and knowledge resources and a variety of solutions for learning, instruction, and interaction.

e-Learning has been mainly used to complement rather than replacing traditional face-to-face training and development. With its advantages over traditional approaches, in respect of anytime and anywhere availability, delivery efficiency, on-demand training, and cost-effectiveness, e-learning is increasingly recognized as an important supportive approach to formal and informal learning in workplace settings (Rosenberg, 2006). e-Learning applications have been deployed in many organizations to afford flexible information access, peer interaction and social networking, Web-based or computer-assisted learning and training, online performance support, and knowledge management. e-Learning has clear advantages in fostering self-direction and social learning, which is crucial to learning in the workplace. Moreover, e-learning helps communicate expert knowledge and allows organizations to capture, transfer, and retain knowledge assets in effective ways (Chute, Williams, & Hancock, 2006; Harris, 2009).

With the proliferation of e-learning in the workplace, the academic and professional literature on workplace e-learning has increased considerably in the past decades. A variety of topics and issues have been explored and discussed in various studies, which have showed the complex, dynamic, and multidisciplinary nature of the field. Researchers, practitioners, policy makers, and other stakeholders have approached workplace e-learning from different disciplinary perspectives, which include training, adult learning, educational technology, computer science, human resource development, psychology, sociology, and management. People of these disciplines speak different languages, use different research and intervention tools and models, and contribute to different literature bases.

Challenges for e-Learning in the Workplace

While e-learning has accounted for a significant proportion of corporate investment, the implementation of e-learning to achieve desired gains has grown more complex and challenging (Admiraal & Lockhorst, 2009; Welsh et al., 2003). The literature has reported a variety of barriers to the success of e-learning initiatives, which made employees inadequately engaged in e-learning practice to achieve desired learning outcomes. The *first* concern is related to learning and instructional design. The use of static and noninteractive e-learning applications or using e-learning to merely replicate traditional delivery without sufficient interaction and feedback makes learners resist the use of e-learning or technology-mediated learning programs. *Second*, e-learning content, especially those produced by vendors, is often generic and irrelevant to daily work or not effectively integrated with business processes (Harris, 2009). *Third*, many e-learning programs are found not well aligned with business objectives and outcomes (Servage, 2005; Wang, 2011). *Fourth*, many organizations introduce e-learning without an appropriate environment or culture in place to support e-learning, which is mainly associated with management and technology support (Nunes, McPherson, Annansingh, Bashir, & Patterson, 2009). *Fifth*, comprehensive evaluation and accountability are seen as the most often ignored part of training and development including e-learning (Burrow & Berardinelli, 2003; Phillips & Phillips, 2016).

It is found that e-learning research and development tend to focus on technical development and ignore pedagogical and organizational aspects as well as contextual or environmental factors that are necessary for effective e-learning in the workplace. There is a lack of pedagogical underpins on the design and use of e-learning applications, with a failure to understand learning behavior that takes place in work and organizational contexts (Moon, Birchall, Williams, & Charalambos, 2005; Tynjälä & Häkkinen, 2005). Technology-dominated approaches make e-learning initiatives less learning effective, showing their limited impact on motivating employees to learn and keeping employee knowledge and skills up to date.

With a further review on the root of the problem, it is found that the dominance in technology makes workplace e-learning not well aligned with individual needs and organizational goals, which could hamper both organizational and personal growth (Burrow & Berardinelli, 2003; Moon, Birchall, Williams, & Charalambos, 2005; Servage, 2005; Tynjälä & Häkkinen, 2005; Wang, 2011). For individuals, although knowledge and skills can be learned by participating in e-learning programs, more often employees do not think that e-learning is relevant to their daily work and helpful for improving job performance. For organizations, e-learning is generally designed without taking into account the organizational vision and mission and specific training requirements. As a result, workplace e-learning has received an increasing criticism in terms of its relevance to key business processes and outcomes and its commitment in the assessment and evaluation process.

Main Contribution of the Monograph

The monograph is written based on the findings from a number of projects on workplace e-learning conducted at the Lab for Knowledge Management & E-Learning led by the author in the past years. The main contribution of the monograph includes the following.

Meta-analytic Review of Workplace e-Learning Research and Development

Various interdependent issues explored in e-learning in workplace settings have showed the complex and multidisciplinary nature of the field. To obtain an extensive, thematic overview of the studies on workplace e-learning for a better understanding of this broad domain, the author and her research team performed a bibliometric analysis of the literature using co-word analysis and text analysis approaches (Cheng, Wang, Moormann, Olaniran, & Chen, 2012). The bibliometric analysis identified six research themes or clusters in the field. Based on the six themes, the research on workplace e-learning is categorized into *four directions*: e-learning for continuing education and professional development, e-learning in the healthcare sector (as one of the most prolific e-learning initiatives), use of social media for e-learning, and integration of knowledge management with e-learning.

In addition, the book summarizes the use of e-learning in various organizations, the benefits of and barriers to using e-learning in workplace settings, and the implications for effective e-learning in practice. The results show that e-learning in the workplace is now at a critical juncture or crossroads. To proceed to the next level of e-learning initiatives and to effectively translate research findings into practice, it is important to integrate technology with pedagogical design to improve technology affordances, align learning with individual needs and organizational goals, reinforce assessments to ensure the achievement of e-learning goals, and make strategic planning for implementation especially in improving organizational environment or culture.

Understanding Workplace Learning from Individual, Social, and Organizational Perspectives

For a better understanding of learning in workplace settings, the author proposes to investigate workplace learning in multiple perspectives: individual, social, and organizational (Wang, 2011). In terms of *individual* perspective, learning in the workplace is featured by a self-directed, lifelong learning process; individuals learn what is required to perform their jobs and evolving tasks; learning is motivated by various incentives (e.g., curiosity, desire to achieve, and rewards and promotion)

and affected by individual differences, for example, in expectancies, learning abilities, personalities, dispositions, attitudes, prior knowledge and skills, and previous experience. In terms of *social* perspective, learning is considerably associated with social interactive experiences such as teamwork, mentoring programs, and communication and networking among peers, which allow the transfer and cocreation of knowledge among individuals, groups, organizations, and communities as well as the development of individual identity within the organization or communities. In terms of *organizational* perspective, an organization is expected to learn and adapt to dynamic environment by creating new knowledge as well as managing and retaining organizational knowledge assets. To build a lasting competitive advantage, organizations should consider the capture, transfer, and retention of tacit knowledge located not only in competencies of employees but also in organizational culture, business processes, routines, and networks; such knowledge is regarded as intellectual assets for sustainable development and innovation of the organization.

Understanding and Managing Workplace e-Learning as a Complex Dynamic System

Traditional approaches to workplace learning or training and development have attempted to reduce its complexity by simplifying its planning, design, implementing, and evaluation (Smith & Sadler-Smith, 2006). However, workplace learning itself and its environment involve complex, uncertain, and sometimes ambiguous sets of circumstances. To cope with such complexity, the author has proposed to apply systems thinking and systems modeling approaches to manage workplace e-learning as a complex system (Wang, 2011). In terms of *systems thinking*, workplace e-learning is outlined as a complex system consisting of multiple interactive elements including learners, learning resource and technology, jobs and tasks, organization, and social context. In terms of *systems modeling*, workplace e-learning can be modeled as a complex system exhibiting goal-oriented individual, social, and organizational processes driven by the goals to improve both individual and organizational performance with the support of technology. To achieve persistent improvement in such complex processes, it is important to make effective communication to align the goals of different individuals and the organization and discern leverage points in mutual causal processes rather than seeking optimal outcomes on specific aspects.

Designing a Performance-Oriented Framework for Workplace e-Learning

To manage goal-oriented individual, social, and organizational processes driven by the goals to improve both individual and organizational performance through workplace e-learning initiatives, we have proposed a framework of performance-oriented

learning in the workplace (Wang, Ran, Liao, & Yang, 2010). The framework involves (1) establishing learning on measurable performance goals, (2) aligning individual and organizational performance goals, (3) supporting performance-oriented self-directed individual learning, (4) promoting performance-oriented social learning, and (5) managing organizational knowledge assets for sustainable performance. In doing so, it is important to make the learning goals explicitly specified with clarity in performance measurement and make individual and organizational goals well aligned in performance measures. Accordingly, clearly specified measurable performance goals based on individual needs and organizational goals can be used to guide and facilitate self-directed individual learning, social interaction and networking, and organizational learning built on knowledge assets management.

Implementing Performance-Oriented Workplace e-Learning Using the KPI-Based Approach and Technology

To implement the framework of performance-oriented learning in the workplace, we have developed a key performance indicator (KPI)-based approach to workplace learning (Wang, 2011; Wang, Vogel, & Ran, 2011). KPIs help organizations to clarify their training objectives and allow employees to make sense of work context and performance requirement. Moreover, KPIs help employees to set up rational learning objectives, acquire relevant knowledge and skills, and communicate with peers and experts to enhance individual and social learning process.

We use a case to illustrate how the KPI-based performance-oriented approach to workplace learning can be established in a company by setting up a KPI model and developing a KPI-based workplace learning system (Wang, Jia, Sugumaran, Ran, & Liao, 2011). A Web-based learning system is demonstrated to show the implementation of the KPI-based approach to workplace e-learning (Jia, Wang, Ran, Yang, Liao, & Chiu, 2011). The details of the system architecture, the implementation of the KPI model into the KPI-based learning ontology, and the performance-oriented learning process are elaborated, in addition to relevant evaluation to show the effectiveness of the approach.

Analyzing the Factors Influencing Employees' Acceptance of Performance-Oriented e-Learning

While integrating the performance-oriented approach to workplace e-learning initiative, there is a need to investigate employees' acceptance of this technology-mediated learning innovation, which can be influenced by a variety of factors such as relevance to individuals, technology affordances, management support, technical

support, and so on. We investigate the impact of individual and social learning support provided by the performance-oriented e-learning approach and the impact of organizational learning environment (including managerial support, job support, and organizational support) on employees' motivation to use performance-oriented e-learning initiatives in the workplace.

Overview of the Monograph

Chapter 1 describes the contexts of workplace learning and e-learning in the workplace and outlines the challenges of e-learning in workplace settings, in addition to an overview of the monograph.

Chapter 2 introduces the basics of workplace learning and outlines its key features and theoretical fundamentals. The differences between school learning and workplace learning are discussed. In particular, the multiple nature of learning in the workplace is identified and elaborated from individual, social, and organizational perspectives. Relevant theories that underpin workplace learning from different perspectives are outlined, which include adult learning, self-directed learning, experiential learning, situated learning or contextualized learning, communities of practice, expertise development, organizational learning, and knowledge management.

e-Learning focuses on the use of computer and network technologies to create and deliver a rich learning environment, which involves a wide range of information and knowledge resources and a variety of learning and instruction solutions to enhance learning performance. Chapter 3 outlines the emerging technologies for workplace learning and how they are used to support workplace learning in a variety of ways with respect to learning content management systems, social media and social interaction, mobile and ubiquitous learning facilities, computer simulations and immersive virtual reality, educational data mining and learning analytics, computer-based learning assistance, and cognitive processing and high-order thinking facilities.

Chapter 4 offers a meta-analytic review of workplace e-learning research and development based on previous reviews and a bibliometric analysis of the literature. Previous reviews of workplace e-learning are discussed in four dimensions: theoretical foundations, design principles, evaluation of e-learning programs, and implementation strategies. The bibliometric analysis of the literature conducted by the author and her team has identified six research themes or clusters in the field, which are further categorized into four directions. The results offer a better understanding of the broad domain based on an extensive, thematic overview of the studies in the field.

While e-learning is increasingly recognized as an important approach to workplace learning, the promise of implementing e-learning to achieve desired gains is not easy to be fully realized. Chapter 5 summarizes the use of e-learning in organizational practice, the benefits of and barriers to using e-learning in the workplace, and the implications for effective e-learning by integrating technology with pedagogical design, aligning learning with individual needs and organizational goals,

conducting relevant assessments to ensure the achievement of the learning goals, and making strategic planning especially in making organizational environment or culture ready for e-learning.

Given that workplace learning is a complex system involving multiple stakeholders, many interrelated components, and dynamic and nonlinear relationships among the components, systems approaches such as systems thinking and systems modeling have the potential to significantly enhance our understanding and development of e-learning in the workplace. Chapter 6 elaborates the systems thinking and systems modeling approaches for understanding, analyzing, and managing complex systems and the potential of applying these approaches to complex workplace e-learning contexts.

Chapter 7 establishes a theoretical foundation to transform the understanding and solutions of workplace learning based on the systems thinking theory and system modeling approaches. Workplace e-learning is understood as a complex system, which consists of a number of components interacting in complex dynamic ways. Within the complex system, we should consider not only learners, learning resource, and learning technology but also jobs and tasks and social and organizational contexts, which form a holistic picture of workplace e-learning. Further, workplace e-learning can be modeled as a complex system exhibiting goal-oriented individual, social, and organizational processes driven by the goals to improve both individual and organizational performance with the support of technology. Managing such a complex system requires the shift from optimizing specific outcomes to effective communication to align diverse goals and discern leverage points in mutual causal processes for persistent improvement.

Chapter 8 outlines learning goals and performance measurement in workplace contexts, as well as the alignment between the two. Learning in the workplace is modeled as goal-oriented individual, social, and organizational processes driven by the goals to improve both individual and organizational performance. Performance measurement is used by organizations as a procedure to improve performance by setting performance objectives, assessing performance, collecting and analyzing performance data, and utilizing performance results to drive organizational development.

Chapter 9 explores a framework of performance-oriented learning in the workplace. The framework aims to establish workplace e-learning on measurable performance goals and align individual needs and organizational goals in setting the performance measures; moreover, clearly specified measurable performance goals based on individual needs and organizational goals are used to facilitate self-directed individual learning, promote and direct social learning, and guide organizational knowledge assets management for sustainable performance.

To implement the framework of performance-oriented workplace e-learning, a key performance indicator (KPI)-based approach is proposed in Chap. 10. The key idea lies in a KPI model, where the mission and vision of an organization are translated into a set of key performance targets that drive workplace learning toward the goal to improving individual and organizational performance. KPIs allow organizations to clarify their training objectives, help employees to make sense of work

context and performance requirement, and accordingly help employees to set up rational learning objectives, acquire relevant knowledge and skills, and communicate with peers and experts to enhance individual and social learning processes.

Chapter 11 explores a case study of using the KPI-based approach to establish a performance-oriented e-learning program in a medium-sized company in mainland China. The case study demonstrates how the KPI-based approach to performance-oriented e-learning in the workplace can be established by setting up a KPI model and developing a KPI-based workplace learning system, in addition to the evaluation of the approach.

In Chap. 12, a Web-based system for KPI-based learning is developed to demonstrate the effectiveness of the KPI-based approach to performance-oriented learning in the workplace. The details of the system architecture, the implementation of the KPI model with the KPI-based learning ontology, the KPI-based learning process, and the developed system are elaborated. In view of the importance of the KPI-based learning ontology in the system, the quality of the ontology is evaluated in multiple aspects.

Lack of consideration for learners' perceptions and attitudes toward workplace e-learning has been recognized as a key barrier to successful implementation of e-learning initiatives. When promoting the performance-oriented workplace e-learning initiative, there is a need to investigate employees' acceptance of this technology-mediated learning innovation, which can be directly influenced by its technology affordance, i.e., usefulness for learning. Chapter 13 provides an analysis on the effects of individual and social learning support provided by the performance-oriented e-learning approach on employees' acceptance of performance-oriented e-learning in the workplace.

While adopting the performance-oriented approach to workplace e-learning, there is a need to investigate the effects of organizational learning environment on employees' motivation to use this technology-mediated learning innovation. Organizational environment or culture has been recognized as a key barrier to successful implementation of e-learning initiatives. Chapter 14 investigates the impacts of organizational learning environment factors including managerial support, job support, and organizational support on employees' motivation to use performance-oriented e-learning in the workplace.

Chapter 15 concludes the monograph by a summary and a look into the future of e-learning in the workplace.

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Part I
Overview of Workplace Learning and e-Learning

Chapter 2
Workplace Learning and Theoretical Fundamentals

Workplace Learning

Workplace learning has been widely recognized as an effective way for employees to acquire work-related knowledge and skills as well as for organizations to improve their performance (Doornbos, Simons, & Denessen, 2008). In the past decades, there have been rapid changes in working life and society, especially those driven by the emerging information and communication technologies, the exponential growth of information, industrial changes, and economic dynamics. These changes have forced organizations to search for new ways to improve their competitive advantage, in which knowledge is regarded as the core resource and learning is viewed as the most important process.

Workplace learning refers to learning or training activities undertaken in workplace environments with the aim to improve individual and organizational performance (Boud & Garrick, 1999; Craig, 1996). It can be summarized as the means, processes, and activities in the workplace by which employees learn from basic techniques to high technology and management skills that are immediately applicable to their jobs, duties, and roles. The field of workplace learning is also known as training and development, human resource development, corporate training, and professional expertise development, among others (Craig, 1996; Driscoll & Carliner, 2005; Piskurich, Beckschi, & Hall, 2000; Smith & Sadler-Smith, 2006).

While "learning" can be referred to as long-term change in the knowledge, skills, attitudes, and values possessed by an individual, "training" is seen as being a focused, specific, and instrumental means by which a predetermined task-related learning need may be met, and "development" is an increase over the longer term of the capacity that an individual has to live a more effective and fulfilling professional and personal life as a result of the acquisition of knowledge, skills, and attitudes (Sadler-Smith, 2006). Accordingly, human resource development, as part of human resource management, has focused on training and development of employees in an

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organization; it helps employees to develop their knowledge, abilities, and positive work attitudes so that the organization and individuals can accomplish their work goals.

Learning in workplace settings includes both formal and informal learning. Formal learning refers to activities that are formally planned and structured and institutionally sponsored, while informal learning is described as processes that are predominantly unstructured, experiential, and noninstitutional (Ellinger, 2005). Similarly, workplace learning can be conceptualized as learning in, for, and through the workplace (Evans, Hodkinson, Rainbird, & Unwin, 2006). It shows how this learning is embedded in work process and social relations and affected by organizational policies and systems.

Workplace Learning Versus School Learning

Learning in a workplace environment is different from learning at schools or in a university environment (Tynjälä, 2008; Tynjälä & Häkkinen, 2005). The main difference in learning occurring in the two types of situations is that learning in the educational system is based on *formal* and planned educational activities, while learning in the workplace is mostly *informal* by building on practical tasks and work situations more than explicit teaching. While school learning tends to be abstract and decontextualized, workplace learning takes place in the context of use and application and is therefore often *contextualized*, embedded in work practices (Brown & Duguid, 1991). Moreover, learning is more *collaborative* in the workplace setting, where social interaction and sharing of knowledge among co-workers is an important part of the learning practice. On the other hand, school learning and workplace learning are connected in view of that formal education aims to produce general knowledge and skills that can be applied and transferred to settings and activities beyond schools, though the transformation is not easy without experience in authentic situations. The increasing cooperation between education and work and new forms of work-based learning will change the nature of learning in both contexts and create entirely new types of learning opportunities.

Learning from Individual, Social, and Organizational Perspectives

Learning in workplace settings can be described on multiple levels such as individual, group, community, organization, and even region (Tynjälä, 2008). Different from learning in an educational institution, learning in an organization refers to a group of people who decide to enhance their capacity to produce desired outcomes about a shared vision and common interests (Senge, 1991). In addition to individual learning, learning in the workplace should integrate with the context of teams and

Fig. 2.1 Integrative nature of workplace learning

the wide organization, allowing individual learning to influence practices and changes within that organization. In this way, the organization is able to learn to ensure continuous transformation in dynamic and competitive environment.

Based on the literature and relevant theories outlined in the following sections, we proposed to investigate learning in workplace settings from multiple perspectives, individual, social, and organizational (Wang, 2011), as depicted in Fig. 2.1.

Individual Perspective

Learning in the workplace is featured by self-directed lifelong learning process. Self-directness in learning distinguishes adult learners from children (Knowles, 1975). Individuals learn what is required to perform their jobs and evolving life tasks, which are also motivated by various incentives, such as curiosity, desire to achieve, rewards, promotion, self-esteem, and satisfaction of accomplishment. Learners need support to identify individual learning needs, plan and implement learning activities, and monitor and evaluate learning processes in performing self-regulated learning.

In this context, it is important to facilitate self-direction and learner autonomy by providing employees with relevant learning resources, expert guidance and feedback, access to peer interaction, and metacognitive strategies on self-reflection and management. Moreover, adaptive learning technologies and computer-based personalized learning environment have been increasingly used to assist learning by adapting learning content and instructions to individual goals, preferences, and situations (Akbulut & Cardak, 2012).

Social Perspective

Learning is a process occurring in physical and social contexts where knowledge is created and applied. In workplace settings, learning is considerably associated with social interactive experiences such as teamwork, communication and networking

among peers, and mentoring programs, which allow the transfer and cocreation of knowledge among individuals, groups, organizations, and communities. Knowledge is acquired, shared, and updated during the process of social interaction among individuals and groups within the organization and in external communities (Fuller & Unwin, 2004; Wenger, 1998).

Social learning in the workplace has been largely promoted by information and communication technologies and social media and networking applications (also known as Web 2.0 technologies), which have been increasingly integrated with formal and informal learning activities in the workplace (Wang, 2015b). Social communication technologies and communities of practice offer more unstructured, self-governing approaches to the creation and transfer of knowledge among employees and the development of new forms of learning communities and networks (García-Peñalvo, Colomo-Palacios, & Lytas, 2012; McAfee, 2009; Seufert, 2012).

Organizational Perspective

Learning in the workplace needs to serve for both individual needs and organizational goals, with the purpose to enhance both individual and organizational performance (Argyris & Schön, 1996). Individuals expect the organization to support their learning from basic techniques to high technology and management skills that are applicable to their jobs, duties, and roles. Meanwhile, the organization expects individual learning to be transferred back to job and utilization of new skills to enhance organizational performance (Craig, 1996; Boud & Garrick, 1999). In other words, an organization should be able to learn to ensure continuous transformation in dynamic and competitive environment (Senge, 1991).

Furthermore, different from institutional learning programs, learning in workplace settings is built on practical tasks and work situations. Most knowledge in the workplace is tacit and embedded in everyday practice; it is located not only in individuals but also in organizational culture, business processes, routines, and networks (Marr, Schiuma, & Neely, 2004). Organizations are expected to cultivate the channels and provide the facilities for the capture, transfer, and retention of tacit knowledge, which is regarded as intellectual assets for sustainable development and innovation of the organization (Argote, 1999; Cyert & March, 1992; Wang, 2015a). The notion of intellectual assets highlights intangible capital such as those represented by competencies of employees; internal structure, procedures, and routines of the organization; and the relationships that the company undertakes with customers and other stakeholders (Marr, Schiuma, & Neely, 2004).

Theoretical Fundamentals of Workplace Learning

Organizations face serious challenges including globalization, economic pressures, and the changing nature of work. To be successful, employees of organizations have to learn continuously to cope with frequent changes. Studies and practices on

workplace learning have proliferated due to the increasingly significant role of professional skills and expertise in organization development. Learning in workplace settings can be explained by a variety of theories, reflecting the divergence of theoretical perspectives involved in workplace learning. The central questions of workplace learning are how people learn in workplace settings and how people can learn better by using appropriate approaches. The questions have occupied the attention of scholars and practitioners since the founding of adult education as a professional field of practice in the 1920s. Some 90 years later, we have no single answer, no one theory or model that can explain all we know about workplace learners, the various contexts where learning takes place, and the process of workplace learning itself. The most relevant theories for workplace learning include the following.

Adult Learning

American educator named Malcolm Knowles, the principal expert on adult education, proposed that adults learn differently than children do and used the term "andragogy" to describe his philosophy of "the art and science of teaching adults" (Knowles, 1975; Knowles, Holton, & Swanson, 1998). Andragogy is a set of assumptions about how adults learn. Educating adults differs from educating children in several ways:

- Adults are more self-directed, rather than relying on others for help.
- Adults have a lifetime of experiences providing a rich source for learning.
- An adult's readiness to learn is linked with individual needs or future goals.
- Adult orientation to learn is problem-centered rather than subject-centered.
- Adult motivation to learn is internal.

Adult learning reflects a specific philosophy about learning based on the assumption that adults can and want to learn, that they are able and willing to take responsibility for their learning, and that the learning itself should respond to their needs. Adult learning can take place in an education or training institution as formal education programs or in the workplace as noncredential practice; it may also go on all the time, resulting from daily life activities related to work, family, community, or leisure. The general purpose of adult learning can be vocational, social, recreational, or for self-development.

Adults exhibit an increasing tendency to self-directness, which distinguishes adult learners from children. Accordingly, adult education has swung from a traditional teacher-centered approach through to a learner-centered approach, which emphasizes empowering learners to make learning decision (Brookfield, 2013) and facilitating their self-direction by providing relevant support. In addition to the learning of knowledge and skills, it is important to keep adults motivated, instill in them confidence, and reinforce positive self-esteem. In this context, learners are encouraged to explore the depths of their feelings, build self-concept, and value human life. The goal of learning is to maximize human potential and build on the innate goodness of the individual, with the support of empathetic teachers as facilitators and partners in learning.

Self-Directed Learning

Self-directed learning was initially claimed by Knowles (1975) to be a universal disposition of adult learners who are judged to exhibit an increasingly tendency to self-directness as they enter adulthood. Self-directness in learning is a central element in Knowles's concept of andragogy. Self-directed learning theory assumes that humans grow in capacity and need to be self-directing; learners' experiences are rich resources for learning; individuals learn what is required to perform their evolving life tasks; and self-directed learners are motivated by various internal incentives, such as need for curiosity, self-esteem, job requirement, desire to achieve, and satisfaction of accomplishment. In self-directed learning, the goal of education becomes more about process (development of critical thinking skills, maturation as a person and citizen) than content. Candy (1991) further linked self-directed learning to lifelong learning by highlighting the goal of lifelong learning as equipping people with skills and competencies to continue their own "self-direction" beyond the end of formal schooling.

Self-directed learning implies a set of elements including personal autonomy (disposition for independence, freedom of choice), self-management in learning (exercise of autonomy), the independent pursuit of learning (learning outside formal educational settings), and the learner control of instruction (Candy, 1991). Accordingly, self-directed learning entails the abilities to set learning needs, make effective planning, implement learning activities, monitor and evaluate learning process, search for help, and increase motivation and emotional engagement. Based on these requirements, the primary goal of adult education is to facilitate self-directness, for example, by providing access to relevant learning resources, peer interaction and expert guidance, feedback on performance, and support on self-reflection and management.

Self-directed learning is related to self-regulated learning and self-determination theory. Self-regulated learning refers to a cyclical process in which learners are described as metacognitively, motivationally, and behaviorally active participants in their own learning process (Winne, 2001; Zimmerman, 1998). Both self-directed learning and self-regulated learning entail intrinsic motivation, goal-oriented behavior, and active engagement; they differ in that the former places more attention to design features of the learning environment, whereas the latter learner characteristics (Loyens, Magda, & Rikers, 2008). Self-regulated learning does not occur automatically but largely depends on individual characteristics, especially motivational factors. In this connection, self-directed learning theory is related to self-determination theory (Ryan & Deci, 2000), which proposes that an individual's adoption of self-motivated behavior leading to better persistence and performance depends on his or her satisfaction with basic psychological needs for autonomy (a sense of control and agency), competence (feeling competent with tasks and activities), and relatedness (feeling connected to and supported by others).

Experiential Learning

Experiential learning is the process of learning through the transformation of experience (Dewey, 1938; Kolb, 1984). It has come to be known as "learning by doing" or "hands on learning." Experiential learning theory challenges the misconception that learning mostly occurs in formal environments such as classrooms and replaces it with the notion that all learning is the result of experience, no matter where it occurs (Barer-Stein & Kompf, 2001). In experiential learning, students learn to apply theories and principles to practice and develop a deeper understanding of the concepts upon experience and reflection. According to Kolb (1984), the "experiential learning cycle" includes four distinct stages of learning, which can start at any stage.

- Concrete experience: active learning as opposed to passive receipt of knowledge (i.e., learn about something directly by being involved with the material rather than learning about it)
- Reflective observation: refers to thinking critically about the experience
- Abstract conceptualization: linking the experience to the theory or concepts underlying it
- Active experimentation: testing out one's learning in new situations

Among the four stages of the experiential learning cycle, reflection is a crucial part of the experiential learning process. The outcomes of learning through practical experience depend not only on participation but more on meaningful reflection on the experience (Moon, 1999; Dewey, 1938). Reflective learning requires that learners should be enabled to reflect on the problem-solving process, observe expert performance for comparison and contrast, and receive timely feedback (Lin, Hmelo, Kinzer, & Secules, 1999).

It is also noted that learning through practice experiences, especially in complex problem-solving situations, often involves complex processes that are difficult to capture and master (Kirschner, Sweller, & Clark, 2006; Jonassen, 1997). The provision of scaffolding has therefore been widely recognized as an important part of learning in such contexts (Hmelo-Silver, Duncan, & Chinn, 2007). Research has shown that desired outcomes of experiential learning cannot be achieved by a mere accumulation of experience but require systematic and deliberate effort with expert help (Ericsson, 2008; Jarodzka, Scheiter, Gerjets, & van Gog, 2010). It is important to engage learners in reflective thinking and deeper learning and provide them with necessary help to foster productive learning with continuous improvement (Wang, Kirschner, & Bridges, 2016). In addition to scaffolding, recent research has highlighted the importance of making thinking visible to students when they work with complex problems (Delany & Golding, 2014; Wang, Wu, Kinshuk, Chen, & Spector, 2013).

Situated Learning/Contextualized Learning

Workplace learning, which situates learning in work contexts, embodies the contextualized learning paradigm. The notion of *contextualized learning* suggests that learning is most effective when it is situated in the context in which it will be used; context is essential to students' understanding of knowledge and skills and when to apply them. The goal of contextualized learning is deep-level processing which goes well beyond the simple acquisition of knowledge and skills to understanding and applying them across various contexts.

Contextualizing learning by providing instruction directly related to the life experiences or functional contexts of adult learners grows out of a constructivist approach to learning. According to constructivist learning theory, individuals learn by constructing meaning through interacting with and interpreting their environments. The meaning of what individuals learn is coupled with their life experiences and contexts; it is constructed by the learners, not by the teachers; and learning is anchored in the context of real-life situations and problems.

The perspectives on contextualized learning include situated cognition and social cognition. Situated cognition theory (Brown, Collins, & Duguid, 1989) claims that knowing is inseparable from doing and that all knowledge is situated in activities bound to physical, social, and cultural contexts. With a focus on social cognition, Lave and Wenger (1991) put forward situated learning theory, which claims that knowledge is co-constructed through communities of practice. The two theories share a common view that situation and cognition are interdependent; cognition is a process occurring in physical and social contexts where knowledge is created and applied. Situated learning and situated cognition form a broader conception in contrast to learning in decontextualized and abstract forms. They are compatible with experiential learning or learning-by-doing theory, which highlights that knowledge is created through the transformation of experience (Dewey, 1938; Kolb, 1984). Further, situated learning is closely related to problem-based learning, i.e., learning that is situated in problem-solving contexts (Hmelo-Silver, Duncan, & Chinn, 2007; Jonassen, 1997). These theories were born from social constructivist learning theory, which views learning as a process whereby learners actively construct or build new ideas based on practice in socially situated settings; instructors should let learners participate in meaningful activities so that they can generate their own knowledge (Schunk, 1991).

Situated learning has primarily been used for learners to develop meaningful understanding of complex knowledge such as abstract concepts, scientific facts, and complicated principles, which are difficult to transmit via expository teaching methods. Meanwhile, situated learning helps learners to apply knowledge and develop problem-solving skills, as well as generate new knowledge from practice. In view of the compelling need for people to deal with novel situations and ill-defined problems, learning by exploration in authentic situations has become more important than ever in today's increasingly dynamic and competitive world.

Community of Practice (CoP)

While knowledge is assumed to be better constructed through interaction with social and physical environments, learning via participation in social practice can be referred to community of practice (Wenger, 1998). A community of practice is a group of people who share a craft or a profession. Such a community can evolve naturally because of the members' common interest in a particular domain or area, or it can be created deliberately with the goal of gaining knowledge related to a specific field. A community of practice is usually characterized by three core elements: mutual engagement, joint enterprise, and shared repertoire. It is through the process of sharing information and experiences with the group that the members learn from each other and have an opportunity to develop themselves personally and professionally.

The notion of community of practice is based on the assumption that engagement in social practice is the fundamental process by which we learn and become who we are (Wenger, 1998). In other words, people are actively attempting to create meaning through engagement in networks; learning is the process of creating connections and developing a network. The preliminary analysis unit of communities of practice is neither the individual nor social institutions but rather the informal communities that people form as they pursue shared goals or interests over time.

Learning in workplace settings can be understood as social networking among peers, mentors, and experts, which allows the cocreation and transfer of knowledge among individuals, groups, organizations, and communities. Knowledge is acquired, shared, and updated during the process of social interaction among individuals and groups within the organization and in external communities, in addition to interactions between the organization and its surroundings. Nowadays, learning by participation in communities of practice in a variety of contexts (e.g., professional, academic, virtual) has been viewed as a continuous, lifelong process.

Expertise Development

Individuals in workplace settings can be in different positions such as novice trainee, apprentice, experienced worker, and expert according to their knowledge and skills in specific domains. Interactions between novices and experts play a critical role in workplace learning (Tynjälä, 2008). In addition to peer interaction, guidance and support from "more knowledgeable others" have been important part of social interaction in communities of practice, which enables novices to accomplish tasks within their zone of proximal development (Vygotsky, 1978) and move from the periphery to the core of the community (Lave & Wenger, 1991). Such interaction is crucial to the acquisition of complex knowledge and skills that are highly tacit and contextualized, not easily transferred or mastered by novices. According to the cognitive apprenticeship model, carrying out a complex task usually involves implicit

processes; it is critical to make these processes visible for novices to observe, enact, and practice with help from the expert (Collins, Brown, & Holum, 1991).

The development of professional expertise is a process of accumulating a set of knowledge and skills, principally promoted by practical and social experiences. According to Dreyfus and Dreyfus (1986), expertise development may go through the following phases or stages: novice, advanced beginner, competent, proficient, and expert. Further to progressive accumulation of knowledge and skills through practice, Ericsson (2006) revealed the importance of deliberate and systematic practice in improving performance and developing professional expertise in diverse fields; Sternberg, Forsythe, Hedlund, Horvath, Wagner, Williams, Snook, and Grigorenko (2000) highlighted the importunate of practical intelligence, i.e., the ability to adapt to everyday life by drawing on existing knowledge and skills.

Organizational Learning

Organizational learning is within the domain of organizational theory. It investigates how an organization continuously and effectively learns and adapts to the environment by the process of creating, transferring, and retaining knowledge (Argote, 1999; Cyert & March, 1992). Organizational learning concerns both the ways individuals learn in organizational context and the ways in which organizations can be said to learn as organizations (Easterby-Smith, Araujo, & Burgoyne, 1999). The notion of organizational learning implies that learning in the organizational context should go beyond individual and social dimensions, and an organization should be able to learn and ensure continuous transformation. Organizational learning can take place at two levels: single loop and double loop. Single-loop learning is about dealing with the problems or symptoms of a situation, rather than the underlying cause; double-loop learning examines the underlying causes of a situation, which may lead to a review of the organization's assumption and goals (Argyris, 1999). The former is about doing things right, while the latter is doing the right things.

Learning in organizations serves business goals by aligning learning with organizational functions, systems, and culture and by developing organizational forms of knowledge. Different from knowledge in educational institutions, most knowledge in an organization is tacit and located in individuals, organizational culture, business processes, routines, and networks. Knowledge management in an organization should involve the entire knowledge spectrum and facilitate its diffusion to individuals, groups, and the entire organization. Organizations need to retain knowledge by retaining individuals, as well as by using knowledge repositories and transactive memory systems (Walsh & Ungson, 1991). To facilitate learning in organizational contexts, knowledge management initiatives should be integrated with training or learning programs to create a coherent and manageable system for working, learning, and innovation (Cheng, Wang, Mørch, Chen, Kinshuk, & Spector, 2014).

In relation to organizational learning, Senge (1991) put forward the concept of learning organization, which described a learning organization as a group of people who are continually expanding their capacity to create the results they truly desire toward common goals. According to Senge (1991), real learning is one that enhances people's capacity to recreate themselves and this applies to both individuals and organizations. Innovative learning organizations need to discover how to tap people's commitment and capacity to learn at all levels. Senge (1991) set out five principles for building and sustaining a learning organization: personal mastery, mental models, building a shared vision, team learning, and systems thinking. A shared vision is to foster genuine commitment and involvement rather than compliance and acquiescence. Systems thinking was emphasized as the fifth and cornerstone discipline, which has had profound influence on the way people rethink and restructure business. He pointed out that most people tend to focus on the parts rather than seeing the whole and fail to see organizations as a dynamic process and with the long-term view.

Knowledge Management

Knowledge management (KM) represents another discipline in relation to organizational learning and community of practice. It refers to a range of approaches and practices that enable individuals in an organization or community to collectively identify, create, represent, share, and distribute knowledge to achieve common goals (Nonaka & Takeuchi, 1995). The concept of knowledge management is inherently multidisciplinary. Some view the origin of knowledge management in information management, whereas others highlight knowledge management as a process for organizations to strengthen their competitive advantages and adapt to changes in dynamic environments (Rosenberg, 2012; Spender, 1996). Reiser and Dempsey (2012) identified knowledge management as one of the ten trends affecting the field of instructional design and technology.

The knowledge management literature emphasizes the difference between explicit and tacit knowledge. The former refers to codified knowledge that is transmittable in a formal, systematic language, such as that found in documents. The latter refers to non-codified knowledge that is more experiential, subjective, and difficult to convey, such as experience and insight. There is much more tacit knowledge than explicit knowledge within an organization. The former is often valuable but hard to manage and is generally acquired through practice and social networks. Nonaka and Takeuchi (1995) present the SECI model that illustrates the conversion between tacit knowledge and explicit knowledge through socialization (sharing of tacit knowledge between individuals), externalization (expression of tacit knowledge in comprehensible forms), combination (systemic organization of explicit knowledge), and internalization (making explicit knowledge personally meaningful).

Learning in workplace settings requires employees to capture tacit knowledge or intuition, contribute to the creation of new knowledge, develop and cultivate the

channels for knowledge transfer and distribution, as well as retain knowledge as intellectual assets for sustainable development and innovation (Wang, 2015a). The notion of intellectual assets highlights intangible capital such as those represented by competences of employees; internal structure, procedures, and routines of the organization; and the relationships that the company undertakes with customers and other stakeholders (Marr, Schiuma, & Neely, 2004).

Organizational learning and knowledge management share a common strategy of creating a learning organization, which implies that learning in organizational contexts should go beyond the individual level and an organization should be able to learn and adapt to the environment. The integration of workplace learning and knowledge management has been increasingly promoted in organizational environments to enable the strategy of creating a learning organization in the knowledge economy (e.g., Lytras, Naeve, & Pouloudi, 2005; Marshall, Zhang, Chen, Lally, Shen, Fox, & Cassel, 2003; Sampson & Zervas, 2013; Schmidt, 2005; Wang & Yang, 2009; Wild, Griggs, & Downing, 2002). How such integration can be implemented and affect organizational performance is a complicated yet important question that requires a variety of conceptual, methodological, and technical approaches (Cheng et al., 2014).

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Chapter 3
Emerging Technologies for Workplace Learning

Background

Advances in information and communication technology have considerably reshaped business operations and communication strategies in organizations. The term *information and communication technology* refers to any technology or product used for processing and communication of information. It includes a variety of technologies such as computer and network hardware and software, radio, television, video, DVD, telephone, and satellite systems. Organizations have been using information and communication technology in almost every facet of their operations. The affordances of ubiquitous and powerful technologies coupled with changes in societies have been making tremendous impact on promoting self-directed, lifelong learning, knowledge management, and open innovations on a global scale (Spector, 2016).

With respect to learning or training in the workplace, information and communication technology has been widely integrated into the daily learning and working lives of individuals, groups, organizations, and communities. Technology has largely expanded the learning opportunity and learning experience in the past decades, showing a shift from traditional face-to-face training to *e-learning*. e-Learning focuses on the use of computer and network technologies to create and deliver a rich learning environment and offer flexible learning experience, which involve a wide range of information and knowledge and a variety of learning and instruction solutions to enhance learning performance (Cheng, Wang, Mørch, Chen, Kinshuk, & Spector, 2014; Rosenberg, 2006).

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Emerging Technologies for Workplace Learning

The emerging technologies have been applied to workplace learning in a variety of ways including learning content management systems, social media and social interaction, mobile and ubiquitous learning facilities, computer simulations and immersive virtual reality, educational data mining and learning analytics, computer-based learning assistance, and cognitive processing and high-order thinking facilities.

Learning Content Management Systems

Learning information and content management has been largely supported by computer-based applications that allow people to create, publish, modify, organize, and maintain information and content through central platforms, so-called learning content management systems. Such applications support collaborative creation and management of information and content mostly through Web portals or Web-based applications. Typical examples of learning content management systems include Blackboard and Moodle, in addition to other authoring tools, which have been widely used for creation and development of e-learning courses.

More recently, the model of open educational resources or open learning content represents the efforts of a worldwide community, empowered by the Internet, to help equalize the access to knowledge and educational opportunities (Benlamri, Klett, & Wang, 2016; Bonk, Lee, Kou, Xu, & Sheu, 2015). For example, Massive Open Online Courses (MOOCs) have brought unprecedented opportunities for learners mainly in the higher education sector to access open online courses with high flexibility and wide choices. A MOOC is an online course aimed at unlimited participation and open access via the Web. In addition to traditional course materials such as video lectures, readings, and exercise materials, MOOCs emphasize the use of online forums, peer review, and other group activities that help learners to interact with peers and instructors. However, there are concerns about the instructional design and sustainable development of current MOOCs, in associate with learner engagement and completion rate (Daniel, 2012). Originally promoted in tertiary education institutions, MOOCs have been applied to corporate training with a view to scale up expert-driven learning to global audience, as a complement to peer learning and collaboration (Herring, 2014). For example, SAP ran a MOOC on the topic of mobile software development on one of its platforms, which attracted 40,000 learners from 158 countries with nearly 20 percent completion rate.

Social Media and Social Interaction

Social media and social interaction tools, also called Web 2.0, have fundamentally changed the way people communicate and interact (Garrison, 2011). Web 2.0 is the term to describe a second generation of the World Wide Web that enables people to

share information and collaborate online. Web 2.0 is a set of trends and tools that refers to the social use of the Web for cocreation and exchange of user-generated content. The main technologies and services of Web 2.0 include online forums, blogs, microblogs (e.g., Twitter), wikis, social networking (e.g., Facebook), video sharing (e.g., YouTube), social bookmarking, tag clouds, rich site summaries (RSSs), podcasts, video and audio conferencing (e.g., Skype), and so on. Online forums have become more extensive and led to the proliferation of blogging. Wikis are used to enable communities to write documents on the Web collaboratively. Social bookmarking enables users to annotate Web documents and share bookmarks such as comments, votes, and tags or keywords. Through social bookmarking or social tagging, users may have a tag cloud, which is a list of tags with the popular tags receiving a bigger or bolder font than less popular ones. The dissemination of news or other regularly changing Web content has evolved into RSSs. Podcasts have been used to disseminate audio or video files in a series on a server for download or subscription.

The technologies and tools for social media and social interaction have brought fundamental change in the way people access information and knowledge and communicate with others, which accordingly affect businesses operations and employee learning in the workplace (Wang, 2015). *Firstly*, Web 2.0 technologies become critical for many facets of business operations: communication with customers and partners, streamlined business processes, analysis of data for forecasts and decision-making, and use of digital media for marketing campaigns. Businesses increasingly rely on horizontal, collaborative relationships among employees, customers, and business partners on a global scale. The ability to communicate and collaborate with people inside and outside the business is becoming a key success factor in a fast-growing global business environment. The new landscape driven by Web 2.0 and its culture of networking, sharing, and collaboration is fundamentally altering people's relationships and activities, especially those related with information and knowledge, in the workplace. Blogs, for example, facilitate reports on project status and, combined with RSS readers, provide an effective way for project sponsors to track the progress of the project. Wikis improve information sharing within and between teams while reducing document production and e-mail communication. With these Web 2.0 tools, people can collaborate more and travel less; self-managing teams can flatten organizations and reduce overhead; communities of practice can share best practices and reduce the number of costly mistakes.

Secondly, Web 2.0 technologies have considerably supported informal learning and knowledge transfer in the workplace by engaging and empowering employees and creating a collaborative environment. Relevant technologies and applications have increasingly integrated with learning or training applications in the workplace for active learning and knowledge sharing, especially through social interaction between those who seek knowledge and those who hold the knowledge. Learning and training opportunities are largely expanded in the workplace by fostering social interactions and learner-centered environment. In specific, technology has allowed more unstructured, self-governing approaches to the creation and transfer of knowledge among employees, especially by the development of new forms of learning communities and networks.

Mobile and Ubiquitous Learning Facilities

Mobile and ubiquitous learning has become a new educational paradigm with the support of the ubiquitous computing technologies associated with handheld, mobile electronic devices such as smart mobile phone and portable computers. Accordingly, ubiquitous learning environments have been increasingly promoted to enable learning at anyplace and at any time. The notion of ubiquitous learning conveys a vision of learning that is connected across all the stages on which we play out our lives (Bruce, 2008). Learning occurs not just in the classroom but also in the home, workplace, playground, library, museum, nature center, and in our daily interactions with others. The main pedagogical premise of ubiquitous learning is related to situated learning (Lave & Wenger, 1991) which emphasizes that "true" learning occurs in the context of real-life activities.

Among different facets of ubiquitous learning, mobile learning or m-learning focuses on the mobility of the learner using personal electronic devices. In developing ubiquitous learning environments, cloud computing has been increasingly used to allow high availability, flexibility, and mobility in accessing and sharing knowledge resources with a wide variety of choices. Cloud computing is an Internet-based ubiquitous computing model, for anyone with a connection to the Internet to access or share content or applications from any device. Through cloud services providers, organizations or educational institutions with limited IT resources can expand their technology capacity without substantial investment on infrastructure and hardware and software applications.

Computer Simulations and Immersive Virtual Reality

To allow learners to access realistic situations that may not occur frequently or would be too expensive or too dangerous, technology-mediated, richly simulated immersive learning environments have been increasing explored to offer expanded opportunities for learning. Such learning environments are constructed using a variety of techniques including computer-based simulations and games and virtual realities. They are distinguished from other learning methods by their ability to simulate realistic scenarios and environments that give learners the opportunity to practice skills and interact with other learners. For example, in medical education, simulations and immersive virtual reality technologies also allow learners to bypass ethical, financial, and practical inadequacies with living patient training.

Virtual worlds and immersive simulations have been found to bring considerable changes in engaging and motivating learners, improving their inquiry and collaboration skills, and enhancing student learning outcomes (Dede, 2009). Simulation-based learning does not necessarily mean that the simulation is physically realistic, but rather than the simulation replicates the core behaviors and cognitions that could occur in the intended transfer settings (Salas, Wildman, & Piccolo, 2009). In addition

to school education, immersive virtual reality simulations have been increasingly used in professional training, for example, in military, medicine, and automobile industry, allowing professionals to improve upon their skills without the consequence of failing the operation. Such applications help save the time and cost for training development and allow the reuse of experiential learning resources.

Recent advances in augmented reality and handheld computing technologies have expanded the opportunities for situated learning via synchronous blending of physical and virtual worlds. Augmented reality can be described as a live view of a real-world physical environment, whose elements are augmented by multimedia representations such as graphics, sounds, and simulations on computers (Dunleavy, Dede, & Mitchell, 2009). Utilizing mobile, context-aware technologies, learners can easily access and manipulate digital information embedded within the physical environment via handheld devices. Further, handheld-based probeware allows for collection of data from physical environments as well as presentation of real-time results, which enables direct interaction with real-world environments and high engagement in inquiry-based investigations (Tatar, Roschelle, Vahey, & Penuel, 2003). Different from situated learning in purely virtual environments, learning with augmented reality highlights the interaction with physical environments and social interaction with other participants. For example, data collected by participants in a decentralized system (e.g., flocking birds) can be quickly gathered and processed for collaborative exploration and analysis; individual responses to a question can be collected for easy analysis and discussion (Roschelle, 2003).

Educational Data Mining and Learning Analytics

To take advantage of the increasing volume, velocity, and variety of learning data especially those generated in computer- or Web-based applications, data mining or learning analytics has received increased attention by educational researchers. Data mining is an analytic process of discovering useful information, hidden patterns, or systematic relationships between variables in large data sets or "big data." It can also be referred to data science or data analytics, an interdisciplinary field across mathematics, statistics, information science, and computer science. The overall goal is to transform raw data into meaningful information that supports efficient assessment of learning outcomes and inform decision-making in educational programs.

Although mainly used in business applications (e.g., business intelligence), data mining has been introduced to educational researchers to analyze data increasingly produced in technology-based learning environments (Baker & Inventado, 2014; Siemens & Long, 2011). Learning analytics has been promoted to develop and apply new evidence-based strategies for learning and teaching, particularly in higher education. Learning analytics is defined as "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" by the Society for Learning Analytics Research (http://www.solaresearch.org). Relevant techniques

such as social network analysis, Web analytics, and information visualization have been applied to explore data coming from educational contexts. The results of learning analytics can be used to identify learners' needs or problems and provide learners with just-in-time feedback or advice.

Computer-Based Learning Assistance

In addition to supporting learning via interaction with various contents, social communities, and real-world problems, computer and information technologies have been playing an important role in providing learners with necessary assistance to achieve desired learning outcomes. Computer-based learning assistance is more important to learning in challenging situations such as learning by self-direction and learning with massive amount of learning resources and real-world problems or authentic tasks, which has become imperative in both school education (e.g., Jia, Chen, Ding, & Ruan, 2012) and workplace learning sectors (e.g., Jia, Wang, Ran, Yang, Liao, & Chiu, 2011). Learners in these situations often face challenges such as being overwhelmed by various materials, getting lost in the learning process, and being confused by complex learning activities and ill-structured problems. Related approaches and techniques have been increasingly explored to address these challenges.

To support self-directed learning via interaction with massive amount of learning resources, intelligent agent and ontology technologies have been applied to model learning content and perform semantic reasoning and provide humanlike adaptive assistance in response to individual needs (Blake & Butcher-Green, 2009; Mahmood & Ferneley, 2006). Intelligent agents here are computer-based facilities or applications that assist learners in performing individual learning tasks such as information retrieval, activity scheduling, and adaptive decision-making; they differ from conventional programs as they can act autonomously and perform tasks intelligently with consideration given to the context and user preferences. In e-learning systems, pedagogical agents are developed as personal tutors, counselors, mentors, or peers, making e-learning suit individual needs, for example, by offering personalized content and guidance.

To make intelligent agents work in such contexts, ontology-based technologies have played an important role in providing a machine-readable representation of a semantically structured knowledge space. Ontology is the formal, explicit specification of a set of concepts and their relations within a domain (Gruber, 1993). They are widely used to support decision-making and learning processes in various applications (Soffer & Hadar, 2007). In e-learning contexts, ontology-based technologies support semantic annotation of learning content, the combination of learning resources, and personalized and context-sensitive learning. Ontology can be refer to the Semantic Web, which provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries. In a Semantic Web, contents are defined and linked using ontologies and formalized

representation technologies, enabling machines to interpret and process information on the Web. Semantic Web is also called the Intelligent Web and enables automated agents to access the Web and perform tasks on behalf of users more intelligently by using Web content with semantic information.

Learners in working with real-world problems and authentic tasks often face challenges of complex learning activities and ill-structured problems. The complex nature of real-world problems and the complexities in performing authentic tasks may overburden learners, making them unable to achieve desired learning outcomes. It has been noted that open-ended exploration in inquiry and problem-solving tasks generates heavy cognitive load to learners (Kirschner, Sweller, & Clark, 2006) and the use of guidance and scaffolding is important to learning in such situations (Hmelo-Silver, Duncan, & Chinn, 2007). Computer-based tools can be used to offer immediate guidance and necessary instructions that help learners accomplish authentic tasks. In addition to such direction support, indirect instruction and scaffolding approaches have received more attention. Among them, structuring or decomposing a complex task into a set of activities has been recognized as an important strategy to assist learning in such contexts (Reiser, 2004). For example, in the "Co-Lab" project, students managed their collaborative inquiry process using a process tool that outlined five high-level activities (starting out, modeling and hypothesizing, collecting data, drawing conclusions, finishing) as well as subordinate activities along with descriptions and hints (van Joolingen, de Jong, Lazonder, Savelsbergh, & Manlove, 2005). Further attention has been placed on facilitating complex cognitive processes and high-order thinking in performing problem-solving tasks with the support of computer-based cognitive tools, as discussed in the next section.

Cognitive Processing and High-Order Thinking Facilities

Many technologies for learning have focused on information processing and content management, with limited affordance for cognitive processing and high-order thinking. The latter focuses on effective understanding of complex ideas and making them transmissible through diverse channels, mainly to support new forms of knowledge representations and knowledge-building activities (Lajoie, 2000). Studies on computer-based mental models and cognitive mapping tools have explored the methods and techniques to externalize complex cognitive structures and processes involved in the understanding of complex issues. Making meaning of complex issues requires the use of language or other forms of representation for effective thinking and communication. Verbal text alone is limited in representing the thinking and understanding of complex issues; a diagram is sometimes worth a thousand words (Larkin & Simon, 1987). Diagrams have been found to be effective in communicating the understanding of complex abstract ideas and improving knowledge retention and integration. In addition, visual representations have the potential to reduce the cognitive load by virtue of the brain's capacity to rapidly process visual images.

Computer-based cognitive mapping tools have been employed to amplify, extend, and enhance human cognition through visual representations on the screen, thus engaging users as they represent, manipulate, and reflect on what they know (Jonassen, 2005). Among various cognitive mapping or modeling tools, concept mapping has been increasingly used to construct and convey complex insights for improving thinking, understanding, and communication (Wang, Cheng, Chen, Mercer, & Kirschner, 2017). Concept mapping is a way of representing knowledge in graphical formats, by representing ideas as nodes and the relationships between them as links with descriptive labels (Novak & Musonda, 1991). It has been promoted as a rich tool for knowledge representation and communication, as well as for assessing learners' understanding of complex issues or integrated knowledge (Nesbit & Adesope, 2006).

Recent work on knowledge visualization has extended traditional concept maps by incorporating additional features toward a holistic representation of knowledge in complex situations (Wang & Jacobson, 2011). In particular, knowledge visualizations go beyond a conceptual view of knowledge by externalizing know-how knowledge such as reasoning processes and decision-making models. Such knowledge is typically tacit and intertwined with experience, not easy to be mastered by novices, but critical for learning driven by problem-solving and expertise development (Sternberg & Horvath, 1999). The integration of conceptual knowledge and procedural knowledge has received more attention in recent studies on learning with real-world problems and authentic tasks. For example, a computer-based dual-mapping cognitive tool was used for medical students to reflect on their problem-solving and knowledge-construction processes when they analyzed patient information and performed diagnostic tasks; the reflection focused on a set of key elements including capture of critical information, reasoning with justifications, hypothesis formulation, identification of key concepts, and relationships between the concepts (Wang, Wu, Kinshuk, Chen, & Spector, 2013; Wu, Wang, Johnson, & Grotzer, 2014; Wu, Wang, Grotzer, Liu, & Johnson, 2016). Given increased interest in using cognitive mapping or visual forms for flexible representation and exploration of complex issues, more studies are needed to examine whether and how student performance in cognitive mapping or visual representation can be guided or scaffolded toward effective thinking and learning.

Challenges

Emerging technologies have largely expanded learning opportunities by offering learner-centered ubiquitous learning environments, in particular by enabling access to various learning resources, expanding social interactions and collaborations, fostering immersion in real-world situations, providing computer-based learning assistance, and facilitating high-order thinking. Meanwhile, technology has limitations and may bring challenges to learning in the new environments.

Emerging technologies have pushed education toward a self-directed learning era that encourages learning through interaction with a variety of online resources. In this context, learners are offered extensive exposure to diverse content and high flexibility in the acquisition of knowledge. Nevertheless, many learners experience information overload and disorientation when navigating in cyberspace (Wang, Peng, Cheng, Zhou, & Liu, 2011). Confronted with a variety of learning resources, many learners feel overwhelmed by the vast quantity and complexity of detail. Without a high level of autonomy and control over their learning process, they may become lost in cyberspace. To address this challenge, prior studies investigated adaptive learning technologies that provide personalized learning content and instructions (Brusilovsky & Peylo, 2003). There is a need for further investigations of the problem together with relevant learning strategies to empower learners not only in acquisition of learning content but also in meaningful learning and high-order thinking.

While social media and communication technologies have been widely promoted for social learning and interaction, they may lead to a plethora of promises by enthusiastic technologists (Wang, 2015). It is not enough simply to deploy the new technologies of interaction and collaboration and then sit back and wait for the benefits to accrue. Social media software integrated into existing business functions may lead to dramatic changes in business processes and challenges in internal communications. For example, Web 2.0 challenges the traditional top-down structure and command-and-control management approaches. It is usually unknown what outcomes will emerge as a result of opening up the interaction space. What will happen if the content on the new platform is uncomfortable for powerful people within a company? This poses a threat to traditional managers who see virtual participation as something that might potentially lead to chaos. Meanwhile, open communication via social media may also bring challenges to employees who expect to be directed instead of to be empowered. The implementation of social media and interaction in the workplace may require a new style of leadership that emphasizes genuine listening, dialogue, and stimulation. Moreover, there are other challenges caused by using Web 2.0 technologies, such as security breaches and the proliferation of information silos posed by using these new tools. A model for organizing interaction and securing information in a meaningful and effective way becomes an integral part for implementation of social media and interaction applications in the workplace.

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Chapter 4
Overview of Workplace e-Learning Research and Development

Background

e-Learning refers to learning conducted via electronic media, typically on the Internet. It can be defined as the use of computer and network technology, primarily over an intranet or an Internet, to deliver information and instruction to individuals (Welsh, Wanberg, Brown, & Simmering, 2003). As noted by Gray (1999), the Internet has shown the liberating potential to deliver new modes of learning; overcome resource, time, and place barriers; and equalize learning opportunities. The benefits of using technology to support the delivery of learning and to enable learner interaction without time and space constraints have accounted for a significant proportion of corporate investment in e-learning (Deeney, 2003). As a result, e-learning is playing important roles in work organizations, e.g., as a tool for just-in-time information access, knowledge management, peer collaboration, staff training, and online performance support.

In the literature, e-learning has been investigated as "instructional medium" (Salas, Kosarzycki, Burke, Fiore, & Stone, 2002), "instructional strategy" (Klein, Noe, & Wang, 2006), "learning environment" (DeRouin, Fritzsche, & Salas, 2005a), "training method" (Burgess & Russell, 2003), "training technique," "learning environment" (DeRouin, Fritzsche, & Salas, 2005a), and so on. The vagueness in terminology reflects the complex, dynamic knowledge and approaches in the domain (Servage, 2005).

Moreover, research on e-learning in the workplace cuts across different disciplines including training, adult learning, education technology, computer science, human resource development, psychology, sociology, and management. Some researchers and experts include knowledge management and virtual collaboration in their studies on e-learning, describing e-learning broadly to include any system that generates and disseminates information and knowledge and is designed to improve performance (Rosenberg, 2012). Workplace e-learning remains a fragmented and

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confusing field, lacking a conceptual or theoretical framework required for interdisciplinary studies and practice (Servage, 2005). A multidisciplinary and holistic view of e-learning in the workplace is therefore important for understanding the research and practice in this field.

Previous Reviews of the Literature

The literature of e-learning in the workplace has been reviewed in different dimensions including theoretical foundations, design principles, evaluation of e-learning programs, and implementation strategies.

The reviews of the literature on *theoretical foundations* emphasized the role of cognitive science and, in particular, the cognitive information-processing model in the research and development of workplace e-learning environments (DeRouin, Fritzsche, & Salas, 2005b; Salas, Kosarzycki, Burke, Fiore, & Stone 2002). Tynjälä and Häkkinen (2005) and Tynjälä, Häkkinen, and Hämäläinen (2014) discussed the theoretical bases of e-learning at work from a broad perspective and outlined the guiding theories from multiple disciplines, including adult learning, learning organization, cognitive sciences, and sociocultural theories.

The reviews on *pedagogical and technological design principles* outlined a variety of design principles based on relevant learning theories and training design practices (e.g., Collis & Margaryan, 2005; Lee, 2010; Salas, DeRouin, & Littrell, 2005; Schreiber, 1998), most of which originated from either behavioristic or cognitive science models. In particular, DeRouin, Fritzsche, and Salas (2005a) summarized the guidelines on design for learner control or learning flexibility in workplace e-learning applications (DeRouin, Fritzsche, & Salas, 2005a). Tynjälä and Häkkinen (2005) reviewed pedagogical challenges and theory-based guidelines for workplace e-learning design and claimed that there was a need to accommodate employees' personal needs and link personal learning to organizational contexts.

The reviews on *evaluation of e-learning programs* in workplace settings focused on issues of effectiveness, return on investment, and completion rates of e-learning programs (Gunawardena, Linder-VanBerschot, LaPointe, & Rao, 2010; Harteis, Gruber, & Hertramph, 2010; Martin, Massy, & Clarke, 2003; Park & Wentling, 2007; Roca & Gagne, 2008). The four-level training evaluation (i.e., learner reactions, learning achievements, work behavior, and organizational results), a widely used evaluation framework proposed by Kirkpatrick (1994), has been discussed in many of the reviews. Other related reviews (e.g., Burke & Hutchins, 2007) synthesized the factors that may have an impact on sustained workplace performance, which can be referred to learner characteristics (e.g., self-efficacy, motivation, and anxiety), intervention design (e.g., learning goals, practice and feedback, and self-management strategies), and work environment (e.g., strategic link, transfer climate, and accountability).

The reviews on e-learning *implementation strategies* in the workplace settings investigated *why* and *how* organizations used e-learning and *what* were the key

points of best practices. Regarding the *why* question, the reviews shed light on the benefits and drawbacks of e-learning, including cost-effectiveness, delivery efficiency, self-directed learning, on-demand learning, and flexibility in time and place (Welsh et al., 2003; Salas, Kosarzycki, Burke, Fiore, & Stone, 2002). Concerning the *how* problem, reviewers examined the current state of workplace e-learning practices regarding issues such as learning content development, training technologies, delivery modes, learner engagement, and control and collaboration (DeRouin, Fritzsche, & Salas, 2005b; Servage, 2005). Moreover, best practices, obstacles, solutions, and implementation strategies of workplace e-learning programs are discussed in the reviews (Berge, 2002).

Bibliometric Analysis of the Literature

To obtain an extensive, thematic overview of the studies on workplace e-learning for a better understanding of this broad domain, we performed a bibliometric analysis of the literature using co-word analysis and text analysis approaches (Cheng, Wang, Mørch, Chen, Kinshuk, & Spector, 2014). This study made a bibliometric analysis of 324 articles on workplace e-learning published in academic journals and conference proceedings from 2000 to 2012 as retrieved from the Elsevier's Scopus database.

Sample Dataset

The sample data used in the bibliometric analysis were collected through a set of procedures. *First*, Elsevier's Scopus database was selected as the data source. Scopus is one of the world's largest multidisciplinary databases of scientific literature (Bar-Ilan, 2008) and has been widely used as the data source in studies depicting the dynamics of science and technology (e.g., Gupta & Dhawan, 2009). *Second*, according to the purpose of this study, the search criteria were formulated by including "workplace," "learning," "training," "web," "online," and "e-learning" as the entry terms. The following search query was constructed and applied in the database:

(TITLE-ABS-KEY(workplace) AND *(TITLE-ABS-KEY(learning) OR TITLE-ABS-KEY(training))* AND *(TITLE-ABS-KEY(web) OR TITLE-ABS-KEY(online) OR TITLE-ABS-KEY(e-learning)))*

The year range of the sample literature determined as from 2000 to 2012. The source type was limited to English language articles published in journals or conference proceedings. The search produced a total of 601 articles. We went through the abstract of these articles to remove irrelevant and repeated records. Finally, 324 articles were selected for data analysis. Most of the irrelevant records were those using online surveys to investigate various issues concerning workplace learning but irrelevant to e-learning or technology for learning.

Analysis Methods

The bibliometric analysis consisted of two parts: (1) co-word analysis of the keywords indexed in the articles to detect the clusters of research topics and (2) text analysis of the titles and abstracts of the articles to assist in understanding the research theme of each cluster.

Co-word Analysis of Keywords

Co-word analysis is an established bibliometric technique widely used in scientometric research to describe and interpret the organization of knowledge in a scientific discipline (e.g., Lee & Jeong, 2008). It involves a co-occurrence analysis of keywords or meaningful terms in a selected body of literature. Co-occurrence analysis, a central task of association analysis in data mining, is used to identify groups of items highly correlated with each other (Tan, Kumar, & Srivastava, 2004). The purpose of co-word analysis is to map and understand the dynamics of science based on patterns of co-occurrence of pairs of keywords representing the various themes in a discipline (He, 1999). The words occurring in an article are assumed to be associated or related with each other or to be similar to some extent. Basically, this method involves the use of statistical techniques such as cluster analysis or factor analysis to generate groups of keywords according to the association strength among the terms measured by co-occurrence frequencies obtained from the domain literature. Then graph drawing techniques are used to map out the relationships between the keywords in groups. Based on the position of, and associations between, the keywords in the group, core research topics can be identified (Ding, Chowdhury, & Foo, 2001). To carry out the co-word analysis, four sequential steps are required: (1) keyword extraction and normalization, (2) co-occurrence matrix construction, (3) clustering, and (4) visual presentation of keyword clusters (Lee & Jeong, 2008).

Text Analysis of Titles and Abstracts

Text analysis is the computer-assisted analysis of data contained in a large collection of written texts (Wegerif & Mercer, 1997). It is a corpus-based approach to the empirical exploration of word meaning within contexts (Graddol, Maybin, & Stierer, 1994). The basic steps of text analysis are data selection, corpus building, data cleaning, computer-assisted analysis, and interpretation of results (Popping, 2000). Typical text analysis techniques include word list generation, collocation, and concordance analysis. Word list generation provides word frequency information in texts; collocation is the tendency of words to co-occur; and concordance describes texts in the form of keywords in contexts. A concordance is a listing of principal words used in a corpus, presented with the words immediately surrounding them. As reported in a survey conducted by Romero and Ventura (2007),

corpus-based quantitative text analysis has been applied in empirical educational research (Romero & Ventura, 2007).

Procedure

Procedure for Co-word Analysis of Keywords

1. Keyword extraction and normalization. To prepare a keyword library for co-occurrence analysis, the author keywords (provided by authors) and the index keywords (provided by the database system) of all the sample article were extracted. There were 2470 raw keywords and phrases in the sample. The keywords and phrases were then cleaned by aligning words of plural and singular forms, standardizing phrases with and without hyphens, and normalizing uppercase and lowercase words. A total of 2322 keywords or phrases were finally reserved for analysis.
2. Co-occurrence matrix construction. Keywords and phrases appearing three or more times in the sample articles (i.e., 332 keywords and phrases) were selected to build the keyword co-occurrence file. First, a term-document matrix was built for the 332 keywords from the 324 sample articles, which produced a 332×324 matrix. Then, the term-document matrix was transformed into a keyword co-occurrence matrix (i.e., a 332×332 matrix). The co-occurrence matrix was then converted into a network file in Pajek (Batagelj & Mrvar, 2009) for further processing. In Pajek, the co-occurrence file was transformed into a dissimilarity matrix based on a dissimilarity measure (Batagelj & Mrvar, 2009).
3. Clustering. Hierarchical clustering using Ward's method was performed on the dissimilarity matrix to produce a hierarchy of keywords in Pajek. According to the generated hierarchy, a number of clusters of keywords were observed. The cluster level was determined according to Ward's measure of error sum of squares within each cluster calculated by Pajek. The identified clusters were then transformed into separate networks in Pajek for graph drawing.
4. Visual presentation of keyword clusters. Each cluster was presented in the form of a graph, in which the keywords were represented by nodes and their associations represented by links between the nodes. Before the graphs were generated, the line values (i.e., dissimilarity) in each network were transformed so that the line width in the graphs indicated similarity (i.e., association) among keywords. To make the graphs readable, the lines with a value lower than the third quartile of the line values in the whole network were set to be invisible in the graphs. Thus, only the strong associations among the keywords (i.e., associations with high values of similarity) were presented as lines in the graphs. To identify the topics in each cluster, the degree centrality of each keyword (i.e., the number of links or relationships owned by the keyword in a network) was calculated and represented by the size of the node. In the graphs, the keywords that had the higher degree centrality (i.e., equal to or higher than the median of the degree

centrality of all keywords in the cluster) were highlighted in red and presented as the central topics of each cluster.

Procedure for Text Analysis of Titles and Abstracts

The text analysis of the titles and abstracts of the articles was performed to identify the theme of each cluster. Several steps were taken to implement the text analysis. *Firstly*, from the total sample of 324 articles, those indexed with the keywords with high degree centrality in each cluster were retrieved. *Secondly*, the titles and abstracts of the retrieved articles in each cluster were extracted and built as corpora. *Thirdly*, data cleaning was implemented to remove redundant information from the corpora. Specifically, four types of redundant information were removed from the corpora: (a) copyright information contained in the abstracts, (b) punctuation (excluding intra-word dashes), (c) numbers, and (d) stop words including prepositions, articles, and pronouns. *Fourthly*, computer-assisted text analysis was performed on the corpora to generate a word list with frequency and collocates to characterize the texts. The word list presented the high-frequency words appearing in the corpora, while the collocates showed the words (with frequencies) appearing immediately to the left or immediately to the right of a specific word in the word list. Finally, the research theme of each cluster was verified and specified based on the textual information derived from the corpus analysis.

Research Themes

The results of the bibliometric analysis identified the following six research themes or clusters in the field.

e-Learning for Continuing Education

The first theme found in the domain literature was e-learning for continuing education. The topics relevant to online or Web-based technologies and curriculum-based continuing education or distance education were strongly associated in this cluster and formed a salient research cluster. Moreover, topics related to pedagogy and workplace competence were emphasized in the articles. This shows the current state of studies on vocational and higher education, which reflects the interaction between formal education and practical experience and new pedagogies for technology-enhanced learning (Tynjälä, 2008; Tynjälä & Häkkinen, 2005). Strong connections between the topics within the theme suggest that it is a coherently developed area of study. Moreover, it was noted that many articles in this cluster were related to medical education and published in journals in medical education, which, however, has not explicitly been reported in previous reviews of workplace learning research.

Computer-Assisted Training for Professional Development

In the second theme, topics concerning training technologies and professional development of workplace knowledge and skills were found to be strongly associated, formulating a salient cluster. As claimed by Welsh et al., (2003), the integration of personnel training with on-demand job support and professional development might become a future direction of workplace e-learning. While covering diversified topics on professional practice and development, this cluster as a whole lacks coherence as reflected by weak connections between the topics.

Computer-Assisted Occupational Health and Safety Education

The third theme identified in the literature was related to occupational health and technology for training. Topics in this cluster were strongly associated and grouped into a well-established field. Most of the articles in this cluster appeared in professional journals on occupational health, medical education, and healthcare. Moreover, research methodology (e.g., questionnaire and controlled study) seemed to receive much attention in these studies.

Computer-Assisted Healthcare and Nursing Education

The theme of the fourth cluster was related to healthcare and nursing education and e-learning technologies. Topics in the cluster were strongly associated and formed a well-established field. Most articles in this cluster were published in journals related to nursing education and medical education. Moreover, issues of learners' attitude and demand for e-learning received more attention. Strong connections between the topics within the theme suggest that it is a coherently developed study area.

Social Media for Informal Learning

In the fifth theme, topics regarding social media technology and informal learning in workplaces were saliently associated. Web 2.0 technologies were reported to enable informal learning by supporting knowledge exchange based on informal social relations, the development of trust and reputation, and knowledge transfer through mentoring (García-Peñalvo, Colomo-Palacios, & Lytas, 2012; Liu, Macintyre, & Ferguson, 2012; Seufert, 2012). While social media for informal learning involves a variety of issues (such as Web 2.0, informal learning, knowledge acquisition, and mobile devices), the cluster itself is not coherently developed reflected by weak connections between the topics.

Knowledge Management in Workplace e-Learning

The theme was about knowledge management. Different from institutional learning programs, learning in the workplace is built on practical tasks and work situations, with more attention to the capture and transfer of tacit knowledge embedded in everyday practice and the commitment to lifelong learning. Many studies claimed that the future of e-learning lies in the integration of information and content management, knowledge management, learning management systems, and personnel training (Rosenberg, 2012; Rossett, 2002; Welsh et al., 2003). The integration of knowledge management and e-learning has also been discussed in the literature (e.g., Lytras, Naeve, & Pouloudi, 2005; Marshall, Zhang, Chen, Lally, Shen, Fox, & Cassel, 2003; Schmidt, 2005; Sampson & Zervas, 2013; Wild, Griggs, & Downing, 2002).

Four Directions

Based on the six themes, the research on workplace e-learning can be categorized into four directions: e-learning for continuing education and professional development, e-learning in the healthcare sector (as one of the most prolific e-learning initiatives), use of social media for e-learning, and integration of knowledge management with e-learning.

e-Learning for Continuing Education and Professional Development

The first direction represents the mainstream of research on workplace e-learning. Formal learning programs in vocational and higher educational institutions as well as in-service training or professional development programs in workplaces constitute the most significant part of workplace learning (Tynjälä, 2008). Both of them have been considerably altered and supported by e-learning or distance learning technologies. At the same time, formal learning and informal learning have been increasingly integrated with the support of technology, providing more expansive and flexible approaches to lifelong learning.

e-Learning in the Healthcare Sector

The second direction about healthcare has emerged as one of the most prolific e-learning initiatives. The world of healthcare is being transformed through e-health innovations including widespread implementation of healthcare information

systems, electronic health records, medical decision support systems, Web-based conferencing, and imaging technologies, among others. These innovations have also pushed the integration of technology into training of health workforce (Booth, Carroll, Papaioannou, Sutton, & Wong, 2009; Childs, Blenkinsopp, Hall, & Walton, 2005; Kushiniruk, 2011). It is surprising that three distinctive themes identified in the aforesaid bibliometric analysis are relevant to health or medical education, which suggests that applications of e-learning in the healthcare sector have become a major focus of interest in the field of workplace e-learning, although most of these studies were published in medical or healthcare-related journals.

Studies on workplace e-learning in the above two directions have paid particular attention to pedagogy and e-learning success factors. It is critical to bridge the gaps between formal and informal learning and between education and work, especially in the development of new pedagogical models such as blended learning, problem-based learning, computer-assisted collaborative learning, and simulation-based authentic learning. For example, while learning through problem-solving has been widely recognized as an effective means of learning especially in complex domains such as scientific inquiry and medical education, effective learning through problem-solving is difficult to realize since learning in such contexts often involves complex processes inaccessible to learners (Wang, Kirschner, & Bridges, 2016). It is crucial to utilize relevant learning technology to externalize the complex cognitive processes and facilitate the connection between problem-solving and knowledge construction (Wang, Wu, Kinshuk, Chen, & Spector, 2013). In examining the success factors of workplace e-learning, studies have taken into account a variety of issues, such as learners' motivation and attitudes, associated costs, technical and administrative support, and cultural shift strategies. More systemic research is needed for assessing the outcomes of workplace e-learning. Also, more ambitious learning outcomes such as problem-solving competence, human development, and organizational change need to be examined in future studies.

Social Media

The third direction about social media has received wide attention in workplace e-learning. The new landscape driven by social media and its culture of networking, sharing, and collaboration is fundamentally altering people's relationships and activities with information and knowledge. The use of social media and networking tools have significantly improved knowledge creation and sharing in the workplace by engaging and empowering people in social interaction (García-Peñalvo et al., 2012; McAfee, 2009). However, many studies on social media are limited to the use and analysis of the tools without taking into account the organizational contexts that may affect the essential attributes of social and collaborative behavior, such as trust, voluntariness, and self-directness. On the other hand, more effort is needed to investigate different types of communities of practice, for example, interaction between expert and novice and interaction between people with different skills or expertise (Fischer, 2013) and their impact on learning in the workplace.

Integration of Knowledge Management with e-Learning

The fourth direction about knowledge management and e-learning has been increasingly promoted in organizational environment (Cheng et al., 2014; Rosenberg, 2012; Spender, 1996; Wang & Yang 2009). Knowledge management is a discipline aimed at enabling individuals in an organization or community to acquire, share, and manage knowledge collectively to achieve common goals (Nonaka & Takeuchi, 1995). Reiser and Dempsey (2012) listed knowledge management as one of the ten trends affecting the field of instructional design and technology. Different from traditional education, learning in workplace contexts requires employees to capture intuition or tacit knowledge, contribute to the creation of new knowledge, and manage knowledge assets for continuous development. Moreover, learning and knowledge management share a common strategy of creating a learning organization, which implies that learning in organizational contexts should go beyond the individual level and an organization should be able to learn and adapt to the environment. Substantial research is needed to explore how organizational systems, structures, and policies can be incorporated into workplace learning applications in order to create a coherent and manageable system for both individual and organizational learning.

A Holistic View of the State of the Art

Various interdependent issues explored in e-learning in workplace settings have showed the complex, dynamic, and multidisciplinary nature of the field. In addition to the key issues and main research themes and directions emerging in the field, it is important to note the potential synergy among different themes and strengthen the linkages among different disciplines. For example, social media for informal learning can play a significant role in healthcare education, especially with those working in isolation from local mentors and experts. The role of knowledge management can influence the other clusters in significant ways, especially as the means for creating and transferring new knowledge in meaningful ways.

The efforts on e-learning in the workplace have evolved into a complex system involving multiple stakeholders and environmental factors. Researchers, practitioners, policy makers, and other stakeholders approach workplace e-learning from the perspective of their own disciplines, which include training, adult learning, education technology, computer science, human resource development, psychology, sociology, and management. Members of these disciplines speak different languages, use different research and intervention tools and models, and read and contribute to different literature bases. Understanding and managing complex problems of workplace e-learning requires systems approaches as well as true transdisciplinary collaboration in both research and practice and between research and practice. e-Learning in the workplace is now at a critical juncture. To proceed to the next level

and to more effectively translate research findings into practice, it is necessary to move beyond familiar approaches and toward systems methods that address complexities and dynamics of the field.

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Chapter 5
Workplace e-Learning at a Crossroads

Background

e-Learning is increasingly recognized as an important approach to both formal and informal learning in workplace settings in view of its advantages over traditional face-to-face training in respect of anytime and anywhere availability, delivery efficiency, on-demand training, and cost-effectiveness (Rosenberg, 2006). Technology for learning and communication has been playing an important role in a variety of aspect of employee training and development including information access, web-based training, peer collaboration, online performance support, and knowledge management.

While e-learning has accounted for a significant proportion of corporate investment, the promise of implementing e-learning to achieve desired gains remains only partly realized. On the other hand, research has shown that comparisons of learning effectiveness between classroom-based and technology-delivered programs are difficult to interpret because of numerous, potential compounds in learning contexts (Welsh, Wanberg, Brown, & Simmering, 2003). It is difficult if not impossible to create training programs that are identical in all ways except for the means of delivery. Therefore, we should be cautious in analyzing the benefits, drawbacks, and other effects of e-learning on employee training and development.

Use of e-Learning in the Workplace

E-learning refers to a wide set of applications and processes such as web-based training, computer-assisted learning, virtual classrooms, and social networking. E-learning applications have been deployed in many organizations to afford just-in-time information access, knowledge management, peer collaboration, and online

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performance support. As an effective way to support training and development of employees, e-learning has been mainly used to complement traditional face-to-face training programs, so-called blended learning. As reported in the survey conducted by the UK's Chartered Institute of Personnel and Development (2013), 91% of organizations believed that e-learning was most effective when combined with other learning methods, with 72% stating that technology-enhanced learning should not be regarded as a substitute for face-to-face training.

Moreover, e-learning has been mainly used for *informal learning*, which is important in workplace settings (Short & Greener, 2014). Firstly, e-learning supports the capture or codification as well as management of tacit knowledge, makes it available to the organization, and improves organizational knowledge assets management (Harris, 2009). Secondly, e-learning makes it easier for employees to form networks with others (including peers, trainers, and experts) to share knowledge and experience and support their daily work and collaboration.

While e-learning has been increasingly adopted by large organizations as well as small- and medium-sized companies, it has been particularly effective for delivering consistent training *across multiple locations* (Welsh et al., 2003). Moreover, as an effective way for *self-directed learning*, e-learning is more appropriate for independent learners or employees in the workplace, especially those who have more autonomy in their decision-making and have self-directed learning skills rather than low-skilled employees.

Benefits of e-Learning in the Workplace

e-Learning, as an emerging approach for enhancing the skills of knowledge workers or digital workforce, has been chosen by organizations for its beneficial features in the following aspects:

- Access convenience and flexibility
- Delivery efficiency
- Self-directed learning
- Peer interaction
- Knowledge dissemination and management
- Cost-effectiveness

Access Convenience and Flexibility The benefits of using e-learning to support the delivery of and access to training programs and to enable learner interaction without time and space constraints have accounted for a significant proportion of corporate investment in e-learning (Deeney, 2003; Short & Greener, 2014). E-learning applications afford just-in-time training and rapid dissemination of knowledge, making on-the-job training more accessible, flexible, and convenient than traditional approaches.

Delivery Efficiency E-learning can help organizations to reduce travel and classroom costs arising from training and development programs and save time off the job. In addition, e-learning courses can be delivered to many people quickly without the constraints of instructor and classroom capacity. E-learning also allows for reuse, allowing the courses to be repeatedly visited by learners. All these features make e-learning more efficient in delivery than traditional approaches (Nunes, McPherson, Annansingh, Bashir, & Patterson, 2009).

Self-Directed Learning Self-directed learning is a universal disposition of adult learners, who are able and willing to take responsibility for their learning; they learn what is required to perform their jobs and evolving life tasks motivated by various incentives (Knowles, 1975). E-learning has clear advantages in fostering self-directed learning, which is crucial to training in the workplace. In addition to convenient and flexible access to learning content, e-learning is featured by using technology to support learning and cognitive processes, for example, using computer simulations and virtual reality technology to support the learning of complex mechanisms and practical skills (Salas, Wildman, & Piccolo, 2009).

Peer Interaction In workplace settings, learning is considerably associated with social interactive experiences such as team work, communication and networking among peers, and mentoring programs, which allow the transfer and cocreation of knowledge among individuals, groups, organizations, and communities. In the meantime, e-learning systems and applications have advantages in supporting knowledge sharing, peer interaction, and collaboration networks (Fuller & Unwin, 2004; Tynjälä, Häkkinen, & Hämäläinen, 2014).

Knowledge Dissemination and Management Learning in workplace settings is built on practical tasks and work situations. Most knowledge in the workplace is tacit and embedded in everyday practice; it located not only in individuals but also in organizational culture, business processes, routines, and networks (Marr, Schiuma, & Neely, 2004). Computer- and web-based systems can help communicate expert knowledge and allow organizations to manage knowledge assets in effective ways (Chute, Williams, & Hancock, 2006; Harris, 2009).

Cost-Effectiveness E-learning has the potential to be less costly than classroom training once the course has been developed. While e-learning may involve some expensive variable costs such as technical support and maintenance, it eliminates several costs associated with the classroom such as travel, lodging, meals, and materials. In general, e-learning is more likely to be cost-effective if there are a large number of learners, if the learners are geographically dispersed, and if the course will be repeated several times (Nunes et al., 2009; Welsh et al., 2003).

Barriers to e-Learning in Workplace Settings

However, the promise of implementing e-learning to achieve desired gains in the workplace remains only partly realized (Admiraal & Lockhorst, 2009). The survey conducted by the UK's Chartered Institute of Personnel and Development (2013)

showed that face-to-face training was considered much more effective than virtual training, with 48% favoring in-house development programs and 39% preferring coaching by line managers. The literature has reported a variety of barriers to the success of e-learning initiatives or potential drawbacks of using e-learning, making employees inadequately engaged in e-learning practice or unable to achieve desired learning outcomes:

- Relevance to individuals
- Alignment with organizational goals
- Instructional design
- Organizational environment or culture
- Assessment
- Costs

Relevance to Individuals e-Learning content in many programs tends to be generic and irrelevant to daily work or not effectively integrated with business processes (Harris, 2009). Vendors often sell generic e-learning packages, while companies need customized solutions for their employees. Although using generic learning content can save the cost, it may confuse learners and lead to poor results. While employees can learn some knowledge by participating in e-learning programs, more often they do not think that e-learning is helpful since the knowledge gained from e-learning does not necessarily help improve their work performance.

Alignment with Organizational Goals It is important that organizations align e-learning with business objectives and outcomes and have in place appropriate plans and strategies to support the e-learning initiative. However, e-learning in many organizations is generally designed without taking into account the organizational vision, mission, and specific training requirements. Workplace training has received an increasing criticism in terms of its relevance to key business processes and outcomes, which is also related to a lack of concern, support, and commitment in the assessment and evaluation of workplace training and development programs.

Instructional Design It is commonly agreed that classroom instruction varies in how the teacher gains and keeps the attention of learners, demonstrates key points, clarifies misunderstandings, offers opportunities for practice, and provides clear and useful feedback. This point is also true for e-learning or technology-delivered courses. However, most e-learning development tends to focus on technical development with insufficient attention to instructional design, i.e., integrating pedagogical principles into e-learning design toward learner satisfaction and learning achievements in organizational and work contexts (Tynjälä & Häkkinen, 2005). In some cases, the use of static and noninteractive e-learning programs tends to create a mindset that electronically encoded information is training. In other cases, e-learning courses merely replicating traditional delivery without sufficient interaction and feedback make learners resist the use of e-learning or technology-mediated learning programs (Welsh et al., 2003).

Organizational Environment or Culture Many organizations introduce e-learning with or without an appropriate environment or culture in place to support e-learning, which is mainly associated with management and technology support (Nunes et al., 2009). For example, managers may not provide sufficient time for employees to take e-learning during the work day. Learners are not aware of the rationale of using e-learning or given a clear expectation on the use of e-learning in association with incentives to engage in e-learning and make some achievement. In addition, employees in the workplace especially those with limited technical skills may experience various technical problems when using e-learning applications; technical support is thus critical for e-learning success in the workplace.

Assessment Assessment or evaluation of training effectiveness has been regarded as crucial to organizational training and development. However, traditional research and practice in this field has shown a lack of concern, support, and commitment in the assessment and evaluation process. There are few standard evaluation or assessment methods and techniques, especially in demonstrating the relation of training to organizational outcomes. Comprehensive evaluation and accountability is seen as the most often ignored part of training and development (Burrow & Berardinelli, 2003; Phillips & Phillips, 2016). In relation to this, workplace training received an increasing criticism in terms of its relevance to key business processes and outcomes. Most measures on trainee performance and organizational outcomes have been too different or distant from each other, unable to reflect the organizational changes expected from the planned training.

Costs Up-front cost was frequently mentioned as drawbacks of e-learning. E-learning initiatives can require considerable investment in information technology infrastructure including hardware and software and in design and development of online courses, for both launch and maintenance (Welsh et al., 2003). While e-learning may save the costs for travel, classroom, and instructor arising from training and development programs, it may involve expensive variable costs on other aspects. Difficulties in ascertaining the full cost of technology-mediated learning can inhibit the adoption of e-learning by small- and medium-sized companies (Sambrook, 2003).

Implications

Learning with Individual Needs and Organizational Goals

The dominance in technology makes many workplace e-learning initiatives not well aligned with individual needs and organizational goals, which could hamper both organizational and personal growth (Burrow & Berardinelli, 2003; Moon, Birchall, Williams, & Charalambos, 2005; Servage, 2005; Tynjälä & Häkkinen, 2005; Wang, 2011). Learning in workplace settings is featured by self-directed learning (Knowles,

1975), where individuals learn what is required to perform their jobs and tasks. It is important to make workplace learning well aligned with individual needs, for example, by providing employees with personalized learning resources, adaptive guidance and feedback, and strategies for self-regulation.

In addition to individual needs, learning in the workplace needs to serve organizational goals in that an organization should be able to learn to ensure continuous transformation in dynamic and competitive environment (Senge, 1991). An organization needs to learn by the process of creating, retaining, and transferring knowledge (Argote, 1999; Cyert & March, 1992), in particular by developing and cultivating the channels for knowledge transfer and distribution as well as for knowledge creation or capture and knowledge retention for sustainable development and innovation (Wang, 2015).

In short, the goal of learning in workplace settings is to enhance both individual and organizational performance. Individuals expect the organization to support their learning relevant to their jobs, duties, and roles. Meanwhile, the organization expects individual learning to be transferred back to jobs and the utilization of new skills to enhance organizational performance (Boud & Garrick, 1999; Craig, 1996). Further, communication and coordination among the members of the organization plays an important role in creating a shared vision (Senge, 1991) and common interests toward the aligned goals.

Integrating Technology with Pedagogical Design

While e-learning has proliferated in workplace settings, most studies and practices in the field have focused on technology development and applications, with inadequate attention to pedagogical and organizational aspects that are necessary for e-learning success in the workplace (Moon et al., 2005; Tynjälä & Häkkinen, 2005). There is a lack of pedagogical underpins on the use of e-learning in most studies and practices on workplace e-learning, in association with insufficient understanding of learning behavior occurring in the organizational context.

Workplaces as learning arenas are different from schools. Learning in the workplace takes place in the context of use and application, whereby knowledge is built on practical tasks and work situations, which differ across individual positions. Also, the knowledge and skills often remain implicit and embedded in daily work and practices. Sharing and transfer of knowledge and experience among co-workers, especially with the support of information and communication technology, is therefore is an important part of the learning process in workplace settings.

In this context, e-learning in the workplace should move beyond jumping from one technology fad to another; it requires more attention to practice, interaction, feedback, and guidance. The design of e-learning programs in the workplace should incorporate adult learning principles, for example, how self-direction and self-management can be facilitated or guided, how adaptive and useful feedback can be offered when needed, and how peer interaction can be encouraged and supported,

with a view to fostering learner motivation and engagement. In addition, e-learning design principles with respect to effective use of technology should be considered, for example, computer-based delivery is more appropriate for short courses, visual formats are effective for representing complex ideas, and computer simulations are useful for the learning of practical skills. To do so, pedagogical principles and adult learning theories should form the basis for the design and implementation of e-learning applications and courses in work environments, just as these principles form the basis for the design of learning environments in other contexts.

Strategic Planning and Organizational Environment

While e-learning is viewed as an emerging approach to workplace learning, the potential of e-learning in the workplace can only be exploited within an appropriate work and learning culture and environment (Tynjälä & Häkkinen, 2005). In addition to technology infrastructure and pedagogical design, the implementation of e-learning requires strategic planning and substantial effort by the organization, especially on improving organizational environment or culture to support e-learning initiatives, with a view to overcoming employees' resistance to e-learning and improving their self-efficacy. Important work environment factors may involve *managerial support*, *job support*, *and organizational support* (Cheng, Wang, Moormann, Olaniran, & Chen, 2012), indicating the support from the different levels of an organizational system, i.e., interpersonal relationship, job performance requirements, and organizational policies and systems, respectively.

Managerial support is concerned with employees' perception and belief of the extent to which supervisors or managers give employees opportunities and reinforcement (e.g., top management support and leadership commitment) for participating in continuous learning and developmental activities. *Job support* refers to the degree to which employees perceive that work characteristics (e.g., job-related information, autonomy, and access to technology) are designed to facilitate learning and developmental activities. *Organizational support* represents the degree to which employees perceive that their employers support individuals' participation in development activities and value their learning through supportive organizational policies (e.g., internal training program, budgetary support, monetary rewards, and promotion).

Learning and Assessment

Learning is fundamentally about changes in attitudes, belief, knowledge, abilities, skills, and behavior. Learning in most situations involves a goal and a process toward the achievement of that goal. Assessment is universally recognized as one of the most important elements of learning experience. It sits at the heart of the learning process, as it provides observable evidence of learning and determines the

achievement or performance of the learner. It is important to conduct relevant assessments to ensure the achievement of the goals for effective learning.

In workplace settings, assessment or evaluation of learning or training programs has been regarded as crucial to organizational training and development. Performance measurement is used by organizations as a procedure to improve performance by setting performance objectives, assessing performance, collecting and analyzing performance data, and utilizing performance results to drive performance development (Slizyte & Bakanauskiene, 2007). However, traditional research and practice on workplace learning has shown a lack of attention and effort to the assessment and evaluation process. Comprehensive evaluation and accountability are seen as the most often ignored part of training and development. Given that workplace training has received an increasing criticism in terms of its relevance to key business processes and outcomes (Burrow & Berardinelli, 2003; Phillips & Phillips, 2016), there is a need for more studies investigating how organizational metrics should be refined and connected with training programs, job performance, and overall output.

Workplace Learning as a Complex System

Learning in organizational contexts tends to become increasingly dynamic, complex, and interdependent, especially in technology-enabled environments. Given individual, social, and organizational dimensions of learning in the workplace as well as multiple elements of workplace e-learning environment, workplace e-learning can be influenced by a variety of factors such as individual motivations and abilities, technology and facilitation for learning, organizational culture, and public policy (Servage, 2005; Smith & Sadler-Smith, 2006). Various interdependent issues explored in workplace e-learning settings have shown the complex, dynamic, and multidisciplinary nature of the field.

The efforts on e-learning in the workplace have evolved into a complex system involving multiple stakeholders and environmental factors. Researchers, practitioners, policy makers, and other stakeholders approach workplace e-learning from the perspective of their own disciplines, which include training, adult learning, education technology, computer science, human resource development, psychology, sociology, and management. Members of these disciplines speak different languages, use different research and intervention tools and models, and contribute to different literature bases. People tend to focus on the parts rather than seeing the whole and dynamic processes of complex situations.

In this context, workplace e-learning applications and programs should be designed based on a thorough understanding of learning in organizational environments, which involves individual, social, and organizational dimensions and consists of multiple elements such as learner, learning resource and technology, jobs and tasks, organization, and social context. Close collaboration is expected among different roles such as learner, instructor or lecturer, domain expert, learning and development advisor, consultant, learning designer, IT developer, and manager. For

example, participatory design, an approach to design which actively involves all stakeholders (e.g., end users, partners, customers) in the design process to help ensure the result meets their needs, has been increasingly used in workplace e-learning projects (Mørch & Engen, 2008; Mørch & Skaanes, 2010).

By making the employees "owners of the problems and champions of the project," they can help to identify the situations for which technology-enhanced learning can improve existing work practice, as well as to sustain the e-learning project after it is completed.

E-learning in the workplace is now at a critical juncture. Due to a lack of a holistic understanding of workplace e-learning and appropriate approaches to its design and implementation, e-learning in the workplace remains a fragmented, complex, and challenging area of research and practice (Collin, 2006; Servage, 2005). Understanding and managing the complex problems of workplace e-learning requires systems approaches as well as true transdisciplinary collaboration in both research and practice and between research and practice. To proceed to the next level and to more effectively translate research findings into practice, it is necessary to move beyond familiar approaches and use systems methods that address complexities and dynamics of the field.

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Part II
Theories for Performance-Oriented Learning in the Workplace

Chapter 6
Systems Thinking and Systems Modeling

Background

Learning in the workplace has been increasingly supported by rapid advances in information and communication technology. This has led to the transformation of traditional training and development to e-learning by using digital media, electronic resources, and various technology applications. However, the promise of implementing e-learning to achieve desired gains in the workplace remains only partly realized. Given that workplace learning is a complex system involving multiple stakeholders, many interrelated components, and dynamic and nonlinear relationships among the components, systems approaches such as *systems thinking* and *systems modeling* have the potential to significantly enhance our understanding and management of e-learning in the workplace.

Systems Thinking: A Shift of Mind

In the field of systems theory, system is defined as "a set of elements standing in interrelation among themselves and with the environment" (von Bertalanffy, 1969). Systems thinking is a way of helping a person to view a system from a broad perspective that includes seeing interactions, overall structures, patterns, and cycles in the system, rather than seeing only specific elements and events in the system. In shore, a system is a complex and dynamic whole, and systems thinking is a discipline for seeing wholes rather than parts. Systems thinking has been applied to the study of medical, biological, environmental, political, economic, human resources, and educational systems, among many others.

Systems thinking is needed more than ever because we are becoming overwhelmed by complexity and interdependency. Education systems including learning

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in schools and organizations are often complex, containing multiple stakeholders, many interrelated components, dynamic and nonlinear relationships among multiple components, and delayed effects of a change (Spector, 2000). For example, learning in the school environment can be understood as a complex system, which is compose of many interacting including learners, teachers, administrators, support staff, and communities, in addition to facilities, technologies, and resources, among others. These components are interconnected in multiple complex ways. In some cases, the effects of a change may be immediate but in other cases may be delayed; a change in one of these components may cause unexpected changes on other components. For example, when a new technology is introduced to learning or training programs, it is tempting to believe that its effects will be immediate and significant. However, the reality is that the impact of new technology on training and learning can be delayed by the time and effort required for people to learn how to integrate the new technology with learning activities. Further, when introducing a new technology, some may feel threatened or anxious about their ability to use the technology and possible changes in job roles and tasks. In such contexts, systems thinking, especially by being comprehensive and flexible in planning and foreseeing the dynamic effects, is crucial to making technology-enhanced learning to be a systematic and rational approach.

Systems Modeling: Approaches to Analyzing and Managing Complex Systems

To investigate how relationships between parts give rise to the collective behaviors of a complex system and how the system interacts and forms relationships with its environment, there is a need to present and analyze a complex system using appropriate models and apply the models to implement feasible solutions to analyze and manage complex systems or solve ill-structured problems in complex situations. In a sense, all science is creating models of the world or of the perceived world depending on a scholar's discipline's ontological and epistemological vantage point. Below are a few commonly used modeling approaches to analyzing and managing complex systems.

Activity Theory for Modeling Human Activities in Sociotechnical Systems

It is important to analyze and manage the activities and interactions in a complex system. Activity theory, pioneered by Vygotsky (1978) and Leont'ev (1978), provides a unique model for analyzing human activities as systemic and socially situated phenomena. Activity theory begins with the notion of activity. An activity is

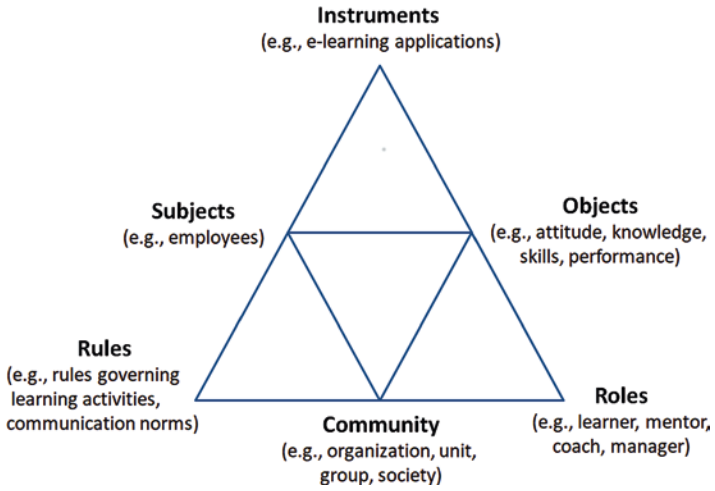

Fig. 6.1 Workplace learning as an activity system

seen as a system of human "doing" whereby a subject works on an object in order to obtain a desired outcome; meanwhile, an activity is carried out within a social context or specifically in a community (Nardi, 1996). In activity theory, the unit of analysis is the concept of object-oriented, collective, and culturally mediated human activity or activity system. An activity system includes six related elements: (1) object, the objective of the activity system; (2) subject, actors engaged in the activity; (3) community, social context; (4) instruments, the artifacts (or concepts) used by actors; (5) division of labor, the division of activities among actors in the system; and (6) rules, conventions, guidelines, and rules regulating activities in the system.

Activity theory is used to describe actions in a sociotechnical system (e.g., team, organization, and society), whereby multiple actors may be involved in multiple roles, operating with a variety of methods and tools, creating various artifacts that will contribute to achieving a common goal. It has been widely used in both theoretical and applied psychology and in education, professional training, and human-computer interaction. Activity theory can be used to analyze learning in organizations or workplaces as complex systems. As shown in Fig. 6.1, individuals, as members of a community of practice, take multiple roles in an organization, communicate with accepted norms and rules, and use various tools including educational technology to achieve shared goals to improve knowledge and skills as well as performance at both individual and organizational levels (Spector & Wang, 2002). Different from educational institutions, organizations as learning arenas do not have learning as a primary objective; learning in the workplace aims to serve corporate goals and needs and in a general sense to increase competitiveness, profit, efficiency, and so on. Challenges of e-learning in the workplace are to facilitate learning in such a manner that technology, pedagogy, and organization are integrated and create a coherent and manageable system for learning activities (Wang, 2011).

Agent-Based Architecture for Modeling and Computing Complex Systems

Agent-based architecture has been identified as unique in its capacity of modeling complex systems (Holland & Miller, 1991). In agent-based modeling, a system is modeled as a collection of loosely coupled autonomous decision-making entities called agents (Bonabeau, 2002). As shown in Fig. 6.2, each agent individually assesses its situation and makes decisions of actions on the basis of knowledge or a set of rules to achieve its goal; meanwhile, it interacts with other agents and performs collaborative activities. In addition, agents may be capable of evolving, allowing unanticipated behaviors to emerge. Accordingly, complex systems can be referred to complex adaptive systems, which self-organize, adapt, and evolve over time. Wooldridge and Jennings (1995) used the term intelligent agent to denote an entity that enjoys the properties of autonomy (operating independently), social ability (communicating with other agents), reactivity (sensing and responding to the environment), and pro-activity (exhibiting goal-oriented behavior by taking initiative). The pro-active property is related to the learning capability and knowledge basis of an agent, i.e., an agent may need to learn or acquire knowledge so as to adapt to the environment more effectively.

Agent-based modeling describes a complex system from the perspective of its constituent units. By concentrating on high-level abstraction of autonomous entities, agent-based modeling is used to model and implement solutions to ill-structured problems that are too complex to be completely characterized and precisely described. Agent-based models have been used in a wide range of fields such as

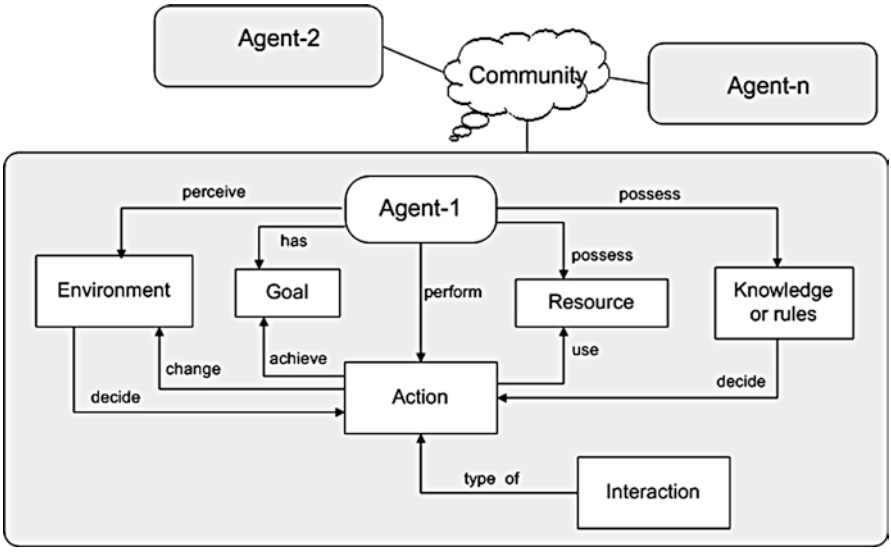

Fig. 6.2 Agent-based architecture

ecology, biology, anthropology, artificial societies, psychology, sociology, economics, traffic, and the military. It can be used to model and analyze learning as complex systems in organizations. Each individual in an organizational environment performs goal-oriented autonomous behavior by performing work-related tasks and learning activities to acquire relevant knowledge; moreover, individuals interact with others in the organization in their working and learning processes. Furthermore, an organization can be regarded as an agent, which performs autonomous behavior to make its business, collaborates and competes with other organizations, and adapts to the changing business environment.

By virtue of advances in computational modeling techniques and artificial intelligence, agent-based complex systems can be examined both computationally and analytically. In particular, agent-based modeling approaches look into autonomous decision-making and adaptation, social communication and interaction, as well as global consequences of complex interactions in a given space. The interactions between the parts are nonlinear, so the overall behavior cannot be obtained by summing the behaviors of the components. Emergence is thus understood as the property of complex systems, and agent-based modeling is a key approach to investigating emergent phenomena, which is abound in the social, political, and economic sciences.

System Dynamics for Modeling Causation in Complex Dynamic Systems

One branch of systems thinking is called *system dynamics*, a methodology for modeling, analyzing, and improving complex dynamic systems by formulating causal or feedback relationships between the elements of the system (Forrester, 1961; Richmond, 1993). System dynamics modeling emphasizes nonlinear causal relationships, indirect causes, simultaneous mutual causation, delayed effects, and causal relationships at an aggregate level and over time. It has been applied to analyze the structure and behaviors of systems in a variety of fields such as environmental changes, corporate planning and policy design, public management and policy, economic behavior, educational problems, and biological and medical modeling, among others.

According to systems dynamics, system behavior results from the effects of both reinforcing and balancing processes. A reinforcing process aims to reinforce some change in the system and is represented as positive feedback. A balancing process is related to negative feedback, which tends to maintain equilibrium in the system. A balancing process may resist needed changes but can provide useful stability. If reinforcement is unchecked by a balancing process, it may eventually lead to collapse. Balancing processes are regarded as goal-seeking behavior—if the current level of the variable of interest is above the goal, then the balancing process pushes its value down, while if the current level is below the goal, the balancing process

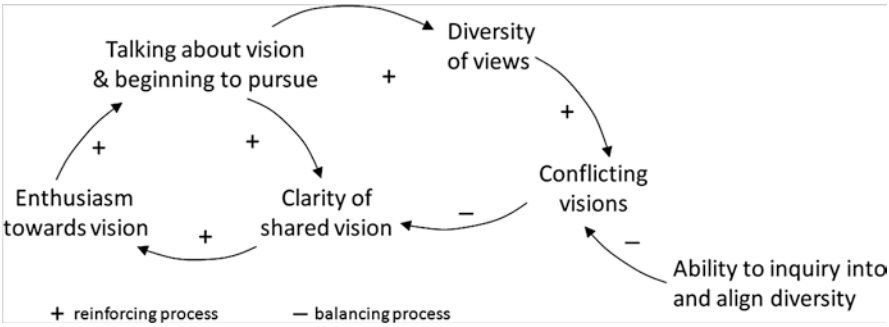

Fig. 6.3 A causal loop diagram about shared vision

pushes its value up. Accordingly, goal seeking is important behavior in complex dynamic systems, which can be associated with goal setting, goal evaluation, goal evolution, and performance measurement (Barlas & Yasarcan, 2006; Forrester, 1961). Moreover, it is important to make the goal explicitly shown along with the "gap" that is driving processes toward the goal.

A combination of reinforcing and balancing processes in the context of shared vision in an organizational system is illustrated in a causal loop diagram (see Fig. 6.3). A causal loop diagram is often used to reveal the structure of a complex system by capturing constituent components and the interactions between the components in feedback loops. As shown in Fig. 6.3, visions spread because of a reinforcing process of increasing clarity, enthusiasm, and communication. As people talk, the vision grows clearer. As it gets clearer, enthusiasm for its benefits builds. Then, the vision starts to spread in a reinforcing spiral of communication and enthusiasm. Meanwhile, as more people involved, the diversity of views dissipates focus and generate conflicts. This is a "balancing process" represented as negative feedback that limits the spread of the visions. In this case, the leverage point is the ability to inquire into diverse visions in such a way that deeper, common vision emerges.

The art of system dynamics lies in helping people to see the big picture or subtle structures of complex dynamic systems and discern leverage points to make actions and changes leading to significant, enduring improvement (Hjorth & Bagheri, 2006; Senge, 1991).

Transforming Workplace Learning Through Systems Approaches

Systems thinking has gained popularity in business settings especially in business management and organizational learning. An organization is regarded as a complex adaptive system composed of many interacting components and interacting with external environment for survival and competition. The notion of organizational learning or learning organization implies that learning in the organizational contexts

should go beyond the individual level, and an organization should be able to learn and adapt to the ever-changing environment.

Peter Senge, founder of the Organizational Learning Center at the Massachusetts Institute of Technology, claimed *systems thinking* to be the capstone for true organizational learning. In his book, *The Fifth Discipline* (Senge, 1991), he lays out five disciplines for building a learning organization: (1) personal mastery, (2) mental models, (3) building a shared vision, (4) team learning, and (5) systems thinking. According to the five disciplines, people in a learning organization are "fully awakened," engaged in their work, striving to reach their potential, and sharing the vision of a worthy goal with team colleagues. They have a clear goal to achieve and a true measure of how close one is to the goal. They have mental models to guide them in the pursuit of personal mastery, and their personal goals are in alignment with the mission of the organization. Consequently, awakened workers understand how to seek enduring solutions to problems instead of quick fixes; they are well-prepared for change and working with others to capitalize on the synergy of the continuous group learning for optimal performance. In this context, working and learning in an organization is far from being a slave to a job; rather, it is seeing one's work as part of a whole, a system where there are interrelationships and processes that depend on each other.

Systems approaches involving systems thinking and systems modeling have the potential to enable the transformation of workplace learning in multiple aspects, including from focusing on specific elements such as technology to discerning interrelationships or underlying structures (e.g., interactions among learner, organization, work tasks, technology, and social context), from delegation to participation, from organizing to self-organizing, from leading and managing to facilitating and empowering, and from discrete to continuous development.

In particular, systems approaches will enable the shift from seeing people as individual passive reactors to seeing them as active participants continuously expanding their capacity to create desired results based on common goals, thereby fostering genuine commitment rather than compliance and acquiescence. Further, it is important to evolve from a traditional model that seeks to optimize specific outcomes to a model that discerns leverage points in mutual causal processes and examines broader questions such as "who we are" and "what we know" to build a deeper, common vision through joint efforts of teams.

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Chapter 7
Understanding Workplace e-Learning as a Complex Dynamic System

Background

Workplaces as learning arenas are different from schools. Much of current e-learning research has been associated with formal courses in educational institutes, where students represent an easily accessible group for research purposes (Moon, Birchall, Williams, & Charalambos, 2005). Although authentic experiential learning has been increasingly promoted in school environments, learning in the classroom tends to be abstract and separated from the context in which knowledge and skills are applied. Workplace learning, on the contrary, is built on practical tasks and work situations with the aim to serve organizational goals. Learning in the workplace takes place in the context of use and application, and the knowledge often remains implicit, embedded in work practices. Learning is also more collaborative in workplace settings, where sharing individual knowledge and experience with co-workers is an important part of the learning process.

In this context, workplace e-learning applications and programs should be designed based on a thorough understanding of learning in organizational environment, which involves individual, social, and organizational perspectives of learning and consists of multiple elements including learners, learning resource and technology, jobs and tasks, organization, and social context. Given individual, social, and organizational dimensions of learning in the workplace as well as multiple elements of workplace e-learning environment, workplace e-learning can be influenced by a variety of factors such as individual motivations and abilities, technology and facilitation for learning, organizational culture, and public policy (Servage, 2005; Smith & Sadler-Smith, 2006).

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Key Elements of Workplace Learning

To have a big picture of complex workplace learning systems, we start from fundamental elements of learning environment. According to Illeris (2003), the foremost element is the learner, which is the chief actor in the learning environment; the other three elements refer to the learning surroundings, including the learning content, social context, and other learning stakeholders such as parents or society. In the workplace setting, the *learner* is an employee in the organization; the *learning content* is the knowledge and expertise required in the workplace; the *social context* considers groups and teams in the workplace; and *other learning stakeholder* is mainly the organization. In addition, workplace learning takes place in work situations, where learning is associated with practical tasks and job performance, as important part of the learning surrounding. Accordingly, the key elements of workplace learning are elaborated in the following.

Learner

Employees are adult learners with distinctive learning characteristics. They are goal-oriented, practical, autonomous, and self-directed (Knowles, Holton, & Swanson, 1998). Employees in an organization have distinct job responsibilities which require different types and levels of expertise. Even assigned with an identical task, employees would have different learning needs and expectancies because of different educational background, working history, and learning abilities. Moreover, individuals differ in personalities, dispositions, and attitudes, which may affect the ways that they perform their duties, handle difficult situations and conflicts, and take advantage of opportunities for learning at work.

A workplace learning system should afford appropriate learning resource and technology with relevant instructions and guidance for learners to develop specific workplace skill. Moreover, the learning system is expected to support self-directed learning by facilitating individual learning process. In doing so, the system may also need to help learners to determine their learning needs and objectives based on personal and organizational development request. Individuals tend to be more motivated to learn with positive emotions and attitude if learning can satisfy their learning needs based on the personal and organizational development request.

Learning Resource and Technology

Learning resource in workplace settings is more contextual, dynamic, and tacit than that in typical school settings, and systematic effort is thus required to manage and maintain the learning resource. First, the learning resource is *contextual* in that most

knowledge in the workplace arises from employees' daily activities and interaction with the working environment and is disseminated within an organization (Raelin, 1998). The workplace learning system should be able to manage (organize, retrieve, publish, and update) different types of learning resource to meet the learning needs. Various learning materials accumulated from work practices and social interactions in the workplace need to be well organized and maintained for continuous learning and improvement. Moreover, the system should also be able to boost learning motivation and potential by providing personalized learning content.

Second, the learning resource is *dynamic* in that employees and organizations have to think new ideas and adjust learning processes to improve the performance. The learning resource is expected to be continuously renovated with changes in learning content and changes from learning needs in the organization's internal and external environments. In addition, given that most knowledge in the workplace remains *tacit* and embedded in routines, the learning system is expected to harvest and manage knowledge assets, especially the tacit knowledge externalized and accumulated from work practices and social interactions.

Learning technology refers to creating, using, and managing appropriate technological processes and resources to facilitate learning and improve performance. In recent decades, emerging technologies have largely expanded learning opportunities by providing learner-centered ubiquitous learning environments, in particular by enabling access to various learning resources, expanding social interactions and communication, fostering experiential learning in authentic situations, offering computer-based assistance, and facilitating high-order thinking. Organizations have been using information and communication technologies in almost every facet of their operations. Learning in the workplace has been shifted from traditional classroom and off-site training to technology-supported and e-learning applications, where computer and network technologies are applied to create and deliver learning environments to facilitate learning and enhance learning performance (Cheng, Wang, Mørch, Chen, Kinshuk, & Spector, 2014; Rosenberg, 2006). More details of these applications can be found in Chap. 3.

Jobs and Tasks

Workplace learning is built on practical tasks and job performance with the aim to serve organizational goals. Different from learning in the classroom or other decontextualized contexts, learning in the workplace is a process of constructing and creating knowledge through the transformation of practical experience. While learning takes place in the context of use and application, the result often remains implicit, embedded in work practices. Learners are therefore encouraged to learn not only by participating in practical tasks but also by making meaningful reflection on the experience to capture tacit knowledge and create new knowledge from practice.

The workplace learning system needs to enable the connection of learning with practical tasks and job performance. The learning process should be facilitated by

making meaning from practical experience for effective construction of new knowledge. Relevant methods or tools (e.g., thing aloud protocol, mental model, cognitive tool) can be incorporated into the system to support effective thinking and communication of complex ideas involved in work practice.

Organization

Different from formal learning in educational institutions, learning in the workplace needs to serve organizational goals and needs and associate with organizational systems (e.g., job system and reward system), structures, policies, and institutional forms of knowledge, in addition to individual needs. Organizations expect individual learning to be transferred back to job and utilization of new skills to enhance organizational performance. Therefore, the workplace learning system should be able to reflect the organization's learning needs, aligned with organizational mission and vision, job design, and reward system.

Moreover, workplace learning is a dynamic process, both influencing and being influenced by the dynamic changes in organizational structures and practices (Bontis, Crossan, & Hulland, 2002). Learning in the workplace should go beyond individual and social levels; an organization should be able to learn and ensure continuous transformation. When the organization rebuilds its organizational structure or redefines job responsibilities, corresponding changes in the learning system should be supported.

Social Context

Workplace learning environment can be regarded as a knowledge society that builds upon communities of practice. Employees bring prior knowledge, skills, and experience with them, which can contribute to their future work and learning. Social interaction and communication between individuals and groups in social networks is important part of learning in the workplace, which allows the creation and transfer of knowledge among individuals and groups and even cross organizations. Knowledge created by individuals can be amplified and crystallized during the process of social interaction within the organization and interaction between the organization and its surroundings (Nonaka & Takeuchi, 1995).

The workplace learning system should be able to provide an environment that makes learning take place through social interactions, communications, and cocreation between individuals or groups in social networks and even cross organizations. Individuals should be supported to have sufficient knowledge of the social learning community by identifying peers and their expertise for more effective knowledge sharing and social networking. They should also be supported to develop their identity in the communities.

A Holistic View of Workplace Learning

Interactions Among the Key Elements

An in-depth understanding of workplace learning requires a holistic view of the above-mentioned key elements and their interactions in the context of workplace learning systems. Such a view is essential to the integration of organizational, social, and pedagogical aspects into the design of e-learning systems and learning programs. As shown in Fig. 7.1, learners in workplace settings should not only interact with learning resource and learning technology but also engage in jobs and tasks and social and organizational contexts, which form a holistic picture of learning in the workplace.

To facilitate the integration of organizational, social, and pedagogical aspects in workplace learning systems, there is a need for building explicit connections among the key elements including learner, learning resource and technology, jobs and tasks, organization, and social context. The design and development of workplace learning programs and applications should consider the alignment of individual and organizational learning needs, the connection between learning and work situations and job performance, the social interaction between individual learners, and the access to various types of learning resource and technology.

First, individual and organizational learning needs should be aligned in the learning system or program. This could be achieved by identifying the learning requirements of an organization based on its mission and vision, job design, and reward mechanism and by helping individuals determine their learning objectives according to both individual and organizational development requirements. *Second*, learning should be directly relevant to work situations and job performance. This could be achieved by organizing learning-by-doing programs and by determining relevant knowledge and skills or core competencies required for a job position in accordance with performance measures. *Third*, social interaction and knowledge transfer in the

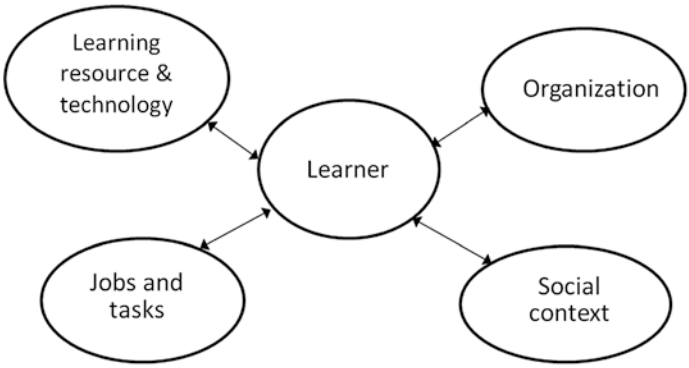

Fig. 7.1 A holistic view of workplace learning

learning community should be encouraged and facilitated. This could be achieved by guiding knowledge sharing and transfer processes and supporting social communications in work context. Fourth, relevant support such as learning resource and technology should be provided for individuals to develop required skills and expertise. Learning resource and technology needs to be organized and managed by linking them to specific knowledge, skills, or expertise.

Integrated Learning in Individual, Social, and Organizational Perspectives

Different from learning in educational institutions, learning in an organization refers to a group of people who decide to enhance their capacity to produce desired outcomes with regard to a shared vision and common interests. The nature of learning in this context therefore involves multiple dimensions: individual, social, and organizational. *First*, learning in workplace settings is featured by self-directed learning process (Knowles, 1975), where individuals learn what is required to perform their job and tasks. It is important to facilitate self-direction and learner autonomy by providing employees with relevant learning resources, expert guidance and feedback, access to peer interaction, and metacognitive strategies on self-reflection and management.

Second, learning in the workplace is considerably associated with social interactive experiences such as teamwork, communication and networking among peers, and mentoring programs, allowing for the transfer and cocreation of knowledge among individuals, groups, organizations, and communities. Knowledge is acquired, shared, and updated during the process of social interaction among individuals and groups within the organization and in external communities (Wenger, 1998). Meanwhile, working and belonging to a workplace community contributes to developing identity of the workers themselves.

Third, workplace learning goes beyond individual and social dimensions in that an organization should be able to learn to ensure continuous transformation in dynamic and competitive environment (Senge, 1991). The goal of learning in workplace settings is to enhance both individual and organizational performance. In addition to individual needs, learning in the workplace needs to serve for organizational goals. Individuals expect the organization to support their learning from basic techniques to high technology and management skills that are applicable to their jobs, duties, and roles. Meanwhile, the organization expects individual learning to be transferred back to job and utilization of new skills to enhance organizational performance (Boud & Garrick, 1999; Craig, 1996). In view of the dynamic and competitive environment, an organization needs to learn by the process of creating, retaining, and transferring knowledge (Argote, 1999; Cyert & March, 1992), in particular by developing and cultivating the channels for knowledge transfer and distribution as well as for the capture and retention of tacit knowledge as intellectual assets for sustainable development and innovation (Wang, 2015).

Understanding Workplace Learning Through Systems Thinking

Workplace learning is regarded as a complex system consisting of multiple stakeholders, interrelated components, and dynamic and nonlinear relationships among the components. Learning in such contexts tends to become increasingly dynamic, complex, and interdependent, especially in technology-enabled environments. To address the challenge of technology domination in workplace e-learning, we need to establish an in-depth understanding of workplace learning through systems thinking.

Systems thinking has profound influence on the way people rethink and restructure business and learning processes (Senge, 1991). People tend to focus on the parts rather than seeing the whole and dynamic processes of complex situations with a long-term view. Systems thinking can shift our minds from seeing parts to seeing wholes, from seeing linear cause-effect chains to seeing nonlinear and cyclical interrelationships, from seeing immediate results to seeing delayed effects, and from seeing obvious and direct causes to seeing invisible and indirect factors. In this way, we will be able to see a big picture or subtle structures of complex workplace learning systems so as to discern leverage points to lead to significant, enduring improvement.

Managing Workplace Learning Through Systems Modeling

While systems thinking enables a shift of our mind in workplace learning, systems modeling methods can facilitate effective management of complex workplace learning systems. According to *activity theory* (Leont'ev, 1978; Nardi, 1996; Vygotsky, 1978), learning is a system of goal-directed action to accomplish the objective through the use of tools, as well as collective and culturally mediated human activity to achieve shared goals through communication, collaboration, and regulation. In addition, learning in the workplace should be built on shared goals among individuals and the organizations.

According to *agent-based modeling* (Bonabeau, 2002; Holland & Miller, 1991; Wooldridge & Jennings, 1995), self-organization rather than traditional hierarchy is encouraged in organizational learning environment. The local interactions of autonomous agents lead to emergent complex phenomena; meanwhile, agents need to connect their individual actions or missions to facilitate the achievement of the collective vision through communication and negotiation.

According to *system dynamics modeling* (Barlas & Yasarcan, 2006; Forrester, 1961; Hjorth & Bagheri, 2006; Richmond, 1993), complex learning systems in workplace settings can be managed by examining nonlinear causal relationships within the system and identifying leverage points that allow people to make actions and changes leading to sustainable improvement. In doing so, dealing with goal dynamics and the associated components such as goal setting, goal evaluation, goal

evolution, and performance measurement will play an important role in managing complex workplace learning systems. For example, the learner should be supported to set learning goals, make effective planning of learning activities, and monitor and evaluate learning process.

Summary

Workplace learning is a complex system consists of many interrelated components interacting in complex dynamic ways. Learners in workplace settings should not only interact with learning resource and learning technology but also engage in jobs and tasks and social and organizational contexts, which form a holistic picture of learning in the workplace. Moreover, it is important to combine organizational, individual, and wider social levels in workplace learning. In addition to the individual level, learning in the workplace should integrate with the context of teams and the wide organization, allowing individual learning to influence practices and changes within that organization. In this way, the organization itself is fostered to learn to ensure continuous transformation in dynamic and competitive environment.

Systems approaches involving systems thinking and systems modeling have shown their potential to transform workplace learning by building a holistic understanding and creating a new, scientifically credible approach to managing e-learning in the workplace. They are essential for thorough understanding and sustainable development of workplace learning as a complex system.

As depicted in Fig. 7.2., in terms of *systems thinking*, e-learning in the workplace is viewed as a complex system, containing multiple stakeholders, many interrelated components, and dynamic and nonlinear relationships among the components. In terms of *systems modeling*, complex workplace learning systems should be managed in such a way that learning is modeled as goal-oriented individual, social, and organizational processes driven by the aligned goals to improve both individual and organizational performance. To align diverse goals of different individuals and the organization, it is important to make effective communication and evolve from a traditional model that seeks to optimize specific outcomes to a model that discerns leverage points in mutual causal processes to achieve persistent improvement.

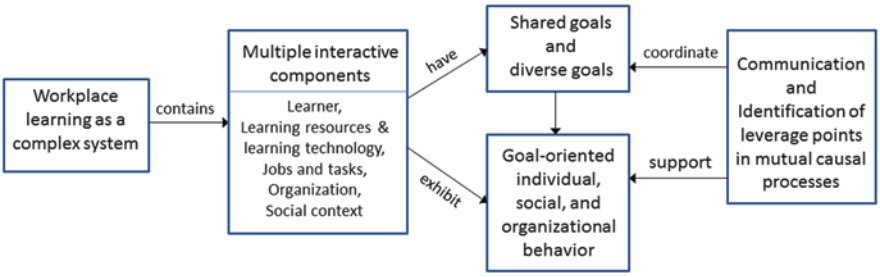

Fig. 7.2 Workplace learning as a goal-oriented complex system

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Chapter 8
Learning Goals and Performance Measurement in the Workplace

Learning, Goal, and Assessment

Learning is fundamentally about changes (e.g., in attitudes, belief, knowledge, abilities, skills, and behavior), especially the changes that tend to persist over time (Spector & Davidsen, 2006). In other words, learning in most situations is a goal-oriented enterprise, involving a goal and a process toward the achievement of that goal. In order to establish that changes have occurred and that goals and objectives have been met, there is clearly a need to conduct relevant assessments. Learning therefore is directed at measurable goals.

The assessment of learning in most situations has focused on the development of knowledge, skills, and attitudes in multiple aspects such as subject knowledge (declarative and procedural); skills for critical thinking, problem-solving, communication and collaboration, and self-regulation; and attitudes and perceptions toward learning and specific issues (Marzano & Pickering, 2001). Assessment is universally recognized as one of the most important elements of an educational experience. It sits at the heart of the learning process, as it provides observable evidence of learning and determines the achievement or performance of the learner. The ultimate purpose of assessment is to inform instruction and guide learning by virtue of formative or qualitative feedback rather than summative scores, so-called formative assessment (Nicol & Macfarlane-Dick, 2006).

Aligning Learning Goals with Assessment

Aligning learning goals and objectives with assessment is central to effective learning. In particular, setting clear and realistic goals and objectives is a prerequisite for successful learning. There has been constant attention to the need for significant

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changes in educational assessment practices, especially in promoting systematic, multidimensional assessment of learning outcomes in alignment with the changing nature of educational goals. For example, Snow (1989) suggested the inclusion of both cognitive and conative aspects in assessing learning and instruction. Schraw and Dennison (1994) emphasized the assessment of metacognitive knowledge and skills with a view to improving learning by promoting learners' metacognitive awareness. Marzano and Pickering (2001) proposed a framework for assessing learning performance or outcomes at five levels including attitudes and perceptions about learning, knowledge acquisition and integration, knowledge refinement and extension, knowledge application, and habits of mind. More recently, twenty-first-century skills have been advocated and discussed to highlight a set of abilities that students need to develop in order to venture successfully into higher education, workplaces, and independent life in the twenty-first century (Bellanca & Brandt, 2010; Salas-Pilco, 2013; Trilling & Fadel, 2009). These discussions have emphasized the development of a set of core competencies in contemporary education such as critical thinking, problem-solving, creativity, collaboration, and information literacy. Based on relevant studies and discussions, Table 8.1 outlines the sophisticated learning goals in multiple dimensions.

The changing nature of educational goals has been reflected in the following aspects:

- *Declarative knowledge* versus *procedural knowledge*. The acquisition of disciplinary knowledge should take into account both declarative knowledge and procedural knowledge. *Declarative knowledge* includes factual knowledge and conceptual knowledge. Factual knowledge includes isolated bits of information, such as terminology and specific details and elements. Conceptual knowledge involves theories, models, structures, principles, and generalizations, which help learners to develop a broad knowledge base in systematic structures or processes. *Procedural knowledge* can be thought of as specific skills, algorithms, heuristics or rules of thumb, techniques, and methods as well as knowledge about when to use these procedures. Procedural knowledge is usually tacit and intertwined with experience but is crucial to scientific inquiry and problem-solving practices.
- *Knowledge* versus *performance*. Knowledge is assumed to be better constructed through the application of knowledge to perform meaningful tasks such as experimental inquiry, problem-solving, investigation, and decision-making. Hence learning in real-world situations, especially through engagement with ill-structured problems and authentic, whole-task experience, has become the central aspect of educational practice. Learners are expected to improve their problem-solving, reasoning, decision-making, and communication skills, as well as consolidate and extend their subject knowledge based on practical experience. In addition to subject knowledge, assessment of learning in such contexts should pay high attention to task performance. Completion of practical tasks has been regarded as an important approach to determining learners' comprehension of relevant subject knowledge (Ausubel, 1961). In contrast to traditional examination-based summative assessment, formative assessment is often used to

Table 8.1 A systematic view of learning goals and assessment

Dimensions of learning goals	Descriptions	Dimension of assessment
Establishing positive attitudes, perceptions, and motivations about learning	A primary focus of effective instruction is establishing positive attitudes and perceptions about learning, without which proficient learning has little chance to occur	Attitude
Acquiring, integrating, and refining knowledge	Acquiring new ideas and integrating them with prior knowledge for retention in long-term memory is an important aspect of learning. In addition, learners should refine their knowledge by such activities as comparing, classifying, synthesizing, making inductions and deductions, analyzing errors, analyzing perspectives, generalizing, and abstracting	Knowledge
Applying knowledge	The most effective learning occurs in using knowledge to perform meaningful tasks such as experimental inquiry, problem-solving, investigation, and decision-making	Skills
Developing skills across disciplinary areas	In addition to discipline-specific knowledge and skills, learners should acquire knowledge and skills across disciplinary areas, such as complex thinking, information processing, effective communication, as well as collaboration and cooperation	
Developing productive habits of mind	Enabling individuals to learn on their own by acquiring strategic knowledge and developing productive mental habits, such as critical thinking, creative thinking, self-management, and learning how to learn, is probably the most important learning goal	Metacognition

assess task performance in a set of dimensions. For example, how a problem-solving task is accomplished by search for relevant information, synthesis of various data, reasoning with interactive components, and formation and revision of hypotheses, in addition to the solution.

- *Disciplinary knowledge* versus *lifelong learning skills and metacognition*. The changing nature of educational goals has reflected the need for acquiring not only the discipline-specific knowledge and skills but also the knowledge and skills across many disciplines and useful to people in many situations during their lifetime. In the context of increased dynamics, learners are expected to improve their competitiveness by developing competencies in critical thinking, problem-solving, creativity, and collaboration. Meanwhile, an important goal of education is to promote and develop self-regulated and lifelong learner by developing learners' ability to reflect upon, understand, and control their learning to adapt to dynamic changes. To develop such abilities, learners need to acquire metacognitive knowledge, which refers to knowledge of thinking processes and approaches to manipulating these processes.

Learning and Assessment in Workplace Settings

Learning in the workplace involves various means, processes, and activities provided for employees to learn from basic techniques to high technology and management skills that are applicable to their jobs, duties, and roles. Assessment or evaluation of the effectiveness of training programs has been regarded as crucial to organizational training and development. However, traditional research and practice has shown a lack of concern, support, and commitment in the assessment and evaluation process. There are few standard evaluation methods and techniques, especially for demonstrating the relation of training to organizational outcomes. Comprehensive evaluation and accountability is seen as the most often ignored part of training and development. As a result, workplace training received an increasing criticism in terms of its relevance to key business processes and outcomes (Burrow & Berardinelli, 2003; Phillips & Phillips, 2016). In recent years, despite the ever-increasing applications of e-learning in the workplace, most of them were found performing inadequately in engaging learners and failing to systematically align the learning with the goal to improve individual and organizational performance (Wang, 2011). In the following sections, we discuss workplace learning as a complex system driven by its goals and relevant performance measures to ensure the achievement of the goals.

Workplace Learning as a Goal-Oriented Complex System

As discussed in previous chapters, learning in the workplace is a complex system, containing multiple stakeholders, many interrelated components, and dynamic and nonlinear relationships among the components. Systems thinking and system modeling theories and approaches have a potential to significantly transform and enhance workplace learning on the basis of relevant theories such as *activity theory*, *agent-based architecture*, *and system dynamics modeling*.

According to *activity theory*, learning in the workplace is a system of goal-directed action and collective activity to achieve shared goals using technology. According to *agent-based architecture*, a complex system is described from the perspective of its constituent units with a focus on autonomous decision-making and adaptation, social communication, as well as global consequences of complex interactions. According to *system dynamics modeling method*, system behavior results from the effects of both reinforcing and balancing processes; thereby it is important to discern leverage points to make actions and changes leading to significant, enduring improvement.

Inherent in these theories is the notion of workplace learning as a goal-oriented complex system. There is clearly a need to conduct relevant evaluation and assessments to ensure the achievement of the goals. Meanwhile, learning in the workplace is driven by the goals of different individuals and the organization, which should be aligned by seeking a shared vision and common interest for sustainable development.

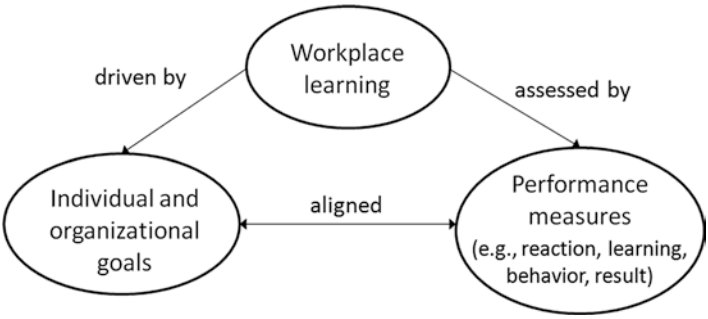

Fig. 8.1 Workplace learning driven by goal-oriented performance measurement

Aligning Goals with Performance Measurement in Workplace Learning

The primary goal of workplace learning is to improve learners' performance in multiple aspects such as knowledge, skills, and attitudes, with a view to improving organizational outcomes reflected in multiple measures such as production, quality, and profits. Performance measurement is used by organizations as a procedure to improve performance by setting performance objectives, assessing performance, collecting and analyzing performance data, and utilizing performance results to drive performance development (Slizyte & Bakanauskiene, 2007). Performance measurement is crucial for organizational development and, therefore, is a main drive for workplace learning, as depicted in Fig. 8.1.

Measurement Models

Kirkpatrick's Model

The most well-known framework for classifying the areas of evaluation comes from Donald Kirkpatrick, who proposed a four-level model to evaluate a training program at four levels: reaction, learning, behavior, and result (Kirkpatrick, 1994; Kirkpatrick & Kirkpatrick, 2006).

- *Reaction* evaluates how participants react to the training program. It is a measure of participants' satisfaction, i.e., what the participants thought of the particular program including materials, instructors, facilities, methodology, etc. The ease of collection of reaction measurements makes them an enticing and, therefore, commonly used measure of training effectiveness.
- *Learning* measures the learner's improved knowledge or enhanced skills by attending the training program. It goes a step beyond reactions by assessing the

objective and quantifiable learning outcomes using multiple methods such as test, skill practices, and job simulations.
- *Behavior* refers to transfer of learning into change of behavior. It measures the learner's change of behavior that is caused by the training program. Favorable reaction and superior achievement in skills do not always result in improved behavior on the job. There are many factors, other than the training program, that can affect on-the-job performance. Evaluation in this category may include before-and-after comparison; observations from the participant's supervisor, subordinates, and peers; and long-range follow-ups.
- *Result* involves organizational and individual outcomes as a result of the training program, such as increased production, improved quality, shortened processing time, decreased costs, reduced turnover, and higher profits. In this evaluation, every effort should be made to isolate other variables which could have caused the changes.

Parker's Model

Another way of classifying the types of evaluation is by Treadway Parker, who divided the information for evaluating a training program into four groups: job performance, group performance, participant satisfaction, and participant knowledge gained (Parker, 1973).

- *Job performance* evaluates the extent to which a training program has contributed to improved job performance of an individual. The evaluation data can come from objective measurements of job performance such as work output, quality, timeliness, and cost savings. Observable changes in on-the-job behavior could be an indication of improved job performance.
- *Group performance* determines the impact of a training program on a group or on the entire organization as a whole. Group performance is difficult to evaluate since many factors besides training can affect the performance of the work group. Types of evaluation data include group performance measures of overall productivity such as output, error rates, costs, and absenteeism.
- *Participant satisfaction* measures how pleased the participants are with the training program, which can be related to the content of the learning program, methods of training, and what has been learned. Questionnaires and interviews can be used to solicit the satisfaction data.
- *Participant knowledge gained* refers to what facts, techniques, and skills are acquired by the participants, which can be assessed by relevant knowledge tests and skill practices.

Jackson and Kulp's Model

Stephanie Jackson and Mary Jo Kulp developed a model to evaluate a training program at four levels: reaction outcomes, capability outcomes, application outcomes, and worth outcomes (Jackson & Kulp, 1979).

- *Reaction outcomes* measure the participants' opinions or acceptance of the training program as a whole or as specific components such as program content, materials, methods, or activities.
- *Capability outcomes* refer to what participants are expected to know, think, do, or produce by the end of the program.
- *Application outcomes* refer to what participants know, think, do, or produce in the real-world settings for which the training program has prepared them.
- *Worth outcomes* determine the extent to which an organization benefits from training in terms of money, time, effort, or resources invested.

CIRO Model

The fourth model proposed by Warr, Bird, and Rackham (1970) evaluates a training program in four categories: *c*ontext evaluation, *i*nput evaluation, *r*eaction evaluation, and *o*utcome evaluation (CIRO).

- *Context evaluation* determines training needs and objectives. It may include ultimate objectives, intermediate objectives, and immediate objectives.
- *Input evaluation* refers to the analysis of available resources with a view to determining how the resources can be deployed to achieve desired objectives.
- *Reaction evaluation* measures the participants' reactions to the training program with a view to improving the training program.
- *Outcome evaluation* determines the results outcomes of a training program. It may include immediate outcomes (e.g., knowledge and skills), intermediate outcomes (e.g., on-the-job behavior), and ultimate outcomes (e.g., organizational performance).

As a summary, the evaluation or assessment strategies should be directed toward important outcomes and processes. According to the literature, most evaluation strategies or performance measures of workplace learning focus on stakeholder perceptions, learning gain, on-the-job performance, and organizational improvement and return on investment (ROI). Among them, learning gain and on-the-job performance are regarded as more critically and directly related to the quality of training program. Measures of improved organizational performance are viewed as more important than individual performance, which, however, can be affected by multiple variables in addition to the effectiveness of training programs. As a result, most training programs are evaluated in terms of how many people have been trained, how they personally reacted to the training program, and how much new knowledge they have gained from the program (Phillips & Phillips, 2016).

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Part III
Methods for Performance-Oriented e-Learning in the Workplace

Chapter 9
A Framework of Performance-Oriented Workplace e-Learning

Establishing Learning on Measurable Performance Goals

Learning in most situations is a goal-oriented enterprise, involving a goal and a process toward the achievement of that goal. With a clear need to conduct relevant assessments to ensure the achievement of the goals, learning is directed at measurable goals. Aligning learning goals and objectives with assessment is therefore central to effective learning. In workplace settings, assessment or evaluation of the effectiveness of learning or training programs has been regarded as crucial to organizational training and development.

Performance measurement is used by organizations as a procedure to improve performance by setting performance objectives, assessing performance, collecting and analyzing performance data, and utilizing performance results to drive performance development (Slizyte & Bakanauskiene, 2007). With respect to workplace learning, the performance measures should focus on important outcomes and processes at multiple levels such as stakeholder perceptions, learning gain, on-the-job performance, and organizational improvement and return on investment (ROI). A four-level model proposed by (Kirkpatrick, 1994; Kirkpatrick & Kirkpatrick, 2006) has been commonly used to evaluate training programs at four levels: reaction, learning, behavior, and result.

However, traditional research and practice on workplace learning have shown a lack of concern, support, and commitment in the assessment and evaluation process. There is a need for more studies investigating how organizational metrics should be refined and connected with training programs, job performance, and overall output. In addition, it is important to take into account a double-loop learning process (Argyris, 1999) in formulating learning goals and setting up performance measures. Rather than sticking with original goals and measures, we should question their underlying policies, assumptions, norms, and purposes, i.e., "changing the rules," with a view to identifying and resolving the root causes resulting in poor performance.

M. Wang, *E-Learning in the Workplace*, Explorations in the Learning Sciences, Instructional Systems and Performance Technologies,
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Aligning Performance Goals at Individual and Organizational Levels

Different from learning in educational institutions, learning in an organization refers to a group of people decide to enhance their capacity to produce desired outcomes with regard to a shared vision and common interests. Learning in workplace settings goes beyond individual and group levels in that an organization should be able to learn to ensure continuous transformation in dynamic and competitive environment. Learning in the workplace therefore needs to serve for individual and organizational goals and needs. Individuals expect the organization to support their learning from basic techniques to high technology and management skills that are applicable to their jobs, duties, and roles. Meanwhile, the organization expects individual learning to be transferred back to job and utilization of new skills to enhance organizational performance (Boud & Garrick, 1999; Craig, 1996). In short, the goal of learning in the workplace is to enhance both individual and organizational performance.

Most workplace learning applications, however, have failed to systematically align the learning with the goal to improve individual and organizational performance, which could hamper both organizational and personal growth (Wang, 2011). Significant gaps exist between corporate interests and learner needs when it comes to training or learning programs (Burrow & Berardinelli, 2003; Moon, Birchall, Williams, & Charalambos, 2005; Servage, 2005; Tynjälä & Häkkinen, 2005). To individuals, although knowledge can be learned by participating in learning programs, more often, individuals do not find it helpful since knowledge learned cannot help improve their work performance; to organizations, training programs are generally designed without meeting organizational vision and mission. Most measures on trainee performance and organizational outcomes have been too different or distant from each other, unable to reflect the organizational changes expected from the planned training.

To address the challenge, it is important to reconceptualize or refine the links between organizational goals, individual requirements, planned training programs, trainee performance, and organizational results. Workplace learning is a complex system of multiple interactions, which can be managed by examining nonlinear causal relationships within the system and by identifying leverage points in mutual causal processes to make actions and changes leading to significant, enduring improvement (Hjorth & Bagheri, 2006). The point is to see the big picture or subtle structures of complex dynamic systems and discern leverage points instead of optimizing specific outcomes.

The alignment of individual and organizational goals in performance measurement to ensure the achievement of the goals is crucial to workplace learning. In doing so, communication and coordination among the members of the organization play an important role in creating a shared vision and common interests toward aligned goals. Shared vision is one of the five disciplines identified by Senge (1991) as necessary to create a learning organization. It gives employees energy and focus and makes them become committed to a long-term view of the organization.

Supporting Performance-Oriented Self-Directed Learning: *Individual Perspective*

Self-directness in learning distinguishes adult learners from children (Knowles, 1975). Adult learning in the workplace is featured by self-directed lifelong learning process. Individuals learn what is required to perform their evolving life tasks, which are also motivated by various internal incentives, such as curiosity, job requirement, self-esteem, desire to achieve, and satisfaction of accomplishment.

Self-directed learners take the initiative to diagnose their learning needs, formulate learning goals, identify resources for learning, select and implement learning strategies, and evaluate learning outcomes. Self-regulation is a kind of metacognitive strategy mainly related to the choice of appropriate learning strategies (Winne, 2001; Zimmerman, 1998). Both self-directed learning and self-regulated learning emphasize intrinsic motivation, goal-oriented behavior, and active engagement.

In workplace settings, it is important to facilitate self-direction and self-regulation or learner autonomy by providing employees with relevant learning resources, expert guidance and feedback, access to peer interaction, and metacognitive strategies on self-reflection and management. Clearly specified measurable performance goals will help employees to identify individual learning needs, plan and implement learning activities, and monitor and evaluate learning processes in performing self-regulated learning. Moreover, adaptive learning technologies and computer-based personalized learning environment have been increasingly used to assist learning by adapting learning content and instructions to individual goals, preferences, and situations (Akbulut & Cardak, 2012).

Promoting Performance-Oriented Social Interaction: *Social Perspective*

Learning is a process occurring in physical and social contexts where knowledge is created and applied. In workplace settings, learning is considerably associated with social interactive experiences such as teamwork, communication and networking among peers, and mentoring programs, which allow the transfer and cocreation of knowledge among individuals, groups, organizations, and communities. Knowledge is acquired, shared, and updated during the process of social interaction among individuals and groups within the organization and in external communities (Wenger, 1998).

Social learning in the workplace has been largely promoted by virtue of information and communication technologies and social media and networking applications (also known as Web 2.0 technologies), which have been increasingly integrated with formal and informal learning activities in the workplace (Wang, 2015b). The new landscape driven by social media and its culture of networking, sharing, and collaboration is fundamentally altering people's relationships and activities with

information and knowledge. Social communication technologies and communities of practice offer more unstructured, self-governing approaches to the creation and transfer of knowledge among employees and the development of new forms of learning communities and networks (García-Peñalvo, Colomo-Palacios, & Lytas, 2012; McAfee, 2009; Seufert, 2012).

Meanwhile, there is some concern that the promotion of social media and communication technologies has led to a plethora of promises by enthusiastic technologists and pedagogues (Aczel, Peake, & Hardy, 2008; Rollett, Lux, Strohmaier, Dosinger, & Tochtermann, 2007). While there is no doubt that the interactive software and Web-based communication tools should be integrated in training and education initiatives, there are arguments on their efficiency and effectiveness. Many of these applications have been developed without taking into account learning strategies and organizational contexts that may affect the essential attributes of social and collaborative behavior. Clearly specified measurable performance goals based on individual needs and organizational goals will allow employees to make their social interactions integrated with their learning practices and serving the organizational goal.

Managing Organizational Knowledge Assets for Sustainable Performance: *Organizational Perspective*

Different from institutional learning programs, learning in workplace contexts is built on practical tasks and work situations, with more attention to intuition or tacit knowledge embedded in everyday practice. Most knowledge in an organization is tacit and located not only in individuals but also in organizational culture, business processes, routines, and networks (Marr, Schiuma, & Neely, 2004). Employees are expected to engage in knowledge management practice, i.e., capture and transfer tacit knowledge, contribute to the creation of new knowledge, develop and cultivate the channels for knowledge transfer and distribution, as well as retain and manage knowledge as intellectual assets for sustainable development and innovation (Wang, 2015a). The notion of intellectual assets highlights intangible capital such as those represented by competences of employees; internal structure, procedures, and routines of the organization; and the relationships that the company undertakes with customers and other stakeholders (Marr, Schiuma, & Neely, 2004). Clearly specified measurable performance goals based on individual needs and organizational goals will help organizations to capture and manage useful or relevant knowledge assets for continuous and sustainable improvement.

Learning and knowledge management share a common strategy of creating a learning organization, which implies that learning in organizational contexts should go beyond the individual level and an organization should be able to learn and adapt to the environment. The integration of workplace learning and knowledge management has been increasingly promoted in organizational environments to enable the strategy of creating a learning organization in the knowledge economy (e.g., Lytras,

Naeve, & Pouloudi, 2005; Marshall, Zhang, Chen, Lally, Shen, Fox, & Cassel, 2003; Sampson & Zervas, 2013; Schmidt, 2005; Wang & Yang, 2009; Wild, Griggs, & Downing, 2002). How such integration can be implemented and affect organizational development and performance is a complicated yet important question that requires a variety of conceptual, methodological, and technical approaches (Cheng, Wang, Mørch, Chen, Kinshuk, & Spector, 2014). Substantial research is needed to explore how organizational systems, structures, and policies can be incorporated into workplace learning applications to create a coherent and manageable system for both individual and organizational learning.

A Framework of Performance-Oriented Learning in the Workplace

Based on the conceptualization of workplace learning as a complex system of individual, social, and organizational processes driven by the goals to improve both individual and organizational performance, we have proposed a performance-oriented framework of workplace learning (Ran, Wang, & Law, 2008; Wang, 2011; Wang, Ran, Liao & Yang, 2010). As outlined in Fig. 9.1, the framework involves (1) establishing learning on measurable performance goals, (2) aligning individual and organizational performance goals, (3) supporting performance-oriented self-directed learning process, (4) promoting performance-oriented social interaction, and (5) managing organizational knowledge assets for sustainable performance.

Workplace learning is a complex system containing multiple stakeholders, many interrelated components, and dynamic and nonlinear relationships among the components. System thinking and system modeling theories and approaches provide a potential to transform and enhance workplace learning. According to these theories, workplace learning should be managed in such a way that learning is modeled as goal-oriented individual, social, and organizational processes driven by clear and measurable goals shared by different individuals and the organization. In doing so, it is important to make the goals explicitly specified with clarity in measurement and make individual and organizational goals aligned in performance measures. Clearly specified measurable performance goals based on individual needs and organizational goals are then used to guide and facilitate self-directed individual learning, social interaction and networking, and organizational knowledge assets management.

Competency-Based Learning

Performance-oriented learning is directly related to competency-based learning, which focuses learning on the development of critical competencies needed to perform specific jobs or tasks (Garavan & McGuire, 2001). As a mode of discourse

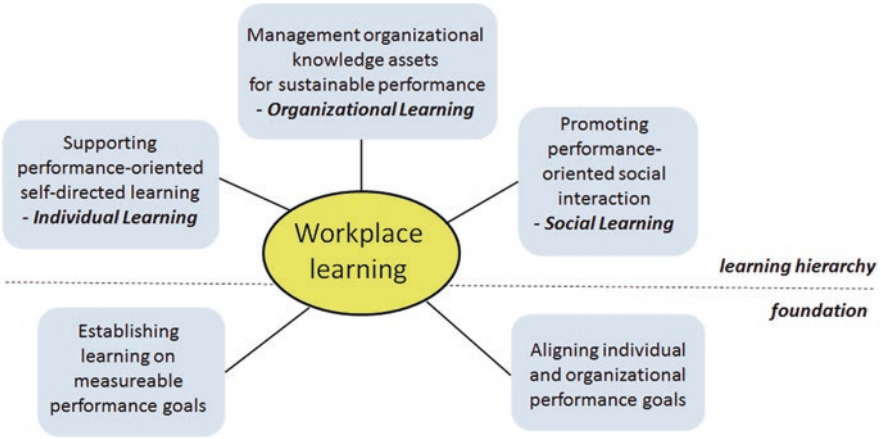

Fig. 9.1 A framework of performance-oriented learning in the workplace

between education and the labor market, competency is perceived as both knowledge specific and task specific and evolves through interplay between both execution and knowledge acquisition. A competency is a combination of skills, abilities, and knowledge needed to perform a specific task. In the vocational education and training literature, competency-based training can be referred to as "competency movement" (Burgoyne, 1993; Rubin, Bebeau, Leigh, Lichtenberg, Nelson, Portnoy, Smith, & Kaslow, 2007), whereby learning is driven by development of specific competencies for dealing with needs and challenges (Ricciardi, 2005).

It is important for organizations to implement a competency-based approach to workplace learning and human resources development to enhance the competencies of employees to respond quickly and flexibly to business needs (Klett, 2010). Competency-based training has been widely used by organizations to drive workplace learning initiatives to enable employees to respond quickly and flexibly to business needs. Such practices can be found in management education (Camuffo & Gerli, 2004), medical education (Folberg, Antonioli, & Alexander, 2002; Long, 2000), and other professional training and education programs (Chang, 2006). Such practice exists not only in organizations but also in higher educational institutions (Barth, Godemann, Rieckmann, & Stoltenberg, 2007; Sicilia & Naeve, 2007), though there is a lack of a precise or widely accepted definition of competency in the literature.

In recent years, researchers have made attempts to integrate competency-based models into e-learning programs to allow employees to develop competencies with a broad degree of self-regulation and self-control (Sicilia & Naeve, 2007). Leyking, Chikova, and Loos (2007) present an approach for aligning a competency-driven learning process with business process contexts via e-learning technology. Wang et al. (2010) propose the use of key performance indicators (KPIs) as a framework to link learning with work competencies and performance in e-learning applications. In addition, ontology-based technology and competency modeling approach

have been integrated to support the development of context-aware workplace e-learning (Ley & Albert, 2003; Ley, Ulbrich, Scheir, Lindstaedt, Kump, & Albert, 2008; Schmidt, 2008).

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Chapter 10
A KPI-Based Approach to Performance-Oriented Workplace e-Learning

Key Performance Indicator (KPI)

Performance measurement is used by organizations as a procedure to improve performance by setting performance objectives, assessing performance, collecting and analyzing performance data, and utilizing performance results to drive performance development (Chan & Chan, 2004; Slizyte & Bakanauskiene, 2007). In education, key performance and quality indicators have been raised to guide teaching and learning development to make institutional practice aligned with objectives and strategic plans of high education (Taylor, 2001). Key performance indicator (KPI), also known as key success indicator, is a flexible and popular approach for conducting performance measurement in organizations (Baker, 1995; Parmenter, 2010). KPIs represent a set of measures focusing on those aspects of organizational performance that are most critical for the success of the organization. KPIs are quantifiable measurements, which reflect the critical factors for success at different level such as organizational level, unit level, and position level.

In this way, the use of KPI is to connect an organization's mission and vision with quantifiable measurements. A vision statement outlines what will be achieved if the organization is successful; a mission statement describes what the organization wants to do now. By intrinsically linking to an organization's strategic goals, KPIs help managers and employees gauge the effectiveness of various functions and processes important to achieving organizational goals. Meanwhile, it is important to market the KPI system to all employees within the organization by showing how KPIs contribute to the broad change strategy, convincing employees of the need for change with open and honest information sharing, and addressing employee resistance to change and to performance measurement (Parmenter, 2010).

KPIs have special meaning to workplace learning. *First*, KPIs promote performance-oriented learning by setting performance objectives, collecting and analyzing performance data, and utilizing performance results to drive learning and

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development. *Second*, by setting up KPIs at multiple levels (organizational, unit, and individual), KPIs help align the goals of improving both individual and organizational performance. Organizational goals can be interpreted into clearly defined key performance targets for each business unit; according to unit goals and objectives, official expertise and capabilities required for each position in the unit can be defined. *Third*, KPIs help integrate workplace learning with organizational strategy, structure, and systems (e.g., job system and reward system) in a holistic and systematic way for sustainable development.

KPI Model

A KPI model can be designed based on an organization's structure and job system (Baker, 1995). It consists of three levels: organizational level, business unit level, and position level. KPIs on the organizational level are defined according to business goals and strategies of the organization. Derived from the organizational KPIs, the unit KPIs for each business unit can be specified. Based on the unit KPIs, the KPIs for each job position within the unit are defined. The KPI for a position can be further broken down into a set of KPI items that measure the performance of employees at that position. In this way, the use of KPI is to connect an organization's mission and vision with its employees' performance targets and help employees set up rational learning goals based on their performance gap.

In developing training or learning programs for employees, the focus is placed on KPIs at the position level. *A KPI item* at a position level is a performance indicator specified for a job position. For example, "project completion rate" and "project quality" can be defined as two KPI items for the project manager position. As shown in Table 10.1, for each KPI item, a *rating criterion* is set up to assess the performance of that KPI item. For each KPI item, the proficiency level achieved by an employee

Table 10.1 An example of KPI item

Position	Project manager
KPI item	Project completion rate
Description	The project tasks actually completed divided by the portion expected to be completed at the kickoff meeting
Rating criterion	(1) Calculate the completion rate of each project that the employee is responsible for during the period of performance review; (2) multiply the result of the first step by corresponding project-weight-number; (3) divide the sum of the result obtained from the second step by the number of projects that the employee is responsible for during the period of performance review
Assessment method	The project auditor records progress and details of all projects and calculates the project completion rate for relevant employees. The project-weight-number is assigned to each project considering its scope and difficulty by project committee
KPI value	For example (80%*1 + 100%*0.9)/2 = 85%
KPI target	70%

is called a *KPI value*. An expected KPI value is called *KPI target*. An employee's performance can be reflected by a set of KPI values of his/her job position. For impartiality and objectivity reasons, most organizations use 360 degree feedback to assess employees' performance. An employee's performance can be assessed by performance records from daily work as well as by peer evaluation from the employee him/herself, his/her supervisor, and his/her subordinate or peers. Each appraisal is given a certain weight. As a result, a set of KPI values will be calculated to evaluate the employee's work performance.

While the KPI model is often set up according to the organizational strategy, structure, and systems, it is important to align the goals and reach consensus among business executives, human resource managers, training managers, domain experts, and employees on the KPI model through intensive collaboration and communication.

KPI-Based Learning Ontology

To make the KPI-based model operable in a workplace learning system, KPI-based learning ontology needs to be constructed to explicitly conceptualize a set of key elements and their relationships in the KPI-based learning environment. Ontology is a formal representation of a set of concepts within a domain and the relationships between those concepts. It defines the basic terms and relations comprising the vocabulary of a topic area as well as the rules for combining terms and relations to define extensions to the vocabulary (Gruber, 1993; Neches et al., 1991). In computer-based learning environment, ontology provides mechanisms for semantic annotation of learning resources and activities, reuse and combining of course materials, and enabling better searching and navigation (Knight, Gašević, & Richards, 2006; Sampson, Lytras, Wagner, & Diaz, 2004). Moreover, learning materials annotated with semantic tags enable a computer-based learning system to reason about learning content and organize it into a customized syllabus according to individual learning needs (Gladun, Rogushina, García-Sánchez, Martínez-Béjar, & Fernández-Breis, 2009). In this way, ontology can be used to design the semantic infrastructures of learning objects, model personalized learning environments, and facilitate adaptive learning via reasoning in multiple contexts.

The KPI-based learning ontology represents a semantically structured knowledge space, which plays an important role in guiding individual learning and managing learning content and knowledge assets. The KPI-based learning ontology involves four concepts: position, KPI item, competency, and learning component. As outlined in Fig. 10.1, an employee at a *position* is assessed by a set of *KPI items* required by the organization; to improve the performance relevant to a specific *KPI item*, the employee needs to develop relevant *competencies*; to develop the competency, the employee needs to learn relevant *knowledge and skills*, which can be acquired from learning materials, learning activities, and training programs. In short, one position is linked with one or more KPI items; one KPI item is linked with one or more competencies; one competency is linked with one or more sets of knowledge and skills.

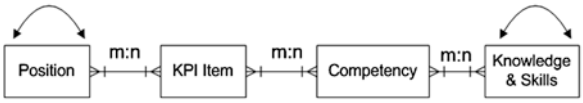

Fig. 10.1. KPI-based learning ontology

Table 10.2. Relationships between the concepts in the KPI-based learning ontology

Relation	Description
Position—position	A position is prior to another position
Position—KPI item	A position has one or more KPI items
KPI item—competency	To improve the performance relevant to a KPI item, one or more competencies need to be developed
Competency—knowledge and skills (KS)	To develop a competency, one more set of KS is required
KS—KS	One set of KS is a part of another set of KS
KS—KS	One set of KS is prerequisite to another set of KS
KS—KS	If one set of KS is acquired, then another set of KS is unnecessary to acquire and vice versa

In addition, recursive relationships between different positions and different knowledge and skills need to be specified. For example, a position (e.g., junior tester) can be a prior of another position (e.g., senior tester); one set of knowledge and skills can be linked to another set of knowledge and skills based on relations such as "part of," "sequential," and "inhibitor." These relationships are described in Table 10.2.

An underlying theory of the KPI-based learning ontology is competency-based learning, which focuses learning on the development of critical competencies needed to perform specific jobs or tasks (Garavan & McGuire, 2001). Competency is perceived as both knowledge specific and task specific, which evolves through interplay between both execution and knowledge acquisition. As a mode of discourse between education and the labor market, competency-based learning is critical to workplace learning and human resources development in enhancing the capabilities and performance of employees to respond quickly and flexibly to business needs (Klett, 2010).

KPI-Based Approach to Performance-Oriented Learning

The establishment of the KPI model and KPI-based learning ontology helps employees to make sense of their work context and required expertise and accordingly help them to set up rational learning objectives, manage individual and social learning processes, and finally improve their work performance and organizational outcomes.

In the following, we elaborate a KPI-based approach to performance-oriented learning in the workplace at three levels: individual, social group, and organization

(Wang, 2011; Wang, Vogel, & Ran, 2011). With respect to *individual learning*, KPIs help individuals make sense of work context and performance requirement and accordingly set up rational learning objectives to develop relevant knowledge and skills and improve work performance. In terms of *social learning*, KPIs assist employees to learn from the peers and experts of relevant expertise based on their KPI profiles, making socially constructed informal learning and knowledge-sharing practices more driven by the goal to improve work performance and job expertise. In terms of *organizational learning*, KPIs help the organization to clarify its performance goals, develop relevant training programs, manage learning resources, and harness knowledge assets in the organization.

KPI-Based Self-Directed Individual Learning

Each employee is required to meet some KPI target in assessing his or her job performance. Therefore, KPI targets at the position level can be regarded as the individual learning objectives, based on which employees' performance gaps and deficits in knowledge and skills can be determined by relevant assessments and tests, in addition to personalized instructions to be provided to facilitate individual learning. Furthermore, a personalized learning syllabus or learning plan can be generated to guide the employee's learning process. According to the learning syllabus, related learning content, learning activities, and training programs can be recommended to the employee.

KPI-Based Social Learning

In addition to individual learning, the KPI model is expected to facilitate social learning through communication and interactions among employees. Employees are expected to engage in teamwork and social interactions while performing collaborative tasks, sharing experiences, discussing problems, and conducting peer evaluation of work performance. Using the KPI model, each employee is provided with a KPI profile including a set of KPI values that indicate his/her expertise and proficiency level. Accordingly, peer learning and knowledge cocreation through collaborative and social activities can be improved by using the KPI profiles to reflect individual work context and expertise. Based on individual KPI profiles, employees are able to know about each other based on their expertise and performance reflected in the KPI values. The KPI profiles help individuals to find peers of similar interests or background and locate experts according to their expertise and performance. Moreover, the KPI model helps to link social communication or discussion with workplace expertise, making social learning more effective and goal oriented.

KPI-Based Knowledge Management for Organizational Learning

In addition to explicit knowledge documented in various learning materials, learning in the workplace gives high attention to intuition or tacit knowledge that is difficult to articulate and codify. Such tacit knowledge is often located not only in individuals but also in organizational culture, business processes, routines, and networks (Marr, Schiuma, & Neely, 2004). The competencies and expertise of employees, especially of those experts, are regarded as important part of tacit knowledge in the workplace. Employees in the workplace are expected to engage in knowledge management practices by capturing and transferring tacit knowledge, cocreating new knowledge, and maintaining knowledge assets for sustainable development (Wang, 2015). The KPI model can help manage and harness such knowledge assets by organizing both explicit and tacit knowledge in line with work context and performance requirement.

Summary

As shown in Fig. 10.2, KPI is used as a systematic scheme to drive self-directed, organization-based, and socially constructed learning activities via the integration of individual needs, organizational objectives, and social context of learning in the workplace.

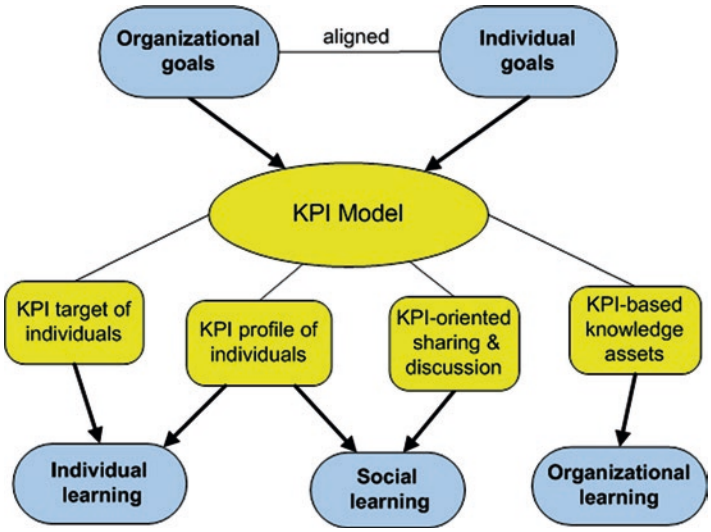

Fig. 10.2 A KPI-based approach to performance-oriented learning

In particular, the KPI model is set up to interpret organizational mission and vision into clearly defined and accomplishable goals for employees and link the goals with the competencies and expertise to be developed by individuals. Further, the KPI-based learning ontology facilitates individual learning by showing a clear picture for each individual in the organization about what is important and what they need to learn to fill the performance gaps. Moreover, the KPI model supports social learning by using KPI profiles to identify each individual's work context and expertise with a view to making social communication and interactions more goal oriented. In addition, the KPI model fosters organizational learning by clarifying organizational goals and training programs and using the KPI-based structure to manage organizational knowledge assets including both learning materials and intellectual assets in a systematic way for long-term development.

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Part IV
A Case Study

Chapter 11
A Case Study of KPI-Based Workplace e-Learning

Background of the Company

The company Peanut Software sells and markets technology products including consumer electronics, computing and communication devices, and software. There are three departments in the company, Front Office, Research & Development, and Back Office, as shown in Fig. 11.1. The Front Office includes three units: sales, customer service, and consulting. The Research & Development department consists of two units: development and testing.

In the software industry, knowledge renewal accelerates technological innovations at an incredible pace. Knowledge quickly becomes obsolete as a result of the shortened product lifespan. While companies struggle to keep employees knowledgeable about new technologies in increasingly complex and competitive marketplaces, training and development have to keep up-to-date with the rapidly changing environment. In this context, how to conduct learning and training programs in an effective way has become one of the most significant issues for software companies including the company selected for this case study.

Learning Requirement

The case study has focused on the Testing Unit. Testing is an important and mandatory part of software development, essential for evaluating the quality of software products by identifying defects and problems. Therefore, training and development of employees in the Testing Unit is essential for organizational operation and advancement of this company. According to the IEEE Standards Coordinating Committee (1990), "software engineering means application of a systematic, disciplined, and quantifiable approach to development, operation and maintenance of

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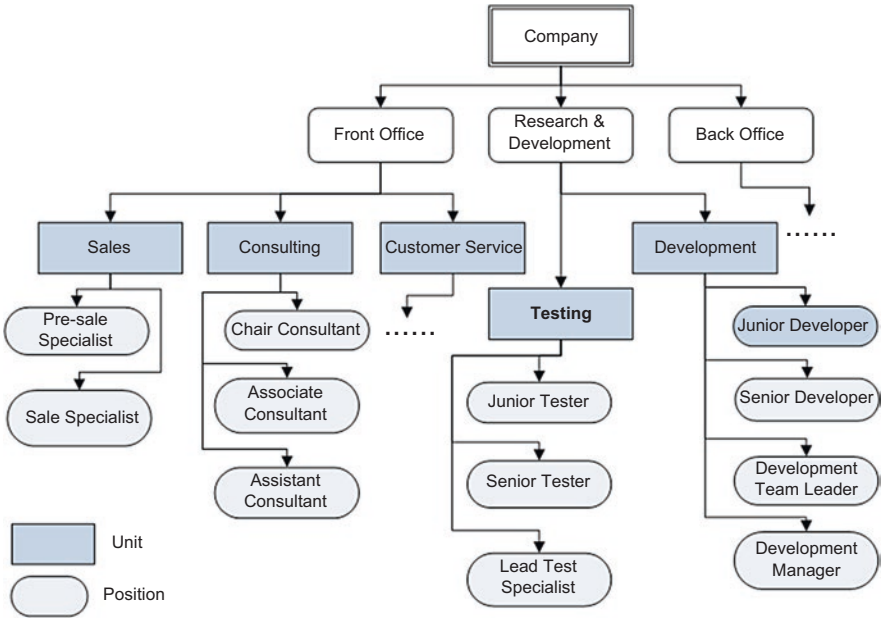

Fig. 11.1 Organizational structure

software." Software engineering education not only concerns software design methods and programming languages but also involves elements such as requirements engineering, software testing, and software quality.

While there is an increased demand for software testing skills in the software industry, there is a dearth of professionals in this field. Universities and schools provide very few courses relevant to software testing, as this subject requires more professional experience. As a result, onsite training programs have become the main channel to acquire the skills of software testing. However, traditional onsite training models often draw on limited resources that are insufficient to support current training efforts. Widely distributed employees need to learn according to their own schedules; traditional onsite training programs face time and space constraints in developing employees' knowledge and skills. Also, the cost of traditional onsite training is too high, especially for small- and medium-sized companies. To deal with the problem, IT companies have started to adopt Web-based training or learning facilities as an important supplement to traditional training models. Web-based learning or training provides a variety of opportunities and benefits including (a) providing just-in-time learning, convenient access, and flexible learning processes, (b) enabling real-time updating of learning content, and (c) facilitating the interconnectivity of people separated by times zones and organizational walls (Ozdemir & Abrevaya, 2007; Rosenberg, 2006).

KPI-Based Approach to Performance-Oriented Learning

Although training in IT and software companies has expanded and developed substantially in recent years, Web-based learning is still at the exploration stage. In this case study, a KPI-based workplace e-learning program is developed for the Testing Unit of the selected software company. In particular, a KPI-based workplace learning system is developed, and relevant experiments are conducted to evaluate the effectiveness of the proposed approach and the developed system (Wang, 2011; Wang, Jia, Sugumaran, Ran, & Liao, 2011). The key idea is to use key performance measures to clarify organizational goals and individual learning needs and integrate them in Web-based learning applications.

The aim of the workplace learning program developed in the case study is to deliver basic knowledge, essential principles and processes, and advanced skills and techniques required for professional software testers. The content covers fundamentals of testing, static techniques, test design, test management, test tools, test approaches and strategies, and so on. The learners selected for the course should have prerequisite knowledge including software engineering, software design methods, and programming languages. After completing this learning program, learners should be able to define the mission of software testing for specific products, acquire the knowledge and skills for various testing types, analyze and report software defects effectively, and assess and report the extent of software testing.

In addition to performance-oriented learning at the individual level, the KPI-based approach supports performance-oriented learning at social and organizational levels. In terms of *social learning*, KPIs assist employees to learn from the peers and experts of relevant expertise based on their KPI profiles, making socially constructed informal learning and knowledge sharing practices more driven by the goal to improve work performance and job expertise. In terms of *organizational learning*, KPIs help the organization to clarify its performance goals, develop relevant training programs, manage learning resources, and harness knowledge assets in the organization.

KPI Model and KPI-Based Learning Ontology

Using the proposed KPI-based approach to workplace learning, a Web-based learning system has been developed for the software testing sector, that is, the system development is customized to the profession of software testing. In doing so, a KPI model is used to identify the KPI items of software testing positions in the software company; ontology technology is employed to conceptualize the KPI model into a machine-readable format in developing the learning system.

KPI is used as an index to direct learning targets and activities and organize and manage learning resources in line with the work context. The KPI model in this study is designed according to the company's organizational structure, job system,

Table 11.1 KPI model cross organizational, business unit, and position levels

KPIs at the organizational level	KPIs at the business unit level	KPIs at the position level
Productivity Quality Organizational capacity Construction	*KPIs for the testing unit:* Bug found Bug returned Artifacts reused	*KPIs for junior tester:* Bug found rate Bug report rework rate
		KPIs for senior tester: Test coverage Reusable test case rate
		KPIs for lead test specialist: Schedule achievement rate Budget achievement rate Deviate rate
	KPIs for other units: ……	……

and performance indicators. The design of the KPI model and the KPI-based learning ontology for the testing positions is based on intensive communication with the stakeholders, i.e., software testers, the manager of the Testing Unit, the manager of the training sector, and executives in the company. In the meantime, the design of the KPI model and the KPI-based learning ontology is based on the IEEE standards for software testing introduced in Bertolino (2001), the knowledge of domain experts, and the cooperation between business executives, human resource managers, training managers, domain experts, and employees.

The KPI model consists of three levels, organizational level, business unit level, and position level, as shown in Table 11.1. KPIs on the organizational level are defined according to business goals and strategies of the organization. Derived from the organizational KPIs, the unit KPIs for each business unit can be specified. Based on the unit KPIs, the KPIs for each job position within the unit are defined. The KPI for a position can be further broken down into a set of KPI items that measure the performance of employees at that position.

As shown in Table 11.1, the company defines "productivity," "quality," and "organizational capacity construction" as its KPIs at the organizational level. For the Testing Unit in this company, its chief function is to find bugs in software products. Therefore, "bug found" is specified as one unit KPI in line with productivity, "bug returned" as another unit KPI to improve "quality," and "artifacts reused" in line with "organizational capacity construction." Based on these unit KPIs, the KPIs at the position level of the Testing Unit are defined accordingly.

An example of a KPI item at the position level is partially presented in Table 11.2. In the table, "bug found rate" is defined as a KPI item for the junior software tester position. Rating criteria and assessment methods are set up to assess the performance of that KPI item. For impartiality and objectivity reasons, 360 degree feedback is used to assess employees' performance. An employee's performance is assessed by his/her performance records from daily work as well as by the evaluation from his/her peers and supervisor. Each appraisal is given a certain weight. As a result, the KPI value is calculated to evaluate the employee's work performance.

Table 11.2 A KPI item at the position level

Position	Junior tester
KPI item	Bug found rate
Description	The number of bugs found before delivering divided by the total number of bugs including those found before and others returned from the customers
Rating criterion	Calculate the sum of (a) performance record (weight: 1/3), (b) peer assessment (weight: 1/3), and (c) supervisor assessment (weight: 1/3). Details: (a) is the number of bugs found before delivering divided by the total number of bugs; (b) and (c) are assessed based on the levels and criteria defined in the following. Level 1, score [0, 0.25): has little knowledge/skill for debugging Level 2, score [0.25, 0.5): has basic knowledge/skill for debugging Level 3, score [0.5, 0.75): use related knowledge/skill to accomplish tasks Level 4, score [0.75, 1.0]: use related knowledge/skill to achieve sound effect
Assessment method	The project auditor makes the performance records and collects the evaluation comments from the peers and supervisor of the employee
KPI value	e.g., 0.72*(1/3) + 0.7*(1/3) + 0.75*(1/3) = 0.72
KPI target	70%

The KPI-based learning ontology involves four concepts: position, KPI item, competency, and knowledge and skills. One position is linked with one or more KPI items; one KPI item is linked with one or more competencies; one competency is linked with one or more sets of knowledge and skills. In addition, recursive relationships between different positions and different knowledge and skills are specified. For example, a position (e.g., junior tester) can be a prior of another position (e.g., senior tester); one set of knowledge and skills can be linked to another set of knowledge and skills based on relations such as "part of," "sequential," and "inhibitor."

KPI-Based Workplace Learning System

Using the proposed KPI-based approach, a Web-based learning system has been developed for the software testing sector. The details of the system architecture, the KPI-based learning ontology implemented in this case, the KPI-based learning process, and the system customized to the profession of software testing are elaborated in next chapter.

Evaluation of the KPI-Based Workplace Learning

The evaluation has focused on the effectiveness of the proposed KPI-based learning approach as demonstrated in the developed system. Therefore, we used experimental and comparative analysis for evaluation of this study. Experiments were

conducted to compare the developed KPI-oriented e-learning system with another traditional e-learning system without KPI support. Two parallel prototypes were used for evaluation—the KPI-oriented learning system (System A) and another traditional e-learning system without KPI support (System B). System B has similar functions to System A in terms of user management, learning resources, assessment management, and communication tools but without KPI-oriented facilities. The interfaces of the two systems are also similar to ensure that no design-related factors other than the KPI-oriented facilities affect usage and perception of the systems.

Measures and Instruments

In this study, the evaluation examines the effectiveness of an e-learning system developed for a workplace setting, which is different from other e-learning systems developed for educational institutions. Therefore, Donald Kirkpatrick's model (Kirkpatrick, 1994; Kirkpatrick & Kirkpatrick, 2006) was utilized, which evaluates training programs at four levels: reaction, learning, behavior, and result.

- *Reaction* evaluates how participants react to the training program. It is a measure of participants' satisfaction, i.e., what the participants thought of the particular program including materials, instructors, facilities, methodology, etc. The ease of collection of reaction measurements makes them an enticing and, therefore, commonly used measure of training effectiveness.
- *Learning* measures the learner's improved knowledge or enhanced skills by attending the training program. It goes a step beyond reactions by assessing the objective and quantifiable learning outcomes using multiple methods such as test, skill practices, and job simulations.
- *Behavior* refers to transfer of learning into change of behavior. It measures the learner's change of behavior that is caused by the training program. Favorable reaction and superior achievement in skills do not always result in improved behavior on the job. There are many factors, other than the training program, that can affect on-the-job performance. Evaluation in this category may include before-and-after comparison; observations from the participant's supervisor, subordinates, and peers; and long-range follow-ups.
- *Result* involves organizational and individual outcomes as a result of the training program, such as increased production, improved quality, shortened processing time, decreased costs, reduced turnover, and higher profits. In this evaluation, every effort should be made to isolate other variables which could have caused the changes.

As mentioned, the KPI-oriented prototype system was developed for the Testing Unit of Peanut Software. Twenty-four employees associated with the Testing Unit participated in the experiments and evaluation. In view of the tight schedules of the employees and the company on this project, the evaluation has focused primarily on users' perception toward the system based on their intensive use of the system during the experiment period, and learning outcomes reflected in knowledge and

skill tests administered before and after the learning program. Research has found (Sitzmann, Brown, Casper, Ely, & Zimmerman, 2008) that learner reaction has a large impact on learning in technology-mediated learning environments. While employees may continue to use the system after the experiments, it takes a longer period of time to ascertain the effect of the system on learners' behavioral change and work performance, as well as the benefits of the system to the company.

Given that the participants of the experiments are limited to a limited number of employees associated with the Testing Unit of the company, the findings from questionnaires might be limited. Interviews were therefore arranged for qualitative and interpretive analysis. The findings from the interviews could help to understand the rich phenomena emerging from the interaction of people, organizations, and technology around the learning system. Moreover, considering the limited number of participants and their individual differences in evaluating the two systems, a supplemental experiment was arranged by swapping the systems between the two groups of participants and asking them to give their preference.

Questionnaires, interviews, and tests were used for data collection and evaluation. The data collected include participants' perception data obtained through questionnaires and interviews, as well as learning outcome-related data obtained through pretests and posttests. The evacuation framework is outlined in Table 11.3. Questionnaire items were developed based mainly on the Kirkpatrick's model. The participants' response to each item in the questionnaire was measured on a Likert scale (from 1 strongly disagree to 7 strongly agree). Pretest and posttest questions were designed based on certification examinations in the software testing profession and adjusted by the domain experts.

Participants

Twenty-four employees who were currently working or had previously worked with the Testing Unit of the company participated in the experiments and evaluation. Some of them were involved in the early stage of this project, providing suggestions

Table 11.3 Evaluation framework

Level	Items
Reaction	The system is able to meet my learning requirement
	The system provides satisfactory functionalities for learning
Learning	The system helps me improve my knowledge and skills
	(Pretest score and posttest score)
Behavior	The system helps me integrate learning with my work practice
	The system supports my social learning with others
Result	The system helps improve my work performance
	The company is able to get benefits from using this system for training

on system design. The participants were divided into 2 groups of 12—the treatment group that used the KPI-based system and the control group that used the traditional system. There was no significant difference between the treatment group and the control group in software industry work experience and the number of e-learning systems used before. In terms of the length of work experience in software profession, 58.8% of the participants had worked for less than 5 years, and 35.3% for 5–10 years. In terms of e-learning experience, 29.4% of the participants had used one system, 5.9% had used more than three, and 29.4% had used none.

Procedure

Due to the tight schedule of the participants involved in this project, the time arranged for the participants for their intensive use of the systems was limited to 4 weeks for the main experiment and 2 weeks for the supplemental experiment, in addition to another 2 weeks for pretest, posttest, surveys, and interviews. Before this, several months were spent on communication and discussion with the participants for analysis of user requirements in system design and development.

The evaluation process can be divided into four stages. *First*, all the participants finished the pretest. *Second*, after using the system for 4 weeks, participants completed the posttest and the main questionnaire for evaluation of the system on reaction, learning, behavior, and result levels. *Third*, the two groups were asked to swap systems and use the systems for 2 weeks; at the end of the stage, the supplemental questionnaire was used to determine participants' preference toward the two systems concerning all the aspects of the system. *Finally*, interviews were conducted for qualitative feedback from the participants.

Findings from the Surveys and Tests

The results obtained from the main experiment are shown in Fig. 11.2. It was found that the KPI-based system was perceived to be more effective in terms of meeting individual learning requirement and functional support for learning (reaction); the KPI-based system was perceived to be more helpful to learners in obtaining knowledge and skill (learning); the KPI-oriented system was perceived to be more helpful in enabling learners to integrate learning into practice and transform individual learning into collaborative learning (behavior); and the KPI-oriented system was perceived to lead to better outcomes in improving work performance and bringing benefits to the company (result).

On the other hand, the results of the pretest and posttest scores indicated that there was no evident difference between the two groups in the pretest or posttest scores. The results are understandable, as other factors associated with the learners (e.g., their learning capability and effort) as well as their learning environment

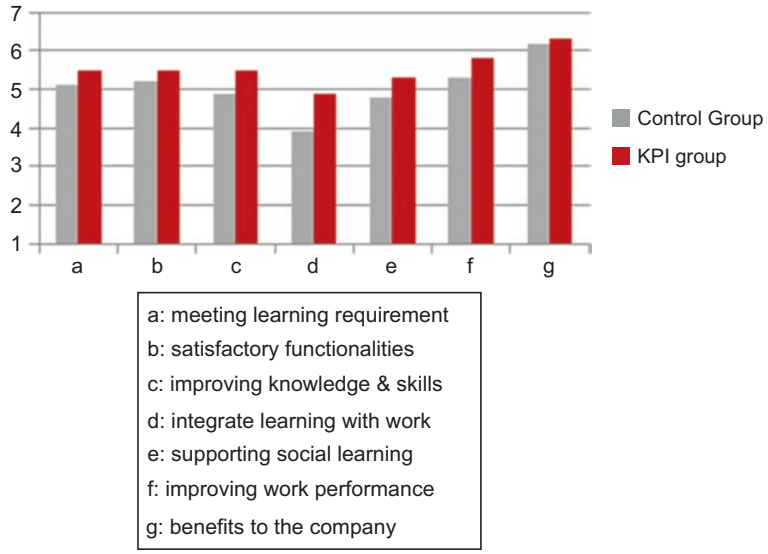

Fig. 11.2 Evaluation of the learning system

(e.g., Internet accessibility, speed, and cost) may affect the results. In addition, the effectiveness of the KPI-based system was not perceived as substantial in the main evaluation compared with the non-KPI-based system. Further analysis based on the supplemental experiment and interviews with the participants is provided as follows.

The supplemental evaluation was conducted by swapping the learning systems between the two groups. 20 out of 24 participants completed the supplemental evaluation. The result of the evaluation, that is, the participants' preference between the two learning systems, is presented in Fig. 11.3. It is shown that a majority of the participants preferred the KPI-oriented learning system concerning all the aspects of the system. This is a clear reflection of the participants' positive reaction toward the KPI-oriented system compared with the non-KPI-oriented system. As mentioned, the supplemental evaluation was arranged in view of the small number of participants and their individual differences in evaluating the two systems. Follow-up discussions with the participants exposed that many of them felt that they would be able to make a more appropriate evaluation after comparing both systems.

Findings from the Interviews

Twenty participants who completed the experiment and two rounds of questionnaires were interviewed. The interview question was the participant's reaction toward the developed KPI-oriented e-learning system on any aspect. Each participant was interviewed individually via telephone or an online communication tool

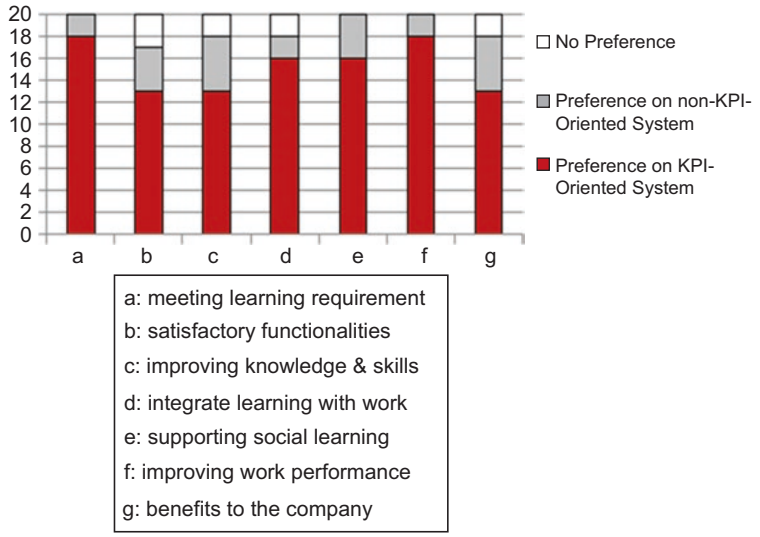

Fig. 11.3 Preference on the learning system

(Windows Live Messenger). Each interview lasted approximately half an hour. To ensure the reliability of the interview, we conducted two to three interviews with each participant. The findings from the interviews are organized in terms of the role of the interviewee—employee, expert, and training manager.

Most of the *employees* were concerned about the learning objective, learning content, and social interaction and communication functions supported by the KPI-oriented system. In terms of *learning objective*, the participants expressed their strong preference to the KPI-oriented system. They felt that learning objectives were clearly set up in the system, in line with the hierarchy of the job system. This provides employees with information about different job positions at junior and senior levels and key capabilities required for the positions. One participant said "With the help of the system, it becomes very convenient for me to check my job requirements." In terms of *learning content*, they felt that comprehensive and abundant learning materials especially cases, work tips, and self-experiences are crucial to an e-learning system. Most felt the KPI-oriented system more helpful because it provides a systemic scheme to organize a broad scope of learning materials and helps learners get familiar with the domain knowledge structure and locate learning resources.

Further, most participants reported that a clear and flexible classification scheme of learning materials is very important and can be improved in the current system. For example, some participants recommended that learning materials be organized around actual projects and be updated with new projects. One participant said "We always need to learn new knowledge when there is a new project. Today, I may need the knowledge relevant to multi-language testing, but tomorrow, I probably have to search for knowledge in biology, if we happen to receive an order from a biological

company." In terms of *social interaction and communication functions* provided by the system, the participants felt that they are important elements which can motivate learners to learn and engage with the learning system. They gave positive comments regarding the KPI-oriented system on its facilities for communications, sharing, and discussion.

All the employees mentioned that they had more opportunities to learn from others by attending discussions and querying experts using the KPI-oriented system. Some participants felt that the system is especially helpful for newly recruited colleagues who do not know whom to consult. Another participant said, "Thanks to the system (KPI-based), once I have done something really well, there is a way for me to contribute and share." Also, the participants believed that the knowledge assets in their company will increase in the long run by using the KPI-oriented learning system. To further improve social interaction, most participants suggested the information about software testing projects and their team members be included in the system for facilitating project-based sharing and communication.

As for the *experts*, they are more concerned about how an e-learning system can guide employees to learn, especially in a social context. The issue to which they gave the first priority on the KPI-oriented e-learning system is defining the capabilities required for each job position, identifying the knowledge gap for individuals, and providing timely and useful help to learners. This would help decrease the e-learning quit rate of employees. Moreover, the experts stressed the importance of providing convenient and instant help for learners to solve their learning problems. They believed that an e-learning system should help learners easily find the right person (partner or expert) or locate relevant guidelines to solve problems in an efficient way. The KPI-oriented framework helps on this aspect. In view of social learning context in the workplace, the experts preferred the KPI-based learning system as it supports social learning and knowledge sharing with a clear target to improve work performance.

Furthermore, the experts provided some insights on the design of the KPI-oriented framework. They believed that the construction of the capability framework in the KPI model is an evolving process and that cooperation is needed from both designers and users of the learning system. They suggested that the construction process be roughly divided into three stages. First, system designers should define the initial framework of the capabilities required for the positions in the workplace according to the KPI model and existing industrial standards. Second, experts in the workplace modify the framework according to their experience and the context of the workplace. Third, the framework should be continuously modified and improved.

With respect to the *training managers*, the greatest issue of their concern is cost. They expressed their preference of e-learning systems to traditional ways of training in classrooms for saving the expense on formal training programs. The managers said "Considering our own situation, we don't have many senior experts and we have to control the training budget. Therefore, we put many efforts to advocate colleagues to learn from each other within the department. The KPI-oriented learning system developed in this study provides a platform to facilitate knowledge sharing

to meet our needs." They also stressed the usefulness of the KPI framework for employee training. One manager said, "I think the first prototype (the KPI-oriented) can satisfy our training requirements exactly." In her opinion, the KPI framework helps training managers easily define and adjust training objectives, including performance and capability requirements for each job position and the organization's expectation on employees' professional development.

Training managers also favored the KPI-based assessment approach. They said that the assessment information of employees associated with their position and capabilities was helpful for managers to check employees' learning status and provide relevant support. In view of final productivity, the managers believed that using the KPI-based prototype might increase the productivity of the company in the long run, while it also depends on many other factors. In relation to this, they felt that the knowledge contributed by employees can be harnessed and well organized around the KPI model; this may enhance further reuse, aggregation, and sharing of the knowledge asset and can be regarded as another type of productivity.

Summary

Using a KPI-based approach, a performance-oriented workplace learning program has been established for a software testing unit of a company. In particular, a KPI-based learning system has been developed for software testing professionals. KPIs are used for assisting the organization to clarify its training objectives, helping individuals make sense of work context and performance requirement, and accordingly helping individuals set up rational learning objectives, acquire relevant knowledge resource, and communicate with relevant peers and experts according to their KPI profiles to enhance their learning process. An empirical study was conducted by inviting employees working in the software testing sector to use and evaluate the system. The results showed the effectiveness of the proposed approach.

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Chapter 12
A Web-Based System for KPI-Based Workplace Learning

KPI-Based System Architecture

A Web-based system for KPI-based learning is developed to demonstrate the effectiveness of the KPI-based approach to performance-oriented learning in the workplace (Jia et al., 2011; Wang, 2011). The architecture of the system is depicted in Fig. 12.1. Three interfaces are provided for the learner, training manager, and domain expert, respectively. The interfaces enable different roles of users to access relevant functions of the learning system and communicate with each other. The *Learner Interface* enables a learner to maintain personal information, access learning resources and personalized learning syllabus, take assessments and tests, participate in discussion and sharing with peers, and consult the domain expert for guidance. The *Manager Interface* enables a training manager to manage learners' profiles, manage learning materials and discussion forums, maintain assessments and tests, and manage the KPI model and the KPI-based learning ontology. The *Expert Interface* enables a domain expert to manage the KPI-based learning ontology, coordinate discussions, provide instructions and guidance, and access learners' profiles to support personalized learning syllabus.

KPI Model

To support KPI-based performance-oriented learning, a KPI model needs to be set up based on an organization's structure and job system. It consists of three levels: organizational level, business unit level, and position level. KPIs on the organizational level are defined according to business goals and strategies of the organization. Derived from the organizational KPIs, the unit KPIs for each business unit can be specified. Based on the unit KPIs, the KPIs for each job position within the unit

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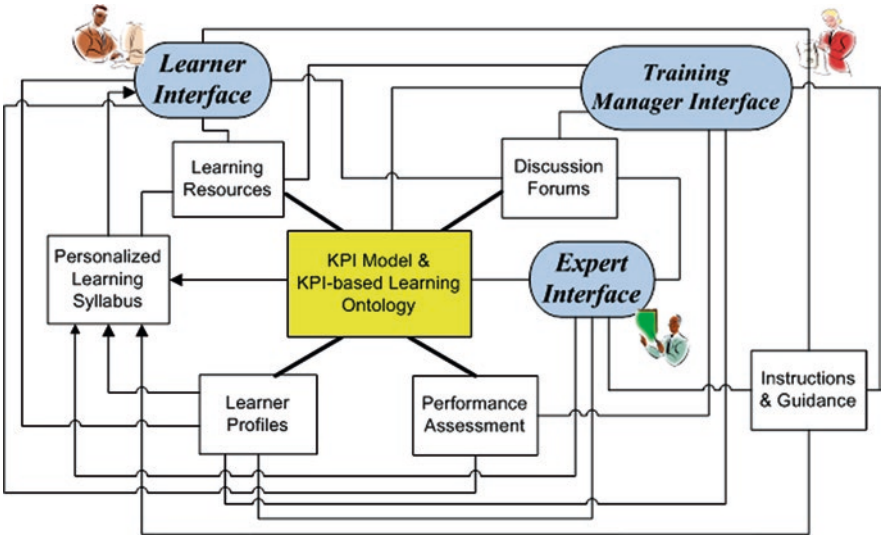

Fig. 12.1 System architecture

Table 12.1 An example of a KPI model at the position level

Junior Software Tester			
	KPI item 1: Bug Found Rate		
		Description	……
		Rating criterion	
		Assessment method	……
		KPI value	……
		KPI target	……
	KPI item 2: Bug Report Rework Rate		
		Description	……
		Rating criterion	……
		Assessment method	……
		KPI value	……
		KPI target	……
Senior Software Tester			
	……		
Lead Test Specialist			

are defined. The KPI for a position can be further broken down into a set of KPI items that measure the performance of employees at that position. An example of the KPI model at the position level is partially presented in Table 12.1. As shown in the table, "bug found rate" and "bug report rework rate" are defined as two KPI item for the junior software tester position. Rating criteria and assessment methods are set up to assess the performance of that KPI item. Based on the rating criteria and

assessment methods, the KPI value can be calculated to evaluate the employee's work performance.

KPI-Based Learning Ontology

In developing the learning system, ontology is employed to conceptualize the KPI-oriented learning environment into a machine-readable format. In other words, the KPI model is implemented by using ontology technology. The KPI-based learning ontology involves four concepts: position, KPI item, competency, and learning component. An employee at a *position* is assessed by a set of *KPI items* required by the organization; to improve the performance relevant to a specific *KPI item*, the employee needs to develop relevant *competencies*; to develop the competency, the employee needs to learn relevant *knowledge and skills*, which can be acquired from learning materials, learning activities, and training programs. In short, one position is linked with one or more KPI items; one KPI item is linked with one or more competencies; one competency is linked with one or more sets of knowledge and skills. In addition, recursive relationships between different positions and different knowledge and skills are specified. For example, a position (e.g., junior tester) can be a prior of another position (e.g., senior tester); one set of knowledge and skills can be linked to another set of knowledge and skills based on relations such as "part of," "sequential," and "inhibitor."

The KPI-based learning ontology is used as a systemic scheme to direct learning goals and activities and organize and manage learning resources and organizational knowledge assets in line with work context. Through the KPI-based learning ontology, performance-oriented goals are translated into concrete learning practices for acquiring relevant knowledge and skills toward the development of relevant competencies to meet the performance goals.

An example of the ontology for the training of software testing professionals is outlined in Fig. 12.2. As shown in the figure, "bug found rate" and "bug report rework rate" are specified as the KPI items for the position "junior tester." To improve the performance on "bug report rework rate," the employees need to develop the competency of "bug reporting." To develop the "bug reporting" competency, the employees may need to learn relevant knowledge and skills such as "test fundamentals" and "defect-based metrics."

In developing the system, OWL-DL (description language) is used to define the KPI-based learning ontology. To support the reasoning process, instruction rules are bound with the ontology using DL safe SWRL (Semantic Web Rule Language). To implement both OWL ontology and SWRL rules, OWL-API to access Pellet (Sirin, Parsia, Grau, Kalyanpur, & Katz, 2007) is used. Moreover, to enable domain experts and training managers to construct and maintain the learning ontology, tools for ontology editing and visualization are necessary. In this study, Protégé together with "SWRL tab" and "Jambalaya tab" plug-in is employed. Protégé is a free open-source ontology editor developed by Stanford Medical Informatics (SMI) at Stanford

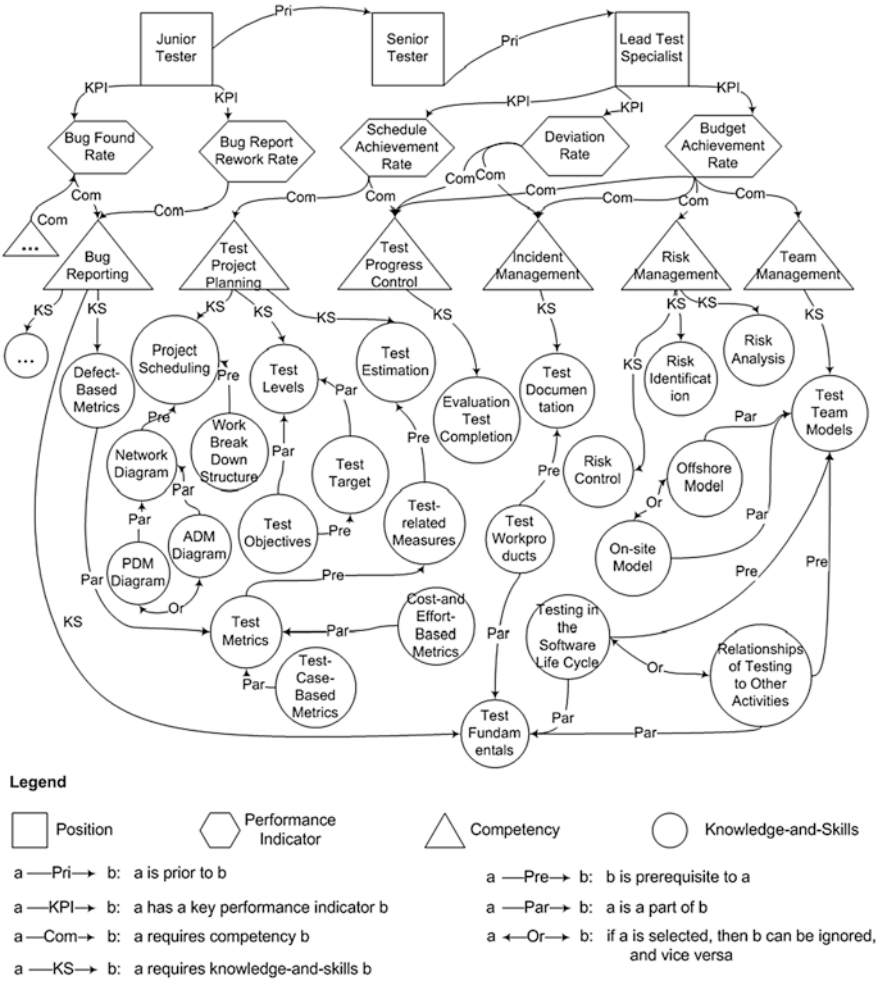

Fig. 12.2 An example of KPI-based learning ontology

University (Noy, Fergerson, & Musen, 2000). Protégé holds a library of plug-ins that adds more functionality to the environment. "SWRL tab" is a plug-in for Protégé, which provides a SWRL Editor that supports the editing of SWRL rules. "Jambalaya tab" is another plug-in for Protégé to visualize the OWL ontology. Figure 12.3 shows a screenshot for the domain expert to edit and view the learning ontology.

KPI-Based Learning Process

The KPI-based learning system allows learners to set up performance-oriented learning objectives, receive personalized learning syllabus and instruction, and access relevant learning resources based on ontology-based reasoning. Using the

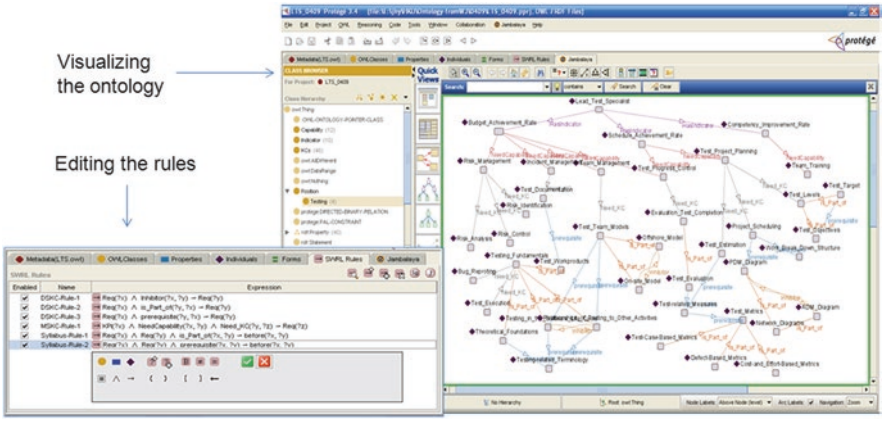

Fig. 12.3 Tools for visualizing the ontology and editing the rules

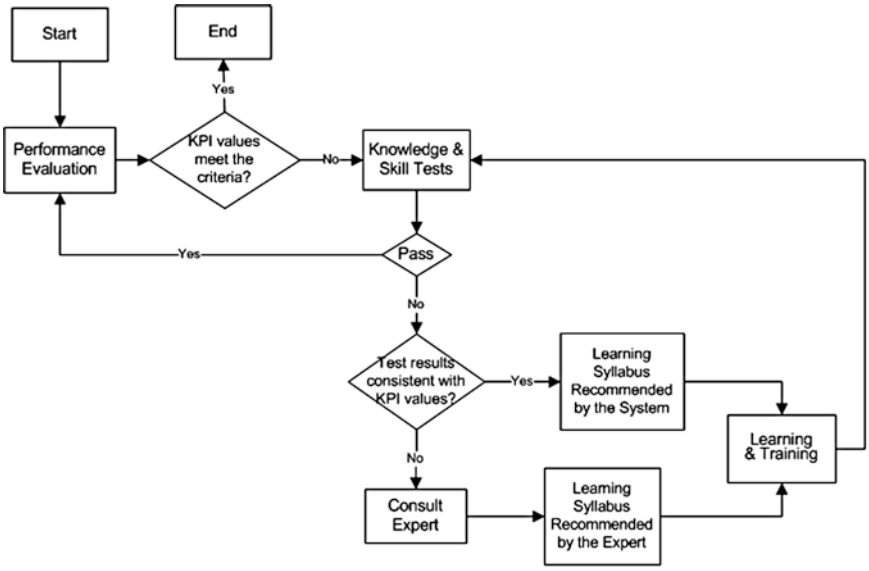

Fig. 12.4 KPI-based performance-oriented individual learning process

system, employees can perform a number of KPI-based performance-oriented learning activities described in the following and outlined in Fig. 12.4.

- An employee's job performance is evaluated and recorded as a set of KPI values. If one or more KPI values of the employee do not reach the required target, an improvement is suggested.

- Relevant tests will then be generated to assess the employee's knowledge and skills related to the KPI items to be improved. The employee's learning profile will also be generated or updated based on the assessment results.
- If the test results are consistent with the KPI values of the employee, a personalized learning syllabus or learning plan will be generated to guide the employee's learning process. Otherwise, the employee will be recommended to consult the training expert.
- According to the learning syllabus, related learning content and learning activities will be recommended to the employee. During the learning process, relevant learning facilities including self-assessment exercises can be provided to support self-regulated learning process.
- If the employee is unable to pass the test within a specified time frame, the learning syllabus will be refined, for example, by adding prerequisite knowledge and skills that the learner should have mastered for the current position and advice from domain experts.
- Otherwise, the employee will be recommended to reevaluate his/her job performance to determine whether he/she meets the requirement.

In addition to performance-oriented learning at the individual level, the KPI-based approach supports performance-oriented learning at social and organizational levels in the following aspects. *First*, the KPI-based approach makes the social learning environment more goal oriented and therefore makes the participants more *voluntarily* engaged in learning by a common purpose to improve work performance. *Second*, the KPI profile of each individual recognizes the expertise and reputation of the learners, which improves the *trust* in social communities. *Third*, the knowledge contributed by peers is harnessed and well organized based on the KPI model, which enhances further aggregation, sharing, and retrieval of the organization's knowledge asset.

A Web-Based System for KPI-Based Learning

The system is built using Java programming tools together with Java Struts Hibernate. A set of screenshots of the main functions of the system is presented in Fig. 12.5.

The KPI-based learning ontology is visualized as a graph for easy communication of the learning context (*lower left* of Fig. 12.5). By clicking on a knowledge and skills node in the ontology graph, the learner can access relevant learning resources to acquire the knowledge and skills required for developing a specific competency. The *lower right* part of Fig. 12.5 shows the screen for the learner to take assessments or tests to assess his/her knowledge and skills relevant to a competency. Based on the learning ontology and the learner's background (position, KPI values, and assessment results), the system may suggest a personalized learning syllabus to the learner (*center* of Fig. 12.5). Moreover, learners are able to contribute and share

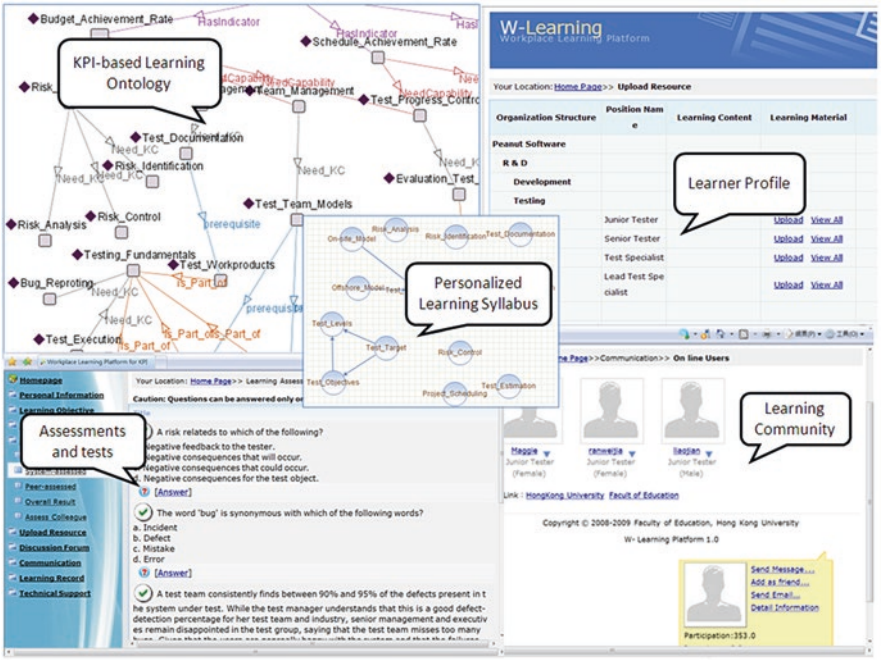

Fig. 12.5 Main functions of the Web-based learning system

learning resources as well as participate in learning communities for discussion, communication, and sharing of learning experience (*lower right* of Fig. 12.5). To support social communications, learners are able to locate peer learners or experts, each profiled by their background, expertise, and contribution to the learning community (*upper right* of Fig. 12.5).

Evaluation of the KPI-Based Learning Ontology

The evaluation of the developed system may need to take into account two parts: the KPI-based learning ontology and the learning system. The effectiveness of the system has been described in reporting the case study in the previous chapter. Given that the KPI-based learning ontology plays an important role in the proposed system, the quality of the ontology needs to be evaluated.

Ontologies are a fundamental data structure for conceptualizing knowledge. Users facing a multitude of ontologies need to have a way of assessing them and deciding which one best fits their requirements the best. Likewise, people constructing an ontology need a way to evaluate the resulting ontology and possibly to guide the construction process and any refinement steps. The need of evaluation methodologies in the field of ontology development and reuse showed up in 1994 and has

been growing ever since (Gangemi, Catenacci, Ciaramita, & Lemann, 2006; Sure, 2004). Although there is no comprehensive and global approach to this problem, a number of principles are suggested as structured descriptions of the quality of ontology (Gangemi et al., 2006; Uschold & Gruninger, 1996). According to these principles, we evaluate the quality of the proposed KPI-based learning ontology in the following aspects.

Cognitive Ergonomics

The KPI-based learning ontology is designed based on an organization's mission and vision, organizational structure, and job system, which can be easily understood by employees and managers. Once KPIs are understood and accepted by the people from different units and at different levels of position, the KPI model and ontology can be easily exploited and manipulated via tight cooperation between managers and employees.

Modularity and Flexibility

Modularity and transparency refer to building blocks for the design of an ontology. To design a complex system, one powerful technique is to decompose it into a number of interrelated components, which in turn have their own components (Baldwin & Clark, 1997; Simon, 2003). In the KPI-based ontology, a complex learning environment is conceptualized into a set of positions, the positions into KPIs, the KPIs into required capabilities, and the capabilities into knowledge components. By explicitly presenting these concepts and their relationships, the ontology provides a rich conceptualization of the performance-oriented learning environment. The ontology can be easily adapted to multiple views by selecting appropriate concepts in the context.

Compliance to Procedures for Extension, Reuse, and Adaptation

The proposed KPI-based learning ontology is easy to be understood and manipulated for reuse, extension, or adaptation by adjusting positions, performance indicators, required capabilities, or knowledge components. The adjustment should consider the work context and job system of the selected organization.

Meta-Level Integrity

The proposed ontology is specified based on description logics, a family of knowledge representation languages that can be used to represent the concept definitions of an application domain. The underlying knowledge model allows representing classes, partitions, relations, attributes, instances, and axioms. It also provides flexible modeling components like meta-classes. These features ensure the meta-level integrity of the ontology.

Computational Integrity and Efficiency

The ontology can be easily processed by computational languages and tools. Before selecting a tool for developing an ontology, it is also important to know the inference services attached to the tool such as constraint and consistency checking mechanisms, type of inheritance, etc. In this study, Protégé is used to edit the ontology in OWL and check any inconsistency within the ontology. "Jambalaya tab," a plug-in for Protégé, is used to visualize the ontology. "SWRL tab," another plug-in of Protégé, is used to support the editing of SWRL rules bound with the ontology. To implement the ontology and SWRL rules, a number of semantic reasoning tools can be used such as Pellet, KAON2, and Hoolet. We use OWL-API to access Pellet in this system.

Compliance to Expertise

The proposed KPI-based learning ontology for software testing in this study is constructed based on a KPI model, which was designed based on the IEEE standards for software testing introduced (Bertolino, 2001), the knowledge of the domain experts, and the cooperation between business executives, human resource managers, training managers, domain experts, and employees.

Organizational Fitness

The KPI-based learning ontology is designed based on the KPI framework that represents an organization's mission and vision, quantifiable measurements, organizational structure, and job system. This ensures the organizational fitness of the ontology. The ontology constructed in this study is easy to be applied in the e-learning system development for the selected company. The fitness of the ontology has also been recognized from the users.

A specific ontology reflects the interests of the knowledge users, which must be captured in the design criteria for ontology construction. An ontology is a fairly complex structure, and it is often more practical to apply qualitative principle-based approaches and focus on the evaluation of different levels of the ontology separately rather than trying to directly evaluate the ontology as a whole (Brank, Grobelnik, & Mladenic, 2005). The above evaluation reflects the quality of the proposed KPI-based learning ontology from the perspective of the principles used in its construction.

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Part V
Influencing Factors on Performance-Oriented e-Learning in the Workplace

Chapter 13
Effects of Individual and Social Learning Support on Employees' Acceptance of Performance-Oriented e-Learning

Background

Technology affordances are among the key factors that influence employees' acceptance of technology-mediated learning innovation. With respect to performance-oriented approaches to learning in the workplace, it is recognized that supporting a personalized learning process and facilitating peer communication and collaboration are two key elements in the instructional design of workplace learning applications (Chang, 2006; Schmidt, 2008; Woelk & Lefrere, 2002). On the other hand, studies on e-learning design have examined the effects of perceived effectiveness of e-learning applications, in terms of individual and social learning support, on the adoption of e-learning in institutional environments (Cho, Cheng, & Lai, 2009; Liu, Chen, Sun, Wible, & Kuo, 2010). However, research exploring the potential impact of individual and peer collaborative learning support on the adoption of e-learning in the workplace situation is very limited and even much less on the adoption of performance-oriented learning. Lack of consideration for learners' perceptions and attitudes toward workplace e-learning has been recognized as the key barrier to successful design and implementation of e-learning initiatives (e.g., Admiraal & Lockhorst, 2009; Brown, Murphy & Wade, 2006; Rabak & Cleveland-Innes, 2006; Servage, 2005; Vaughan & MacVicar, 2004). This chapter examines the effects of individual and social learning support provided by the performance-oriented e-learning approach on employees' acceptance of performance-oriented e-learning in the workplace (Cheng, Wang, Yang, Kinshuk, & Peng, 2011).

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Theoretical Foundations

Acceptance of e-Learning Technology

To explain user acceptance of new technology, a variety of models consisting of different sets of predictive factors have been produced (Venkatesh, Morris, Davis & Davis, 2003). Among these, the technology acceptance model (TAM) by Davis (1989) is one of the most influential and widely used (King & He, 2006). TAM posits that users' perceived usefulness and perceived ease of use of a system have positive impacts on their behavioral intention to use the system, and this behavioral intention in turn predicts users' actual usage behavior. By reviewing and empirically comparing the existing user acceptance models, Venkatesh et al. (2003) formulated and empirically validated a unified theory of acceptance and use of technology (UTAUT). The UTAUT model synthesizes the constructs from eight widely employed models: the theory of reasoned action (TRA), the technology acceptance model (TAM), the motivational model (MM), the theory of planned behavior (TPB), a model combining the technology acceptance model and the theory of planned behavior (combined TAM and TPB), the model of PC utilization (MPCU), the innovation diffusion theory (IDT), and the social cognitive theory (SCT). It also posits four combined constructs as predictors of technology acceptance intention and use behavior: performance expectancy, effort expectancy, social influence, and facilitating conditions; and four individual characteristics variables as moderators between the causal relationships: gender, age, experience, and voluntariness of use.

In the e-learning literature, TAM and UTAUT have been widely employed by researchers to investigate learners' intention to use, and continued use of, e-learning systems. Perceived usefulness of e-learning systems, for example in improving learning performance and learning outcome, has been found to have a significant positive impact on learners' use and continuance intention (Cho et al., 2009; Lee, 2010; Liu et al., 2010; van Raaij & Schepers, 2008). Evidence from research on acceptance of e-learning in the workplace environment also suggests that perceived usefulness of e-learning in improving individual learning effectiveness has a significant effect on employees' attitudes, satisfaction, and use intention toward e-learning (Chen, Yang, Tang, Huang, & Yu, 2007; Hashim, 2008; Ong, Lai, & Wang, 2004; Roca & Gagne, 2008; Yeung & Jordan, 2007).

Individual Differences in the Acceptance of e-Learning Technology

Previous research has also found mixed results of ***gender*** *and* ***age*** *differences* in perceptions and acceptance of e-learning technology such as online games and mobile learning (Bonanno & Kommers, 2008; Lu & Chiou, 2010; Wang & Wang, 2008; Wang, Wu, & Wang, 2009). In the information systems literature, research

findings have suggested that the effect of perceived usefulness on behavior intention is more salient for men than for women (Sun & Zhang, 2006; Venkatesh & Morris, 2000; Venkatesh et al., 2003), and more salient for younger people than for old people (Sun & Zhang, 2006; Venkatesh et al., 2003).

Moreover, ***prior experience*** has been found to have a moderating effect on the relationship between perceived usefulness and intention to use, Taylor and Todd (1995) hypothesized a stronger influence of perceived usefulness on behavior intention for experienced users, but their findings were to the contrary, which indicated that perceived usefulness was a stronger predictor of behavior intention for inexperienced users. In the e-learning literature, findings from research indicate that after participating in a technology-mediated class, participants have more positive attitudes, satisfaction, and use intention toward technology-mediated learning (Johnson, Lohman, Sharp, & Krenz, 2000; Welsh, Wanberg, Brown, & Simmering, 2003).

Besides the gender, age, and prior experience differences, employees' *work experience* may also have potential moderating effect between employees' perception on and intention to use workplace e-learning applications. Previous technology acceptance studies in sales force and nurse population recognized the potential effects of length of services and work experience in predicting employees' perception and acceptance of workplace technologies (Rivers, Aday, Frankowski, Felknor, White, & Nichols, 2003; Robinson, Marshall, & Stamps, 2005). In these investigations, the effects of work experience are justified via the mechanism of employees' resistance to change.

Workplace Learning Influenced by Individual Factors

Workplace learning is viewed as a continuous process relevant to training, socialization, and employee development within an organizational context (Ford, Kozlowski, Kraiger, Salas, & Teachout, 1997). Studies on workplace learning have provided useful perspectives and basis for examining the position of self-regulated individual learning support as well as communication-based social learning support in design of workplace e-learning applications. Researchers have proposed various models to examine factors influencing workplace learning engagement and effectiveness (Burke & Hutchins, 2007; Colquitt, LePine, & Noe, 2000).

In these models, individual factors such as needs, attitudes, and goal orientation and organizational factors such as organizational climate and business strategy are usually identified as antecedents of employees' motivation to participate in workplace learning and learning outcome (Mathieu & Martineau, 1997; Noe, Wilk, Mullen, & Wanek, 1997). In e-learning and distance learning environments, instructional design factors such as providing learner control have been found to have a significant impact on adult learners' reaction toward computer-based instruction (DeRouin, Fritzsche, & Salas, 2005). The theoretical foundation of such investigation can be found in andragogy and self-directed learning theories, which form the basis for the design of e-learning practices in work environments. The implications

of adult learning theory for the workplace context are that learners will be motivated once learning objectives have been rationally set that meet their needs, and learning programs should be designed to give emphasis to self-directed learning so as to help learners select and carry out their own learning goals, objectives, methods, and means (Merriam, 2001). With e-learning methods, learning can take place on demand, and learners are given greater control over their learning content, sequence, and pace than before. To achieve this, it has been suggested that complex learning content should be segmented into smaller parts, with course maps to define and visualize learning topics and their interrelationships. It has also been suggested that some form of adaptive control be designed that tailors learning to individual needs and motivation in e-learning applications (Clark & Mayer, 2008).

Previous research on the adoption of e-learning has indicated that perceived usefulness of e-learning applications in supporting individual learning, such as improving learning performance and learning outcome, has a significant impact on learners' use and continuance intention (e.g., Cho et al., 2009; Liu et al., 2010; van Raaij & Schepers, 2008). Evidence from research on acceptance of e-learning in the workplace environment also suggests that perceived usefulness of e-learning in improving individual learning effectiveness has a significant effect on employees' attitudes, satisfaction, and use intention toward e-learning (e.g., Chen et al., 2007; Hashim, 2008; Ong et al., 2004; Roca & Gagne, 2008).

Workplace Learning Influenced by Social Factors

Moreover, learning is a phenomenon that is situated in a culture and social context. Researchers suggest that learner communication and peer relationship development in a distance learning environment may have an impact on learners' motivation to use online learning in the workplace (Alavi, 1994; Salas, Kosarzycki, Burke, Fiore, & Stone, 2002). The theoretical foundations of such investigation can be found in multiple disciplines such as communities of practice (CoPs) and knowledge management (KM). A CoP is a group of practitioners with a common interest or purpose, dedicated to supporting each other in increasing their knowledge, creating new insights, and enhancing performance in a particular domain. The assumption of a CoP is that engagement in social practice is the fundamental process by which people learn and become who they are (Wenger, 1998). KM, from another point of view, refers to a range of approaches and practices used by organizations to identify, create, represent, and distribute knowledge for reuse, awareness, and learning (Nonaka & Takeuchi, 1995). It focuses on creating opportunities for collaboration between individuals and teams so that intellectual assets can be shared. Crucial to the collaborative learning process is the interaction between novices and experts. Technology offers means of facilitating communication and collaboration, managing knowledge repositories, and increasing access to experts and expertise (Rosenberg, 2006).

In the workplace training and human resource development literature, *mentoring and peer relationship* is recognized as one important form of employee developmental activity (Noe et al., 1997). In the literature on distance learning and e-learning for human resource development, training researchers suggest that *learner communication and collaboration* in distance learning environment may address learners' social needs and therefore promote learners' satisfaction and motivation toward using online learning (Alavi, 1994; Salas et al., 2002). Furthermore, findings from research on success factors and acceptance of e-learning in an academic background also show that *perceived interaction* has a significant impact on learners' intention to use e-learning (e.g., Liu et al., 2010).

Conceptual Model

The literature discussed above provides useful perspectives and a basis for examining the position of self-directed individual learning support as well as communication-based social learning support in design of workplace e-learning applications. This theoretical basis and empirical support provided the foundation for developing the conceptual framework of our analysis.

Accordingly, we hypothesized that perceived individual and social learning support in performance-oriented workplace e-learning applications would have a significant influence on employees' intention to use the application. To capture the characteristics of workplace peer relationship and learner collaboration, we broke down the perceived social learning support into two aspects: perceived support for enhancing social ties and perceived support for promoting a norm of cooperation, based on Nahapiet and Ghoshal's (1998) conceptualization of social capital. On the other hand, given the explanatory power of TAM and UTAUT in explaining the behavioral intention to adopt new technologies in diverse situations (King & He, 2006; Sun & Zhang, 2006), the two models are adopted as the main framework of this study, with some adjustment to the constructs according to the workplace context. The conceptual model for analysis is outlined in Fig. 13.1.

Measures and Instruments

An online survey and semi-structured interviews were conducted to collect and analyze perceptions and reactions from employee learners toward the performance-oriented learning application. The survey questionnaire included four constructs to be measured and modeled in this study. *Perceived individual learning support* refers to the extent to which performance-oriented workplace e-learning is perceived to be helpful for employees in assessing his/her position-specific performance and enhancing the effectiveness of acquiring work-related knowledge, skills, and ability. Measures of perceived individual learning support were based on eight items

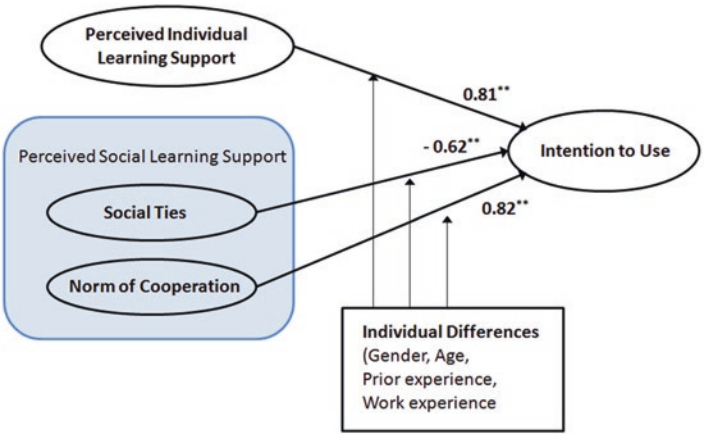

Fig. 13.1 Conceptual model and path coefficients

adopted from Kirkpatrick and Kirkpatrick (2006) and Davis (1989). *Perceived social learning support* refers to the extent to which performance-oriented workplace e-learning is perceived to be helpful for employees to enhance peer relationships and promote a norm of cooperation in workplace learning and development. Measures of *perceived support for enhancing social ties* were based on six items derived from Chiu, Hsu, and Wang (2006) and van der Gaag (2005). Measures of *perceived support for promoting a norm of cooperation* were composed of three items derived from Kankanhalli, Tan, and Wei (2005) and Noe et al., (1997). The construct *intention to use* has been widely investigated in technology acceptance research, and this study adopted three items from Venkatesh and Davis (2000) and Kirkpatrick and Kirkpatrick (2006). The items in the questionnaire were rated on a seven-point Likert scale worded from "strongly disagree" to "strongly agree."

In addition to the questionnaire survey, we implemented a semi-structured in-depth interview study to triangulate the findings obtained from the survey. The interviews were guided by the following three questions:

Q1: What are the key motivators and inhibitors for you to try or continue to use a new technology in your organization?
Q2: What are the key motivators and inhibitors for you to use a performance-oriented approach to guide your work-related learning and professional development?
Q3: From the learning perspective, what are the key success factors of designing and adopting a performance-oriented e-learning system for employee learning and professional development in your organization?

Besides, to situate the interview responses in a broader setting, several aspects of performance appraisal practices in the interviewees' companies, which include the purposes, standards, sources of ratings, dimensions of job performance, ways, and frequency of performance appraisal, were also asked in the course of the interview.

Procedure

An online survey was conducted to collect and analyze perceptions and reactions from workplace learners toward a performance-oriented e-learning application delivered at a Web-based system. The main instructional intervention provided in the e-learning application was a performance-oriented learning model, which specified performance indicators, required competencies or skills, and associated knowledge and skills for job positions according to job requirements and professional standards (Wang, 2011). The system was designed to facilitate performance-oriented, self-directed, and socially constructed online learning activities in the workplace. The effectiveness of the system has been examined with positive results (Wang, Vogel, & Ran, 2011; Wang, Jia, Sugumaran, Ran, & Liao, 2011). To conduct the survey in this study, a demo and introduction of the workplace e-learning system was presented on a website to allow easy access to the information. A survey questionnaire was created and posted to a website for free online surveys, with a link to the website of the system information. After the online survey, semi-structured interviews were arranged with the participants from seven different companies. The time for each interview varied from 12 to 35 min.

Participants

The sampling method used in the survey was convenient sampling and snowball sampling. The questionnaire and system information were disseminated to a convenient sample of respondents and contacts in their social networks and a reachable sample of clients of a training and consulting company in mainland China. Respondents were chosen from different organizations of various size and sectors such as companies, schools/colleges, and public sectors. There were a total number of 222 usable responses. The demographics of the participants are outlined in Table 13.1.

The interviewees were from seven different companies of various size and industry in mainland China and held different positions such as engineer, manager, administrator, and senior manager. Five out of the seven companies had practiced performance-oriented approaches for various purposes such as performance appraisal and selection. The information of the interviewees is outlined in Table 13.2.

Data Analysis

To estimate the measurement and structural coefficients simultaneously, a structural equation modeling approach was adopted to test the hypothesized model. Following the two-stage strategy recommended by Anderson and Gerbing (1988), the

Table 13.1 Demographics of participants

	Frequency	Percentage
Gender		
Male	120	54.05
Female	102	45.95
Age		
18–35 years old	169	76.13
36–55 years old	52	23.43
Over 55 years old	1	0.45
Work experience		
0–6 years	127	57.21
7–12 years	47	21.17
Over 12 years	48	21.62
Prior experience using online learning applications		
Yes	139	62.61
No	83	37.39

Table 13.2 Information about the interviewees

Interviewee	Position	Industry	Number of employees	Performance-oriented practice
1	Engineer	IT integration	Over 10,000	Yes
2	Senior manager	IT vocational education and training	Over 200 at headquarter	Yes
3	Administrative staff	Telecommunication	Over 1000	Yes
4	Purchasing officer and manager	Household appliance manufacturing	Over 50,000	Yes
5	Staff	Automobile manufacturing	Over 2500	No
6	Engineer and manager	E-commerce and internet retailing	Over 3000	No
7	Engineer	Network and communication equipment	Over 80,000	Yes

measurement model was firstly tested via confirmatory factor analysis (CFA), and then the structural model was examined.

To validate the measurement model, we assessed its reliability and validity. Cronbach's α was assessed for reliability. Content validity, convergent validity, and discriminant validity were also checked. Content validity was ensured by all of the items being adopted from previous published research. Convergent validity was assessed by examining the factor loadings (λ_i), the composite reliability (CR), and the average variance extracted (AVE) (Chiu et al., 2006; Fornell & Larcker, 1981). Discriminant validity was verified by looking at the average variance extracted and

the squared correlations between constructs using the approach recommended by Fornell and Larcker (1981).

To examine the moderating effects of individual characteristics, the multigroup causal model's comparison approach was adopted in this study. Following the procedures introduced in Chiou and Lin (2009), Myers, Calantone, Page Jr., and Taylor (2000), and Steenkamp and Baumgartner (1998), the measurement invariance was first tested. After ensuring that the same measurement model held across different subsamples, the comparisons of path coefficients across subsamples were made. Each time, the entire sample was divided into two subsamples according to values of the moderating variable. To test the moderating effects of gender, the entire sample was split into the male group and the female group; for effects of age, the entire sample was divided into the younger group (35 or lower) and the older group (above 35); for effects of prior experience, the entire sample was split into the experienced group and the inexperienced group; and for effects of work experience, the entire sample was divided into two groups, one consisted of respondents with a shorter period of work experience (0–6 years) and the other consisted respondents with a longer period of work experience (over 6 years).

Results

Measurement Model Testing Result

To examine the measurement properties of the instrument, the initial measurement model consisting of 15 indictors loading on four constructs was tested against the sample data. Based on the model fit indices values, the measurement model was slightly revised by dropping some indicators of one construct; each construct was measured by at least three items in the revised model.

Reliability and Validity

All Cronbach's α values of the measurement model were higher than 0.7, showing satisfactory internal consistency reliability of the scales. For convergent validity, all the factor loadings were higher than 0.7 (except loading of PS-ST1 = 0.69) and significant, the four composite reliability values all exceeded 0.8 (except CR for PS-ST = 0.78), and all the four AVE values were higher than 0.5, showing satisfactory convergent validity of the scales against the criteria recommended by Fornell and Larcker (1981). Moreover, the four scales had acceptable discriminant validity according to Fornell and Larcker's (1981) principle, i.e., the average AVE values of any pair of constructs should be larger than the squared correlation between that pair of constructs.

The items of the final instrument are listed below.

Perceived Individual Learning Support

1. The system would be helpful for me to construct knowledge in my work context (Kirkpatrick & Kirkpatrick, 2006).
2. Using this system would enhance effectiveness in my work-related learning (Davis, 1989).
3. This system would be helpful for me to identify my knowledge gaps or learning needs (Kirkpatrick & Kirkpatrick, 2006).

Perceived Support for Enhancing Social Ties

1. In my perception, this system can promote interaction between my colleagues (Chiu et al., 2006).
2. This system would be helpful for broadening connections among employees in my company (van der Gaag, 2005).
3. In my perception, this system would be helpful for closer relationships between my colleagues (Chiu et a., 2006).

Perceived Support for Promoting a Norm of Cooperation

1. This learning platform would be helpful for formation of a workplace climate of cooperation in work-related learning (Kankanhalli et al., 2005).
2. This learning platform would be helpful for formation of a workplace climate of peer mentoring and coaching (self-developed based on Noe et al., 1997).
3. This learning platform would be helpful for formation of a workplace climate of teamwork (Kankanhalli et al., 2005).

Intention to Use

1. Given that I had access to the system, I predict that I would use it (Venkatesh & Davis, 2000).
2. If possible, I would recommend this learning platform to other teammates (Kirkpatrick & Kirkpatrick, 2006).
3. Assuming I have access to the system, I intend to use it (Venkatesh & Davis, 2000).

Structural Analysis Result

To test the hypothesized relationships, the path coefficients among the latent variables were estimated via maximum likelihood by LISREL 8.7. The results are presented in Fig. 13.1. As seen in the path diagram, the relationship between perceived individual

learning support and intention to use ($\gamma_{11} = 0.81$, $t = 9.78$) as well as the relationship between norm of cooperation and intention to use ($\gamma_{13} = 0.82$, $t = 4.08$) were supported, while the relationship between social ties and intention to use ($\gamma_{12} = -0.62$, $t = -2.92$) was rejected with a significant negative effect. The three exogenous latent variables explained a total of 96% variance of the dependent variable.

The results indicate that the two aspects of social learning support, perceived support for enhancing social ties and perceived support for promoting a norm of cooperation, had a significant impact on intention to use. On other hand, it was surprising that perceived support for enhancing social ties was found to have a significant negative effect on behavioral intention. The negative effect means that if the performance-oriented workplace e-learning application is perceived to be able to promote interaction and close relationships between colleagues, then the application tends not to be used.

Multigroup Analysis Result

Results of the multigroup analysis indicated that no gender, age, prior use experience, or work experience differences were supported in the main effect of perceived individual learning support on intention to use.

Gender, age, prior experience, or work experience difference was not found in the effects of social learning support and intention to use the performance-oriented workplace e-learning application.

Interview Results

The interviewees' responses to the three questions were collected and summarized. For the *first interview question*, elements such as (a) relevance to job, practical value, benefits, and usefulness; (b) convenience in use and ease of use; (c) time to learn and use; and (d) management support and so on were identified as the main factors in the respondents' adoption of new technologies.

For the *second question*, factors such as (a) relevancy to positions and organizational practices; (b) ease of use; (c) support for knowledge sharing; and (d) organizational leaning culture were reported as the main motivators or inhibitors for the interviewees' application of a performance-oriented approach in their personal learning.

For the *third question*, elements such as (a) organization of knowledge base according to competency requirements; (b) abundance and richness of learning materials; (c) support for knowledge sharing among colleagues; (d) cooperation between human resource experts and workers; (e) convenience in use; and (f) leadership support were indicated as the key success factors in the interviewees' opinion of design and adoption of performance-oriented workplace e-learning systems.

Table 13.3 Responses to performance appraisal practices

Responses	Interviewee 1	2	3	4	5	6	7	Total
Q1. What are the purposes of performance appraisals in your company?								
Salary administration	x	x	x	x	x	x	x	7
Promotion	x		x	x	x	x	x	6
Retention/termination			x			x		2
Layoffs			X					1
Recognition of individual performance	X	X	X		X	X	X	6
Identification of poor performance	X		X					2
Identification of individual training needs	X				X			2
Performance feedback	X		X	X				3
Determining transfer and assignments			x	x				2
Workforce planning			√					1
Determining organizational training needs	X		X		X	X		4
Assisting in goal identification	X	X						2
Evaluating personnel system					x			1
Reinforcing authority structure	x							1
Q2. Who are the sources of ratings in performance appraisals?								
Self	x		x					2
Subordinates			x					1
Supervisors	x	x	x		x	x	x	6
Human resource department					x			1
Client				x				1
Q3. Which dimensions of job performance are evaluated?								
Job-specific performance	x	x	x	x	x	x	x	7
Organizational citizenship behavior		x	x		x		x	4
Pro-social organizational behavior	x		x		x	x	x	5
Q4. How is the information obtained?								
Observation		x		x		x	x	4
Interview			x					1
Reports	x		x		x			3

The interviewees' responses to performance appraisal practices in the interviewees' companies were summarized in Table 13.3.

Discussions

Individual Learning Support and Individual Characteristics

Perceived individual learning support was found to have a significant positive impact on respondents' intention to use the performance-oriented e-learning applications. This result was reasonable and consistent with widely validated findings in

technology acceptance research. In this study, perceived individual learning support was defined as the extent to which the performance-oriented workplace e-learning application was perceived to be helpful for respondents in identifying their knowledge gaps and learning needs based on the performance model, in constructing knowledge in their work context, and in enhancing effectiveness of their work-related learning. The result suggests that if the performance-oriented learning design is thought to be useful for improving learners' self-directed on-the-job learning process and performance, the technological applications involving those elements tend to be adopted. The interview data also suggest that in the interviewees' opinion, factors such as personalization of the performance model to fit individual learning needs and richness of knowledge bases organized according to specific job requirements are the key elements in design and adoption of the performance-oriented workplace e-learning applications.

Results of the multigroup analysis indicated that no gender, age, prior use experience, or work experience differences were supported in the main effect of perceived individual learning support on intention to use. The information system literature suggests that the effect of perceived usefulness or system performance expectancy on behavioral intention is more salient for male than for female and is more salient for younger people than for older people in adoption of general workplace technology (Sun & Zhang, 2006; Venkatesh et al., 2003). However, the gender and age differences are not found in the e-learning systems adoption research (e.g., Lu & Chiou, 2010; Wang et al., 2009). Consistent with the findings in the e-learning systems adoption literature, the effect size from performance expectancy of the performance-oriented workplace e-learning systems in enhancing workers' individual learning to their behavioral intention to use the systems is not significantly different across gender or age groups. This result means that regardless of the gender and age distribution of a company's workforce, the emphasis of implementing performance-oriented e-learning initiatives in an organizational environment should be placed on the functional design and improvement of employees' perception and expectancy on the practical value and relevancy of the applications in supporting their work-related learning. Based on this result, another interesting question could be proposed for further research: what characteristics of a performance-oriented workplace e-learning application may be perceived to be especially useful for each gender group or different age groups?

Regarding the prior use experience difference in the effect from perception on individual learning support to intention to use, evidence was not found in this study. In the information system acceptance literature, the moderating effect of prior experience on the relationship between perceived usefulness and behavioral intention is usually not directly hypothesized and evidenced (except Taylor & Todd, 1995). However, empirical studies on e-learning for job-relevant training suggest that e-learning experiences can lead to improved perceptions and positive attitudes toward e-learning applications, which in turn may increase participants' intention to use them again (Johnson et al., 2000; Welsh et al., 2003). Lack of evidence of the prior use experience difference in the path from perception to intention across the

experienced group and the inexperienced group is unexpected and subject to further investigation.

The work experience difference in the effects of perceived social learning support on intention to use was not supported in this study. The effect of work experience as a predictor on perception and acceptance of workplace technologies is mixed in the literature. For example, a shorter period of work experience was found related to a higher likelihood of acceptance of technology in Rivers et al., (2003), while in Robinson et al., (2005) the relation between length work experience and perception and acceptance of technology was not supported. Concerning the role of resistance to change in adoption of new workplace technology (e.g., Karsh, 2004; Umarji & Seaman, 2005), length of work experience might be a factor of employees' acceptance of e-learning. Our interviews found that factors such as personal habits, employee passiveness, and cost of transfer, potentially associated with length of work experience, may affect employees' adoption of new work technology or performance-oriented learning in some extent. However, there is no quantitative evidence found in this study. Further investigations may be needed.

Social Learning Support and Individual Characteristics

The results indicate that the two aspects of social learning support, perceived support for enhancing social ties and perceived support for promoting a norm of cooperation, had a significant impact on intention to use. Contrary to our hypothesis, perceived support for enhancing social ties was found to have a significant negative effect on behavioral intention. The negative effect means that if the performance-oriented workplace e-learning application is perceived to be able to promote interaction and close relationships between colleagues, then the application tends not to be used. The negative effect of supporting social networking on intention to use the application may possibly be attributed to adult learners' perceptions of the online learning application as a kind of social software. The perceived support for social networking in the online learning application means that the application will facilitate explicit exchange and expression of employees' social information such as identity, role, attitude, and personal relationships in a shared space (Shirky, 2003). This kind of perception may lead to adult's distrust of the application due to adult learners' characteristics, especially in a Chinese cultural setting. Another possible reason for the negative effect may be related to adult learners' working habits and workloads as suggested in Choy and Ng's (2007) research on part-time students using a wiki for online learning. While there are no direct research findings regarding the negative effect of adult learners' perceptions of social networking support on their intention to use the online learning application, further research on this issue is needed.

The positive effect of perceived support for promoting a norm of cooperation on intention to use was evidenced in our empirical findings. Tynjälä and Häkkinen (2005) posit that participating in workplace e-learning is a social process involving adult learners' interaction and communication. Salas et al. (2002) hypothesize that

learner communication and collaboration in a distance learning environment may address adult learners' social needs and therefore promote learners' satisfaction of, and motivation toward using, online learning. The positive effect of perceived support for promoting a norm of cooperation on intention to use supported in this study suggests that workplace learning designs that promote peer mentoring and teamwork and collaboration in on-the-job learning, such as position-guided and performance-oriented peer discussion, consulting, and coaching, are critical to the success of technological applications that are designed to deliver those learning interventions. Therefore, e-learning designers may need to consider supporting performance-oriented peer discussion and collaboration activities in the learning platforms, e.g., searches for peer learners based on their expertise or competencies. Moreover, support for knowledge sharing among peer colleagues is also mentioned by some interviewees as an important issue in applying performance-oriented e-learning systems in the workplace.

Gender, age, prior experience, or work experience difference was not found in the effects of social learning support and intention to use the performance-oriented workplace e-learning application. Further studies may be needed to examine the moderating effects of individual differences on the relationship between social learning support and acceptance of learning technologies.

Summary and Implications

The chapter reported an empirical study that examined employees' perceptions and acceptance of performance-oriented workplace e-learning applications. The basic assumption was that perceived usefulness of e-learning design for self-directed and collaborative learning embedded in e-learning applications would be helpful for the diffusion of performance-oriented e-learning applications to adult learners. Built on the literature of technology acceptance and individual and social factors on workplace learning, a conceptual model hypothesizing causal relationships between individual learning and social learning support and intention to use was proposed and tested against a sample data collected from work settings in mainland China. Structural equation modeling and multigroup structural equation modeling techniques were applied to analyze the data collected from a questionnaire survey. The results show the positive effects of perceived individual learning support and perceived support for promoting a norm of cooperation on employees' intention to use the performance-oriented e-learning application. It was also found that perceived support for enhancing social ties had a negative effect on employees' behavioral intention. Besides, qualitative data collected via semi-structured in-depth interview provide complementary evidence to the findings.

Findings of this study contribute to the current endeavors to integrate performance-oriented instruction and training for adults with advanced e-learning technologies and provide implications for instructional design of workplace learning applications. Support for learning is essential in the design of any e-learning applications

including those for workplace settings. The empirical results suggest that perceived usefulness of work-integrated pedagogical design in terms of improving self-directed learning processes and promoting collaboration among colleagues has positive influences on employees' intention to use technology-delivered workplace learning innovations such as performance-oriented e-learning applications.

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Chapter 14
Effects of Organizational Learning Environment on Employees' Motivation to Use Performance-Oriented e-Learning

Background

Employees' engagement and participation in developmental activities is a critical issue in the workplace learning literature. A number of studies have been carried out to examine the antecedent factors such as work environment, training design, and trainee characteristics for trainees' motivation to learn (Doornbos, Simons, & Denessen, 2008). In e-learning settings, existing research on trainees' motivation to learn mainly focuses on examining the predictive effects of technological attributes, trainees' individual differences (Roca & Gagne, 2008), or instructional design factors (DeRouin, Fritzsche, & Salas, 2005), while the role of work environment is left insufficiently understood. Due to the nature of workplace learning such as being integrated with work and daily routines, the importance of contextual and situational factors in e-learning implementation has recently attracted attention in discussions (Tynjälä & Häkkinen, 2005; Welsh, Wanberg, Brown, & Simmering, 2003). For example, while e-learning is viewed as a form of organizational learning, the potential of e-learning as a solution to workplace learning can only be exploited within an appropriate work and learning culture and environment (Tynjälä & Häkkinen, 2005). The significance of work environment factors also has been taken into account in e-learning design, e.g., the use of a performance-based learning approach to align employees' personal learning with the organizational and social contexts (Wang, 2011) and the design of social learning for co-workers (Collis & Margaryan, 2004). However, the impacts of the work environment factors on employees' motivation to use e-learning have not yet been theoretically modeled and empirically tested. The chapter investigated the impacts of organizational learning environment factors, including managerial support, job support, and organizational support, on employees' motivation to use performance-oriented e-learning in the workplace (Cheng, Wang, Moormann, Olaniran, & Chen, 2012).

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Theoretical Foundations

Expectancy Theory of Adult Learning Motivation in the Workplace

Expectancy theory (Vroom, 1964) is a meaningful and relevant theoretical approach to trainee's motivation to participate in workplace learning (Dubin, 1990; Farr & Middlebrooks, 1990; Mathieu & Martineau, 1997; Mathieu, Tannenbaum, & Salas, 1992; Noe, 1986). It relates the internal perception and belief components of individual's motivation to the situational influences in the work environment of trainees. According to the expectancy-theoretical model, there are three components of motivation: expectancy, instrumentality, and valence (Mathieu & Martineau, 1997; Tharenou, 2001). *Expectancy* refers to one's personal belief regarding the likelihood that participating in training and development activities would lead to improved knowledge, skills, and ability (KSAs). *Instrumentality* concerns the perception of likelihood that those KSAs gained from participating in training and development would lead to specific outcomes (e.g., peer respect, salary increase, and better job performance). *Valence* is the relative desirability or importance of those outcomes for each individual.

Based on the Valence-Instrumentality-Expectancy (VIE) approach, a number of work environment factors have been linked as antecedents to employees' motivation to participate in workplace learning and developmental activities. For example, Kozlowski and Farr (1988) assessed the impacts of job characteristics perception and psychological climate for updating on engineers' responses to technical competence updating (e.g., updating orientation, technical performance). The identified perceptual factors in job and updating climate included a collection of five dimensions: updating climate (e.g., organizational policies), work characteristics (e.g., autonomy), feedback, social interaction, and work technologies. Similarly, Tharenou (2001) evaluated the relations of a set of work environment factors, which included job challenge, supervisor support, employer support, and situational constraints, to trainees' motivation through the composite of expectancy, instrumentality, and valence. Tracey, Hinkin, Tannenbaum, and Mathieu (2001) also empirically tested the impacts of a set of work environment elements, including managerial support, job support, and organizational support, on trainees' pretraining motivation. Besides, using the expectancy-theoretical approach, Mathieu and Martineau (1997) particularly constructed a conceptual model of situational influences, which included situational constraints in the workplace, social-psychological influences (i.e., interpersonal relationship), and the maintenance system (i.e., the skill-based pay system), on training motivation. Other studies made similar endeavors to investigate the work environment influences on individual's motivation to participate in learning and developmental activities (Chiaburu & Tekleab, 2005; Facteau, Dobbins, Russell, Ladd, & Kudisch, 1995; Mathieu, Tannenbaum, & Salas, 1992). Although a variety of work environment factors have been investigated, there still lacks a consistent taxonomic view of these factors as antecedents of trainee motivation.

Three of the important work environment factors, i.e., *managerial support*, *job support*, *and organizational support*, were taken into account in this study. From the multilevel point of view of organizational systems for training design (Kozlowski & Salas, 1997), these three factors indicate the support from the different levels of an organizational system (interpersonal relationship, job performance requirements, and organizational policies and systems) which are key drivers of employees' developmental needs and thus are expected to be highly relevant organizational learning environment factors in the present study. These factors have been commonly investigated in prior research (Kozlowski & Farr, 1988; Mathieu & Martineau, 1997; Tharenou, 2001; Tracey, Hinkin, Tannenbaum, & Mathieu, 2001), although they have not been examined in the technology-enabled learning environment.

Social Influences and Facilitating Conditions in Technology Acceptance

With a view to examining trainee's motivation to use and participate in workplace e-learning, the technology acceptance and usage models were included as a highly relevant theoretical framework. Based on the leading technology acceptance models (TAMs) such as the "theory of reasoned action (TRA)" (Fishbein & Ajzen, 1975), the "theory of planned behavior (TPB)" (Ajzen, 1991), and the "unified theory of acceptance and usage of technology (UTAUT)" (Venkatesh, Morris, Davis, & Davis, 2003), two predominant external contextual factors, i.e., social influences and facilitating conditions, were identified to have impacts on perceived usefulness of using information technologies.

Social influence refers to the degree to which individuals perceive social pressure or expectations to engage in some behavior and feel motivated to comply with that pressure (Davis, Bagozzi, & Warshaw, 1989; Fishbein & Ajzen, 1975). In technology acceptance models, social influences is represented by subjective norm, which is defined as "a person's perception that most people who are important to him/her think he/she should or should not use the system" (Venkatesh, Morris, Davis, & Davis, 2003). The underlying logic for the impact of social influence on an individual's intention is that a user's belief in the usefulness of a technology tends to be consistent with the beliefs of important referents such as the top management, supervisors, or co-workers in a relevant social network to reassure oneself about legitimacy (Lewis, Agarwal, & Sambamurthy, 2003; Venkatesh & Davis, 2000). According to these definitions, top management and supervisors are one of the important, perhaps the most important one, reference groups of belief regarding the importance of using technologies within an organizational context and thus would impose a direct influence on individual's perception and belief about the usefulness of using e-learning.

Facilitating condition is defined as "objective factors in the environment that several judges or observers can agree to make an act easy to do" (Thompson,

Higgins, & Howell, 1991). It is modeled as a core component of perceived behavior control, which is described as the perception of presence or absence of requisite resources and opportunities in the job procedures and organizational policies needed to perform behavior. The perceived resource can be measured by formative indicators such as access to hardware/software, knowledge, time, financial resources, someone's help, documentation, and data (Mathieson, Peacock, & Chin, 2001). According to the definitions, facilitation conditions in job characteristics and in organizational policies would impact on people's beliefs about the usefulness of adopting, and actual utilization of, technologies, and the empirical evidences have been found in the technology acceptance literature (Mathieson, Peacock, & Chin, 2001; Thompson, Higgins, & Howell, 1991).

Conceptual Model

Based on the above theoretical frameworks, i.e., the expectancy-theoretical model of training motivation and the social influences and facilitation conditions in technology acceptance, a conceptual model is outlined in Fig. 14.1.

The model involves three organizational learning environment factors, i.e., managerial support, job support, and organizational support, which have been widely examined in prior studies. The three environmental factors were posited as antecedents of trainees' perception and belief regarding the usefulness of e-learning applications. This relationship was derived from the two theoretical frameworks. The model also posited trainees' perceived usefulness of e-learning as the motivational determinant of trainees' intention to use e-learning applications. This path was based on the widely tested relationship between perceived usefulness and intention to use in technology acceptance models, which was theoretically grounded by the expectancy theory of motivation.

Further, perceived usefulness was decomposed into perceived usefulness for individual learning and perceived usefulness for social learning. This was because

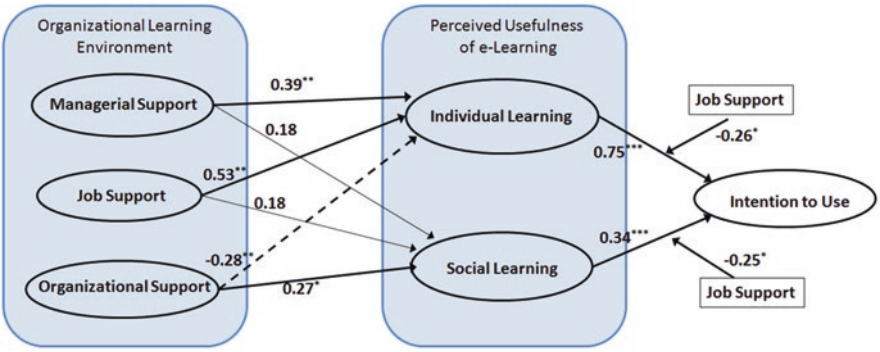

Fig. 14.1 Conceptual model and path coefficients

in prior work on design of e-learning at work, two important pedagogical principles for the design were to support individual cognitive learning processes (e.g., self-directed reasoning, learner control of content, etc.) and to support social construction of knowledge (Tynjälä & Häkkinen, 2005). The theoretical basis for the design of individual learning support is related to andragogy and self-directed learning theory, which inform that learners will be motivated once learning objectives have been rationally set that meet their needs, and learning programs should be designed to give emphasis to self-directed learning so as to help learners select and carry out their own learning goals, objectives, methods, and means (Merriam, 2001). The theoretical ground for the design of social learning support is based on the phenomenon that learning is situated in a culture and social context and the multidisciplinary perspectives of learning such as the communities of practices framework (Brown & Duguid, 1991) and the knowledge management (KM) model (Nonaka & Takeuchi, 1995; Rosenberg, 2006). Based on these design principles and learning theories, the expected outcomes of using an e-learning would include the individual and the social dimensions. Besides, in technology acceptance literature, the construct-perceived usefulness was acknowledged not to be unidimensional and could include multiple components (Thompson, Higgins, & Howell, 1991).

Environmental Influences on Perceived Usefulness of e-Learning

Managerial Support

Managerial support is concerned with trainees' perception and belief of the extent to which supervisors or managers give employees opportunities and reinforcement for acquiring new KSAs through participating in continuous learning and developmental activities (Facteau, Dobbins, Russell, Ladd, & Kudisch, 1995). According to the expectancy-theoretical model of training motivation, perceived managerial support may enhance trainees' perception and belief of the valence of the outcomes (i.e., supervisor recognition) gained through participation in learning. Empirical evidences for this relation can be found in prior studies (e.g., Chiaburu & Tekleab, 2005; Tharenou, 2001). From the technology acceptance perspective, managerial support has been widely examined in technology acceptance models as an antecedent of potential users' perceived usefulness of a technological system (e.g., Lewis, Agarwal, & Sambamurthy, 2003).

Job Support

Job support refers to the degree to which trainees perceive that work characteristics such as autonomy and task assignments are designed to facilitate the attainment of KSAs through learning and developmental activities (Kozlowski & Farr, 1988;

Mathieu, Tannenbaum, & Salas, 1992; Tharenou, 2001). From the expectancy-theoretical perspective, a high level of perceived job support for learning may motivate trainees' participation by cuing that mastery of new knowledge and skills will be instrumental in achieving valued extrinsic outcomes (e.g., better job performance). The link between job support and perceived usefulness of learning has been empirically evidenced in previous research (Mathieu, Tannenbaum, & Salas, 1992; Noe & Wilk, 1993). In the technology acceptance literature, facilitating conditions in job procedures (e.g., time availability, job-related information, hardware/software access) have been found to have a direct effect on potential users' perceived usefulness of using technologies (e.g., Mathieson, Peacock, & Chin, 2001).

Organizational Support

Organizational support represents the degree to which employees perceive that their employers support individuals' participation in development activities and value their learning through supportive organizational policies such as skill-based pay systems and visible rewards (Kozlowski & Farr, 1988; Tharenou, 2001; Tracey & Tews, 2005). Based on the expectancy-theoretical model, supportive organizational policies for learning may advance employees' belief about the valence and benefits of the outcomes gained from participation in learning. The positive link between organizational support and perceived usefulness of learning is empirically evidenced in literature (Maurer & Tarulli, 1994; Tracey, Hinkin, Tannenbaum, & Mathieu, 2001). From the technology acceptance perspective, facilitating conditions at the organizational level (e.g., internal training program, perceived financial resources) have been found to have a direct effect on perceived usefulness of using a technology (e.g., Igbaria, Zinatelli, Cragg, & Cavaye, 1997; Wang, Lin, & Luarn, 2006).

Perceived Usefulness as the Motivational Determinant of e-Learning

The impact of perceived usefulness in explaining individual's behavioral intention to use technologies is theoretically grounded in Vroom's (1964) expectancy theory (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989). According to the expectancy-theoretical model (e.g., Snead & Harrell, 1994), an individual's motivation (i.e., intention) to use e-learning is explained by the valence (i.e., attractiveness or usefulness) of the outcomes of using e-learning (i.e., first-level outcome, e.g., acquisition of new KSAs) and the expectancy (i.e., perception or belief of likelihood) that his/her behavioral effort in usage will lead to the specific outcomes. The valence of the outcomes of using e-learning is further determined by the valence of the extrinsic rewards (i.e., second-level outcome, e.g., improved job performance, pay increases, or promotions) that result from the outcomes of usage and the perceived likelihood

(i.e., instrumentality) that the outcomes will lead to the rewards. In such a way, perceived usefulness is represented by outcome expectancy in the expectancy-theoretical model. The expectancy theory provides one of the theoretical bases for TAM and has been empirically applied in explaining information system usage behavior (e.g., Burton, Chen, Grover, & Stewart, 1993; Snead & Harrell, 1994; Watson & Hewitt, 2006).

Previous research studies on acceptance of e-learning in the workplace environment suggest that perceived usefulness of e-learning in improving individual learning effectiveness has a significant effect on employees' attitude, satisfaction, and intention to use e-learning (Roca & Gagne, 2008). Studies in distance learning and e-learning for human resource development suggest that learners' communication and collaboration in distance learning environments may address their social needs and therefore promote learners' satisfaction with and motivation to use online learning (DeRouin, Fritzsche, & Salas, 2005a).

Moderator

Beyond the indirect influences mediated by perceived usefulness, perceived job support is alternatively hypothesized to moderate the relations between trainees' perception of usefulness and their intention of using e-learning. This means that the effect of trainees' perceptual beliefs about the usefulness of e-learning on their intention to use e-learning is dependent on the perceived job conditions. The assumption is that, if trainees perceive that they cannot translate the perceived outcome (i.e., mastery of KSAs) of using e-learning into an improved job performance because of the poor job support, e.g., no opportunities to apply the KSAs due to no autonomy in work scheduling or fixed task assignments, then the trainees will be frustrated and not motivated to use e-learning. This moderating effect has been stated and tested in prior studies (Mathieu, & Martineau, 1997; Mathieu, Tannenbaum, & Salas, 1992; Tharenou, 2001). From the technology acceptance perspective, the theoretical rationale for the moderating role of job support between perceived usefulness and intention to use can be found in the elaboration likelihood model (ELM), which is a theory from social psychology literature explaining human attitudinal and behavior change. The ELM model has recently been introduced into the IT acceptance area to construct alternative models of influences and to specify moderating factors. It posits that individuals' attitude change is driven by external information, and the information recipients' motivation and ability to elaborate the informational messages will moderate the influence processes (Bhattacherjee & Sanford, 2006). In IT acceptance literature, the perceived job relevance of a target technology is defined to operationalize the potential user's motivation dimension of elaboration and is modeled as a moderator between perceived usefulness and behavioral intention (Kim & Garrison, 2009). In the present study, perceived job support is regarded to provide a stimulus for the trainees' extrinsic motivation to elaborate

information about e-learning and thus is expected to moderate the influence of perceived usefulness of e-learning on usage intention.

Measures and Instruments

In this study, Tracey and Tews' (2005) general training climate scale (GTCS) was adopted to measure the three organizational learning environment factors: managerial support, job support, and organizational support. *Managerial support* is defined as "the extent to which supervisors and managers encourage on-the job learning, innovation, and skill acquisition and provide recognition to employees in support of these activities"; *job support* refers to "the degree to which jobs are designed to promote continuous learning and provide flexibility for acquiring new knowledge and skills"; and *organizational support* represents "policies, procedures, and practices that demonstrate the importance of training and development efforts, such as reward systems and resources to acquire and apply learned skills" (Tracey & Tews, 2005). The conceptual foundation of the three-factor definition of the training climate is associated with the three-facet taxonomy of organizational climate and the diagnostic theories of organizations, which both characterize organizational work environments in terms of three systems: social, job-related/technical, and organizational (Ostroff, 1993). The three factors also are accordant to the multilevel point of view of organizational systems for training design (Kozlowski & Salas, 1997). The measure of training climate is made up of 15 items, with 5 items measuring each of the three sub-constructs. In a validation study, the three sub-constructs of the training climate scale were tested to have satisfactory psychometric properties (i.e., internal consistency, convergent and discriminant validity, and criterion-related validity) (Tracey & Tews, 2005). *Perceived usefulness for individual learning* refers to the extent to which the workplace e-learning application/application is perceived to be useful for employees to assess their job competencies, identify personal learning needs, and support the process of independent on-the-job learning. Measures of perceived support for individual learning included eight items adopted from Arbaugh (2000); Davis, Bagozzi, and Warshaw (1989); Kirkpatrick and Kirkpatrick (2006); and Thurmond, Wambach, Connors, and Frey (2002). *Perceived usefulness for social learning* is the extent to which the workplace e-learning system/application is perceived to be useful for a group of workers to develop the interpersonal relationship of cooperation and collaboration in learning and developmental activities. Three items derived from Kankanhalli, Tan, and Wei (2005) and Noe, Wilk, Mullen, and Wanek (1997) were used for measurement. The construct *intention to use* was operationalized by three items from Kirkpatrick and Kirkpatrick (2006) and Venkatesh and Davis (2000).

Following Kankanhalli, Tan, and Wei (2005), the raw collection of items were conceptually validated. For this purpose, the 29 items, with a random order, were administered to 12 subjects of an educational level of postgraduate or above. The definitions of the six constructs were introduced with the items. The subjects were

asked to link each item to the most proper construct according to their understanding of the items and constructs. After the responses had been collected, the inter-judge agreement statistics for each item were calculated, and only items that were placed to the intended constructs with a high inter-judge agreement were preserved as the indicators of the constructs. After the pilot revision, 5 items were deleted and 24 items were preserved.

Procedure and Participants

An online survey was conducted to collect and analyze perceptions and reactions from workplace learners towards a performance-oriented e-learning application delivered at a web-based system. There were a total number of 222 usable responses from different organizations of various size and sectors. The details of the procedure and the participants are the same as described in the previous chapter.

Data Analysis Methods

Structural equation modeling (SEM) technique was adopted to test the model involved multistage causal relationships. SEM is advantageous in simultaneously evaluating the measurement model and estimating the structural coefficients. LISREL 8.7 was used as the statistical tool to implement the modeling program. The two-stage strategy recommended by McDonald and Ho (2002) was followed such that the confirmatory factor analysis (CFA) was carried out first to evaluate the measurement model, and the full model was then tested to generate the path coefficients. The moderating effects in the model were tested via Mathieu, Tannenbaum, and Salas' (1992) method which involves latent product terms to evaluate latent variable interaction effects.

Measurement Model

To examine the measurement properties of the preliminary survey instrument, a confirmatory factor analysis (CFA) was implemented. Based on the model fit indices values, the initial measurement model was revised.

To examine the psychometric properties of the revised measurement model, Cronbach's α, convergent validity, and discriminant validity were assessed. Cronbach's α reflects the *internal consistency reliability* among indicators of a construct. Following Fornell and Larcker (1981) and Chiu, Hsu, and Wang (2006), *convergent validity* was ensured via three criteria: (a) all indicator loadings should be significant and exceed 0.7, (b) construct reliabilities should exceed 0.8, and (c)

average variance extracted (AVE) should exceed 0.5. For *discriminant validity*, Fornell and Larcker (1981) suggested that the square root of the AVE from the construct should be larger than the correlation shared between the construct and other constructs in the model. Based on Fornell and Larcker's (1981) principle, Chiou and Lin (2009) suggested that the average AVE values of any pair of constructs should be larger than the squared correlation between that pair of constructs.

In addition, multicollinearity among the exogenous constructs (managerial support, job support, and organizational support) was checked. Besides, whether common method bias is a concern was assessed using a single-factor confirmatory factor analysis (CFA), which is a variant of Harman's one-factor test (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Structural Model

To examine the causal effects in the proposed model, the path coefficients in the structural model were estimated via maximum likelihood by LISREL 8.7.

To interpret the nature of the indirect paths in the structural model, the mediating roles of perceived usefulness for individual learning and perceived usefulness for social learning between the three exogenous variables and the dependent variable, intention to use, were examined. Following Baron and Kenny's (1986) causal step approach, the four conditions for mediation were tested in two models. First, the direct relationship between the independent variable and the dependent variable was tested in a direct path model. Second, the significance of the path coefficients in a mediating model which includes the mediator was tested. Besides, according to Wood, Goodman, Cook, and Beckman's (2008) recommendation, Sobel's (1982) Z was calculated to test the significance of change in the direct effect between the independent and dependent variables. According to these authors, full mediation occurs when the direct effect of independent variable on dependent variable changes from being significant to no longer significant after inclusion of the mediator, while partial mediation can be inferred when the direct effect between independent and dependent variables decreases but remains significant, both plus that the Sobel Z is significant.

Moderating Effect

In this study, the latent product approach (Mathieu, Tannenbaum, & Salas, 1992) was adopted to test the hypothesized moderating effects of job support. The moderation effects were tested through two stages of implementation. First, whether there exist significant moderating effects in the model was diagnosed using Mathieu, Tannenbaum, and Salas' (1992) significance test of $\triangle\chi^2$ and further checked through Carte and Russell's (2003) F-statistic and Cohen's (1988) formula for effect

size (f^2). Second, on the basis that the moderating effects were verified, the plots of interaction between the moderator and the predictor were depicted to interpret the nature of the interaction effects following Ping's (2002) and Cohen, Cohen, West, and Aiken's (2003) approach.

Results

Measurement Model Testing Result

Based on the model fit indices values of CFA, the initial measurement model that consists of 24 items loading on the six constructs was revised by dropping two items loading on managerial support, two items loading on organizational support, and one item loading on PU-IL. The revised model showed satisfactory fit to the sample data contrasted to the recommended fit values.

All Cronbach's α values were higher than 0.7, showing satisfactory internal consistency reliability of the scales. The other results suggested satisfactory convergent validity and discriminant validity of the revised measurement model. In addition, the result indicated no serious multicollinearity problem among the exogenous constructs (managerial support, job support, and organizational support). Based on the single-factor confirmatory factor analysis (CFA) result, the one-factor model didn't fit the data well (χ^2/df = 11.09, RMSEA = 0.21, GFI = 0.55, CFI = 0.87), suggesting that the method factor (i.e., self-reported data from a single-source survey) was not an account for the covariation in the data.

The items of the final instrument are listed in the following.

Perceived Managerial Support (Tracey & Tews, 2005)

1. Supervisors give recognition and credit to those who apply new knowledge and skills to their work.
2. Top management expects continuing technical excellence and competence.
3. Top management expects high levels of performance at all times.

Perceived Job Support (Tracey & Tews, 2005)

1. Job assignments are designed to promote personal development.
2. Gaining new information about ways to perform work more effectively is important in this organization.
3. Work assignments include opportunities to learn new techniques and procedures for improving performance.

Perceived Organizational Support (Tracey & Tews, 2005)

1. There is a performance appraisal system that ties financial rewards to use of newly acquired knowledge and skills.
2. There are rewards and incentives for acquiring and using new knowledge and skills in one's job.

Perceived Usefulness for Individual Learning

1. The e-learning system would be helpful for me to construct knowledge in my work context (Kirkpatrick & Kirkpatrick, 2006).
2. Using this e-learning system would allow me to arrange my learning more effectively (Arbaugh, 2000).
3. Using this e-learning system would enhance effectiveness in my work-related learning (Davis, Bagozzi, & Warshaw, 1989).
4. This e-learning system would be helpful for me to identify my knowledge gaps or learning needs (Kirkpatrick & Kirkpatrick, 2006).
5. Using this e-learning system in my job would enable me to acquire job-related competency more quickly (Davis, Bagozzi, & Warshaw, 1989).

Perceived Usefulness for Social Learning

1. This e-learning system would be helpful for formation of a workplace climate of cooperation in work-related learning (Kankanhalli, Tan, & Wei, 2005).
2. This e-learning system would be helpful for formation of a workplace climate of peer mentoring and coaching (self-developed based on Noe, Wilk, Mullen, and Wanek (1997)).
3. This e-learning system would be helpful for formation of a workplace climate of teamwork in learning (Kankanhalli, Tan, & Wei, 2005).

Intention to Use

1. Given that I had access to this e-learning system, I predict that I would use it (Venkatesh & Davis, 2000).
2. If possible, I would recommend this e-learning system to other teammates (Kirkpatrick & Kirkpatrick, 2006).
3. Assuming I have access to the e-learning system, I intend to use it (Venkatesh & Davis, 2000).

Structural Analysis Result

According to the structural analysis results, the fit values of indexes showed that the full model fit the sample data acceptably. As shown in Fig. 14.1, the path coefficients suggest that managerial support (MS) had a significant impact on perceived usefulness for individual learning (PU-IL) ($\gamma_{11} = 0.39$, t-value = 3.19, $p < 0.01$) but had no significant effect on perceived usefulness for social learning (PU-SL) ($\gamma_{21} = 0.18$, t-value = 1.39, not significant at $p < 0.05$).

The structural coefficients also demonstrate that job support (JS) had a significant effect on perceived usefulness for individual learning (PU-IL) ($\gamma_{12} = 0.53$, t-value = 3.41, $p < 0.001$), but had no significant effect on perceived usefulness for social learning (PU-SL) ($\gamma_{22} = 0.18$, t-value = 1.12, not significant at $p < 0.05$).

The effect of organizational support (OS) on perceived usefulness for individual learning (PU-IL) ($\gamma_{13} = -0.28$, t-value = -2.82, $p < 0.01$) was negative and significant, and the path from OS to perceived usefulness for social learning (PU-SL) was significant ($\gamma_{23} = 0.27$, t-value = 2.51, $p < 0.05$). The two paths to intention from employees' perceptions are both significant ($\beta_{11} = 0.75$, $p < 0.001$; $\beta_{12} = 0.34$, $p < 0.001$).

According to the structural equation modeling results, 50% of the variance of perceived usefulness for individual learning (PU-IL) could be explained by the three exogenous variables ($R^2 = 0.50$, $\zeta = 0.50$), 31% of the variance of perceived usefulness for social learning (PU-SL) could be explained by organizational support ($R^2 = 0.31$, $\zeta = 0.69$), and 84% of the variance of intention to use could be explained by the two perception dimensions of usefulness ($R^2 = 0.84$, $\zeta = 0.16$).

The mediation testing results indicate that perceived usefulness for individual learning completely mediate the effects of the three exogenous constructs on the dependent variable, and perceived usefulness for social learning contributes partial mediation in the effects from the three exogenous variables to intention to use.

Moderating Effect Analysis Result

The significant $\triangle\chi^2$ and F-statistic suggest that the significant moderating effect of job support on the relationship between perceived usefulness for individual learning and intention to use is supported. The size of the moderating effect is 0.75, indicating a large effect. The LISREL estimate results suggested that perceived job support weakened the relationship between perceived usefulness for individual learning and intention to use ($\gamma = -0.26$, t-value = -4.46).

To interpret the nature of the moderation effect, the interaction between job support and perceived usefulness for individual learning on intention to use was plotted following the standard procedures (Aiken & West, 1991). Using Ping's (2002) and Cohen, Cohen, West, and Aiken's (2003) approach, the significance of the simple slopes were tested. Results show that all three simple slopes are significant at

$p < 0.05$ (i.e., for low job support, t-value $_{(slope)} = 12.15$ and standard error = 0.0003; for mean job support, t-value $_{(slope)} = 11.34$, and standard error = 0.0002; for high job support, t-value $_{(slope)} = 8.18$ and standard error = 0.0003).

For the moderator role of job support on the relation between perceived usefulness for social learning on intention to use, the $\triangle\chi^2$ between the interaction model and the main effect model is significant ($p < 0.01$, $\triangle\chi^2_{(df=1)} = 16.59$), verifying the significant moderation. The F-statistic further confirms the effect ($F_{(1183)=}114.38$, $p < 0.01$). The moderating effect of job support on the relation between perceived usefulness for social learning on intention to use is at a large size (Cohen's $f^2 = 0.63$). The LISREL estimate results suggest that perceived job support attenuates the relationship between perceived usefulness for social learning and intention to use ($\gamma = -0.25$, t-value = −3.88).

To interpret the nature of the moderation effect, the interaction between job support and perceived usefulness for social learning on intention to use was plotted following the standard procedures. The three simple slopes are tested to be significant at $p < 0.05$ (i.e., for low job support, t-value $_{(slope)} = 6.44$ and s.e. = 0.0007; for mean job support, t-value $_{(slope)} = 5.22$ and s.e. = 0.0005; for high job support, t-value $_{(slope)} = 2.96$ and s.e. = 0.0007).

Discussions

To address the issue of enhancing employees' participation in workplace e-learning, this study built and tested a model of work environment influences on employees' motivation to use an e-learning system mediated by their valence, instrumentality, and expectancy belief. The results suggested that (1) perceived managerial support and perceived job support had a significant positive impact on perceived usefulness of the workplace e-learning system in supporting individual learning such as identification of knowledge gap and acquirement of work-related competency and (2) perceived organizational support had a significant positive effect on perceived usefulness of the workplace e-learning system in supporting social learning, such as peering mentoring and coaching and teamwork climate. The two dimensions of employees' perceptions of the usefulness of using the e-learning system both had a significant positive influence on their intention to use the system. Perceived usefulness for individual learning was found to completely mediate the paths from the three exogenous variables (managerial support, organizational support, and job support) to intention to use e-learning, while perceived usefulness for social learning contributed partial mediations in the effects of the three work environment factors on trainees' intention to use e-learning. On the other hand, perceived job support was found to have significant mitigating moderation effect on the relationships from the two perceived usefulness dimensions to employees' intention to use e-learning.

The finding of positive effect of perceived *managerial support* on perceived usefulness of the workplace e-learning system in supporting individual learning was consistent with the expectancy-theoretical explanation of the social context impacts

on trainees' motivation to participate in learning. The significant path means that influences from interpersonal relationships such as supervisor and manager reinforcement will act as a motivator for trainees' expectation of gaining beneficial outcomes from using e-learning and their subsequent intention to accept the system. The result is also accordant with the positive link between social influences and workers' perceived usefulness of using workplace technology (Lewis, Agarwal, & Sambamurthy, 2003; Venkatesh & Davis, 2000). In corporate e-learning literature, while senior management support and top leadership commitment were stated to be an important factor in e-learning effectiveness (Rosenberg, 2006), the results of this study provided quantitative support for these claims.

The finding of significant direct relationship between perceived *job support* and perceived usefulness of the e-learning system for individual learning is consistent with the relation between perceived resources (e.g., sufficient knowledge and data resources) and perceived usefulness of work technologies found in technology acceptance literature (Mathieson, Peacock, & Chin, 2001). From the expectancy-theoretical point of view, the result suggests that a high degree of job support, e.g., many opportunities for workers to learn and transfer new knowledge and skills in their job, will increase employees' expectancy that the learned knowledge and skills from participation in e-learning will be useful in leading to improved job performance and consequently motivate them to use and participate in e-learning activities.

The finding of significant impact of perceived *organizational support* on perceived usefulness of the workplace e-learning in supporting social learning is accordant with the expectancy-theoretical explanation, that is, organizational supportive policies (e.g., budgetary support, monetary rewards, promotion, etc.) for e-learning is an effective factor for increasing employees' expected benefits of learning and thus will motivate them to use and participate in e-learning. In the technology acceptance area, from an institutional theory point of view, organizational norms, values, culture, and history all have a significant influence on the thoughts and actions of individuals within an organization (Lewis, Agarwal, & Sambamurthy, 2003). This justification was empirically evidenced in the case of workplace e-learning usage in the result of this study. The result implies that organizational policies and procedures is a critical dimension of a facilitative work environment for learning, and thus, elements that constitute organizational policy infrastructures such as business strategies, incentives systems, financial and budgetary support in human resource development, and organizational decision structure will be essential conditions for e-learning success.

On the other hand, perceived *job support* was found to have mitigating moderating effects on the relationships between the two dimensions of employees' perceived usefulness and their intention to use the e-learning system. One of the possible reasons may relate to the phenomenon of resistance to changes. Prior research findings pointed out that implementation of new workplace technologies often involves learning new technologies, changes in work practices, and an additional workload. These may lead to a fear of adverse consequences or reduced behavior control and resistance to changes, and employees' resistance to change may reduce the effective use of the new technologies (Karsh, 2004; Umarji &

Seaman, 2005). In terms of e-learning technology, the implementation of a new online learning system and accompanying policies in an organization may lead to additional learning effort and workload for workers as well as to employees' feelings of uncertainty and reduced behavioral control in the new environment. Another possible reason may be associated with employees' individual characteristics such as computer self-efficacy and learning goal orientation, which have been found to have an impact on learners' motivation and intention to use learning technologies (Klein, Noe, & Wang, 2006).

It was unexpected to find that perceived *organizational support* has a significant negative effect on perceived usefulness of the e-learning system for individual learning. This result is not consistent with the theoretical assumption. However, in prior literature, similar results were reported, e.g., Tharenou (2001) found employer support was negatively linked to trainees' motivation through expectation, and in Kozlowski and Farr (1988), updating climate was found to have no significant relation with trainees' technical updating responses. These mixed results may imply that further investigations are needed.

Implications

The findings provide implications to both practice and research. In the practical side, the results indicated that the three work environment factors, i.e., managerial support, job support, and organizational support, were significant motivators for employees' acceptance of the e-learning system. This finding implies that, for the management in organizations who are in charge of e-learning initiatives, it would be a first step to check and redesign work environment elements, e.g., social atmosphere, work flow design, and skill-based reward system. It could be wise to identify and overcome the potential situational constraints in the organizational systems that may be detrimental and misguiding for workers' expectancy beliefs toward using e-learning prior to making the financial inputs in e-learning design and development efforts. It could be expected that if it is initiated in an appropriate work environment, the potential of e-learning as an approach to employee formal and informal learning could be exploited. At the macro level, organizations in the process of strategic change via e-learning should consider and put adequate attention to leadership commitment, job system design, and organizational human resource development policies and strategies; each of these aspects constitutes an essential dimension of a facilitative organizational environment for e-learning implementation. Besides, the results of the present study indicate that both perceived usefulness for individual learning and perceived usefulness for social learning play a mediating role in the work environment influences on individuals' motivation to learn. This finding suggests that the two pedagogical design principles for e-learning, i.e., design to support individual cognitive learning and to support social construction of knowledge, should be considered in instructional design practices of workplace e-learning applications.

From the theoretical standpoint, the findings of this research extend the literature on e-learning acceptance by including and validating the effects of work environment factors. The expectancy theory of training motivation as well as the social influences and facilitating conditions in technology acceptance models provide sound theoretical foundations for integrating work environment influences in e-learning acceptance models. Education or training is a kind of complex system. There are many interacting components in an educational or training system, including learners, instructors, professional communities, administrators, support staff, technologies, facilities, infrastructure, funding and support, reporting, etc. It is crucial to have a holistic view or system perspective and a comprehensive planning for effective application of learning technologies in school, institutional, and organizational environment (Wang, 2011). Future research on effectiveness of e-learning at work could make more endeavors to build and test integrative models involving organizational, technological, instructional design, and individual differences factors for e-learning motivation, achievements, and transfer.

Summary

This chapter examines the role of work environment factors in explaining employees' motivation to use performance-oriented e-learning in the workplace. The research model is established on the theoretical frameworks of expectancy theory of training motivation and the external contextual influences and facilitating conditions in technology acceptance models. Managerial support, job support, and organizational support are identified as the key factors of organizational learning environments.

Findings of this study add to the current understandings on workplace e-learning success factors by validating the environmental influences on trainees' motivation to use e-learning through changing their valence, instrumentality, and expectancy beliefs. The results suggested that employees' perceived managerial support and job support had a significant impact on their perceived usefulness of the e-learning system for individual learning, and that perceived organizational support had a significant influence on the perceived usefulness of the e-learning system for social learning. Perceived usefulness for individual learning was found to completely mediate the environmental influences on individuals' motivation to use the system, while perceived usefulness for social learning made partial mediation in the effects of the environmental factors on intention to use. In addition, perceived job support was found to have moderating effects on the relationship between employees' perceived usefulness of the e-learning system and their intention to use the system. Consistent with previous findings, employees' perceptions about the usefulness of the e-learning system have significant effects on their intention to use the system in the work setting.

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Chapter 15
Conclusion and Summary

Workplace e-Learning as a Complex, Multidisciplinary Field

With the exponential growth of information and open learning content and the affordances of ubiquitous and powerful technologies, e-learning has emerged and been increasingly employed in workplace settings to support employee training and development. e-Learning affords just-in-time training and rapid dissemination of knowledge and makes on-the-job training more accessible, flexible, and convenient than traditional approaches. It has a substantial impact on promoting self-directed, lifelong learning, social interaction and open innovation, and organizational learning and knowledge assets management, all of which is crucial to learning and development in the workplace.

While e-learning has been increasingly used by organizations, the literature has reported a variety of barriers to the success of e-learning initiatives. The main concerns involve the use of static and noninteractive e-learning applications, generic content irrelevant to daily work or not effectively integrated with business processes, lack of alignment with business objectives and outcomes, ignorance of comprehensive evaluation and accountability, and insufficient attention to the development of appropriate organizational environment or culture to support e-learning. Managers are also concerned about the cost and technology requirements for implementing e-learning. Technology-dominated approaches have made e-learning applications less effective in motivating employees and improving learning outcomes in workplace contexts. e-Learning in the workplace has received criticism in terms of its relevance to key business processes and outcomes and its commitment in the assessment and evaluation process.

With the proliferation of workplace e-learning research and development, a variety of topics and issues have been explored, showing the complex, dynamic nature of the field. Based on the findings of our study on bibliometric analysis of the literature, the research on workplace e-learning is categorized into *four directions*:

M. Wang, *E-Learning in the Workplace*, Explorations in the Learning Sciences, Instructional Systems and Performance Technologies,
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e-learning for continuing education and professional development, e-learning in the healthcare sector (as one of the most prolific e-learning initiatives), use of social media for e-learning, and integration of knowledge management with e-learning. Research on e-learning in the workplace has cut across different disciplines such as employee training, adult learning, educational technology, computer science, human resource development, psychology, sociology, and management. People in these disciplines speak different languages, use different research models and intervention tools, and contribute to different literature bases.

Workplace e-Learning as a Complex Dynamic System

Workplace learning is a complex system involving multiple stakeholders, many interrelated components, and dynamic and nonlinear relationships among the components. Systems approaches have shown their potential to transform workplace learning by building a holistic understanding of workplace e-learning and creating a new, scientifically credible approach to managing e-learning in the workplace. This book has investigated workplace e-learning as a complex system in the following aspects. *First*, it is important to identify and integrate the individual, social, and organizational levels of learning in workplace settings. Learning at the individual level focuses on self-direction and learner autonomy together with necessary support to facilitate such learning. Moreover, learning in the workplace should integrate with the context of teams and the wide organization, allowing individual learning to influence practices and changes within that organization. Further, the organization itself is expected to learn to ensure continuous transformation in dynamic and competitive environment. *Second*, when exploring e-learning in the workplace as a complex system, we should consider not only learners, learning resources, and learning technology but also jobs and tasks, social contexts, and organizational systems, which form a holistic picture of workplace e-learning. *Third*, as a complex system, workplace e-learning exhibits goal-oriented individual, social, and organizational processes driven by the goals to improve both individual and organizational performance with the support of technology. Managing such a complex system requires the shift from optimizing specific outcomes to effective communication to align diverse goals and discern leverage points in mutual causal processes for persistent improvement.

A Performance-Oriented, Technology-Enabled Approach to Workplace e-Learning

To manage workplace e-learning as goal-oriented individual, social, and organizational processes driven by the goals to improve both individual and organizational performance, we present a performance-oriented approach to e-learning in the

workplace, which has been implemented and analyzed in our projects. The approach is featured by (1) establishing workplace learning on measurable performance goals, (2) aligning individual needs and organizational goals in setting the performance measures, and (3) using clearly specified measurable performance goals to facilitate self-directed individual learning, promote and direct social learning, and guide organizational knowledge assets management for sustainable performance. To implement the approach, key performance indicators (KPIs) are used to translate the learning goals into performance measures. A case study has been explored to demonstrate how the KPI-based performance-oriented approach to workplace e-learning can be established in medium-sized company and implemented in a web-based learning program. An empirical study was conducted by inviting employees to use and evaluate the KPI-based performance-oriented e-learning program, with results showing the effectiveness of the proposed approach.

Acceptance of Performance-Oriented Workplace e-Learning

Given that technology affordances and organizational environment or culture are among the key factors that influence employees' acceptance of technology-mediated learning innovation, we investigated the impact of these factors on employees' acceptance of the KPI-based performance-oriented e-learning initiative through a questionnaire survey with employees. In terms of *technology affordances*, the results of our study show that perceived usefulness of the e-learning initiative in terms of improving self-directed learning processes and promoting collaboration among colleagues has positive influences on employees' intention to use such technology-delivered workplace learning innovation, but perceived support for enhancing social ties had a negative effect on employees' intention. In terms of *organizational environment or culture*, the results of our study suggest that managerial support- and job support-perceived employees has a significant impact on their perceived usefulness of the e-learning initiative for individual learning, and that perceived organizational support had a significant influence on the perceived usefulness of the e-learning initiative for social learning.

Conclusion and Future Directions

Workplace learning is essential for individual and organizational development and performance. This is particularly true in recent decades when organizations have faced accelerating pace of change in economic growth, marketplaces, population structures, societies, and technology innovations. As a result of these pressures, organizations are seeking difficult-to-imitate ways to configure their resources, structures, and processes, among which knowledge workers have received

high-priority attention. Knowledge workers are seen as substantial capital of an organization, and learning is viewed as a key attribute of successful organizations.

Clearly, e-learning and blended forms of e-learning are on the rise in organizational training and development environment. A combination of online and face-to-face learning has become the dominant delivery method in workplace contexts. Self-directed learning is more prevalent now than ever due to a combination of 24/7 Internet accessibility as well as an entire generation of digital natives entering the workforce. Individuals are taking active control of their own learning and development by setting learning goals with career targets, exploring open-ended resources, and reflecting on their performance. As digital natives populate the workforce, the trend of technology-supported self-directed learning will continue to grow together with the emergence of high-tech, knowledge-based societies.

While many organizations have recognized the need to promote e-learning for training and development, the research and development efforts associated with the application of new technologies for improving workplace learning and performance have grown more complex and challenging. Recognizing the need to integrate pedagogical, social, managerial, and technological perspectives in workplace e-learning initiatives, this book explores a theory-driven design, implementation, and analysis of a performance-oriented, technology-enabled approach to improving e-learning in the workplace. More substantial efforts are needed to explore how emerging technologies, learning theories and instructional strategies, and organizational systems, structures, and policies can be incorporated into workplace e-learning research and development.

Given that workplace learning is highly situated and practice-oriented, effective e-learning design, for example, by using authentic cases and scenario, simulations or games, and virtual team collaboration and problem-solving, will receive more attention in future research and practice. While e-learning encourages learner control and autonomy, it is important to provide learners with necessary support especially for complex tasks or skills that are inaccessible to novices. Also, while individuals are offered high flexibility in access to diverse content and knowledge, they may experience information overload and disorientation; there is a need to empower learners not only in access to learning content but also in the development of a meaningful, connected, and coheerent understanding.

Social media and technology have been playing a considerable role in learning and communication in organizational environment. They may also cause challenges such as security breaches and the proliferation of information silos posed by using these new tools. The implementation of social media and interaction in the workplace may require a new style of leadership for organizing interaction and securing information in a meaningful and effective way.

Developing the ability of the employees and the organization itself to acquire new knowledge and skills has become a core strategy for gaining competitive advantage. In addition to knowledge acquisition, the capacity to create new knowledge and manage organizational knowledge assets for sustainable development represents the opportunity for building a lasting competitive advantage. Learning in workplace contexts should go beyond the individual and social levels, and an

organization should be able to learn and adapt to the dynamic environment. More substantial research is needed to explore how organizational systems, structures, and policies can be incorporated into workplace learning initiatives with a view to creating a coherent and manageable system for both individual and organizational learning.

Index

M. Wang, *E-Learning in the Workplace*, Explorations in the Learning Sciences, Instructional Systems and Performance Technologies,
DOI 10.1007/978-3-319-64532-2