Explaining changes in learning and work practice following the adoption of online learning: a human agency perspective

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Abstract
Online learning applications are typically introduced with expectations that they will be used to improve learning and work practices, yet they often fall short of expectations following implementation. Numerous empirical studies have reported unintended use (and nonuse) of new IT applications, providing initial support for practice-based research for viewing emergent changes in work practices. Human agency is a core concept in theories of practice, which seek to explain how recurring patterns of action develop in social contexts such as work settings. However, current applications of theories of practice do not provide satisfactory explanations for the reasons underlying changes in work practice. In this study, we investigate changes in learning and work practices associated with the implementation of an online learning system in a Taiwanese hospital. We apply a temporal theory of human agency that disaggregates agency into elements reflecting actors' orientations to the past, present, and future. We use this theory to address the following research question: why do learning and work practices change following the implementation of online learning? The case study reveals that actors face pressures to respond to the attractions of new ways of learning while preserving traditional work practices. In addition, technological features and social structures constrain the exercise of human agency. As a result, use of the online learning system declined in the period following implementation. Our analysis adds explanatory power to the practice perspective by incorporating human agency, technological constraints, and structural conditions that affect practice.
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Introduction
Online learning is frequently overlooked as an important application of information technology (IT) in organizations. Although frequently studied in educational environments (Leidner & Jarvenpaa, 1995; Webster & Hackley, 1997; Lang & Zhao, 2000), online support for the training and development of an organization's human resources is relatively neglected. However, organizations continue to allocate significant resources to build online learning environments (Lang & Zhao, 2000; Alavi & Gallupe, 2003), with the expectation that work performance will improve. In work contexts, desired benefits from online learning occur when learners maintain skills and acquire new knowledge that is incorporated directly into their work practices. Where learning is not embedded within users'

work practices, online learning applications may not meet expectations. For these reasons, online learning is often integrated as part of ongoing work practices rather than established as a separate activity (Hsiao *et al.*, 2006).

Health care settings, particularly hospitals, stand to benefit from the greater flexibility of access to professional development opportunities afforded by online learning. The need for professional development is great in health care and is often mandated by licensing and accreditation agencies. Changes in specialized treatment techniques, pharmaceutical products, and legal requirements in areas such as patient privacy all necessitate the ongoing professional development of health care workers. In recent years, health insurers have also pressured hospitals to operate more efficiently and to control costs of health care. In response, most hospitals have attempted to improve their performance by implementing IT applications such as patient care information systems (PCIS) and, more recently, telehealth (Constantinides & Barrett, 2006; Cho, Mathiassen & Robey, 2007). The implementation of online learning applications in health care appears to be consistent with other efforts to improve performance through investments in IT.

Despite the critical importance of IT applications in health care, previous research on IT in health care suggests that difficulties often occur (Chiasson & Davidson, 2004). Many such difficulties can be traced to the shifts in work practices required if IT applications are used as intended. For example, PCIS are often adopted and implemented because hospitals wish to integrate the heterogeneous network of clinical services (Berg, 1999). However, using a PCIS changes the physician's role from an individual master to a member of a team (Berg, 1999), and it alters record keeping from a private activity to a public one (Stevens, 1989; Howell, 1995). Implementing integrated care delivery systems, therefore, may involve 'radically restructuring the traditional, ''functional organized'' health care organizations' (Berg, 2001, p. 150). Similarly, telehealth programs may encounter resistance when they contradict institutionalized medical practices (Constantinides & Barrett, 2006; Cho *et al.*, 2007). Where telehealth and other IT applications are integrated with the work practices of physicians and other health professionals, they encounter less resistance and are used more effectively (Mattarelli & Weisband, 2006).

Clearly, research is needed that provides insights into the problems of integrating IT applications with work practices in health care. Response to such needs is evidenced by the growing literature on health information systems (IS) (Chiasson & Davidson, 2004). Unfortunately, studies on health IS have neglected online learning applications. Chiasson & Davidson's (2004) review of 165 research articles on health IS published between 1985 and 2003 included no articles on the use of IT in learning. This dearth of previous work, along with the importance of professional training and development to health care, motivate the study reported in this paper.

In this study, we address the following research question: *why do work and learning practices change following the implementation of online learning?* We adopt recent perspectives on work practice to investigate changes in learning and work practices associated with the implementation of an online learning system in a Taiwanese hospital. Specifically, we seek to explain the actions of hospital employees, who initially expressed enthusiasm toward the online learning system but who later stopped using the system almost completely. Moreover, work practices were not affected by online learning. These changes in behavior are puzzling and are not easy to understand theoretically. On the one hand, research on IT adoption suggests that IT applications that are perceived as useful would be adopted and used as intended (Davis, 1989; Ong *et al.*, 2004). On the other hand, research on IT implementation suggests a variety of technical and organizational factors that might impede the intended use of IT (Newman & Noble, 1990; Jarvenpaa & Ives, 1991; Clarke *et al.*, 2005; Jasperson *et al.*, 2005). However, neither of these research streams is oriented to answer questions about dramatic differences between intentions prior to adoption and actions during periods of use. We phrase our research question to ask 'why,' indicating our aim to provide a satisfactory theoretical interpretation of the study's findings.

Our perspective on practice focuses on human agency, usually defined as the capacity of human beings to act in ways not predetermined by social structures (Sewell, 1992; Emirbayer & Mische, 1998; Hatch & Cunliffe, 2006). Agency is a core concept in theories of practice, which seek to explain how and why recurring patterns of action develop in social contexts such as work settings (Schultze & Boland, 2000). A particular interest of the IS literature is to understand the implications of IT for work practices (Orlikowski, 2000). Although IT may be introduced with the expectation of shaping or controlling aspects of work performance, the practice perspective on IT usage suggests a wide variety of possible responses to IT interventions. The exercise of human agency largely shapes how IT is used and incorporated into work practices.

We begin with a selective review of theoretical approaches to human agency and practice and how those theories explain IT's influence on practice. Based on this review, we identify Emirbayer & Mische's (1998) temporal theory of human agency as suitable for our objective to explain changes in work and learning practices. However, we also acknowledge criticisms of the temporal theory, including its relative de-emphasis of technology and social structure. We then describe the research method and report our results. Our Discussion section offers insights from our use of theory to extend the explanatory power of the practice perspective, and suggests future theoretical and empirical directions. The Conclusion summarizes our contribution, discusses the study's limitations, and identifies the implications

of our analysis for the design of online learning systems in work contexts.

Human agency and the practice perspective

As mentioned earlier, human agency is a core concept in theories of practice. Over the past half century, social theories have gradually moved away from structural explanations involving technology and social structure and toward explanations involving human agency (Archer, 1982; Reed, 1988; Hirsch, 1997). This discernible 'turn' in theorizing most likely reflects changes in social conditions which, in Western cultures at least, have moved from relative stability following World War II to relative instability in the early 21st century. Coinciding with this period of social change, venerable concepts like culture and social structure have been recast to emphasize change rather than stability. For example, Swidler (1986) argues for a model of culture appropriate to 'unsettled times,' viewing culture as a repertoire of habits, skills, and styles from which people construct strategies for action. Similarly, theories of social structure have become increasingly concerned with explaining social change rather than the persistence of social structures. Social structures represent '…the tendency of patterns of (social) relations to be reproduced, even when actors engaging in the relations are unaware of the patterns or do not desire their reproduction' (Sewell, 1992, p. 3). However, such structures are increasingly defined in cognitive terms such as 'memory traces' (Giddens, 1984) and 'schemas' (Sewell, 1992). In these senses, structure is seen as more 'virtual' than concrete.

Along with the 'softening' of concepts formerly conceived in concrete terms, theories of human agency and practice have emerged as appealing tools for explaining social change. The basic appeal of agency is the restoration of concepts such as free will, rational choice, and praxis to social theory. Thus, human actors become more than simple performers of social roles or carriers of cultural values and traditions. Rather, actors exercise agency through their inherent capacity to control resources and to reinterpret and mobilize them in the service of specific ends (Sewell, 1992).

Despite a shared commitment to the concept of human agency, theoretical explanations of agency's role in practice vary considerably. Some theorists see practice as recurring patterns of activity that endure despite actors' desire for and capacity to change. Others see agency as the capacity of individuals and groups to transform even the most oppressive structural and technological constraints. Because not all theories of practice share the same views on this issue, we distinguish between theoretical approaches to explaining agency and practice, first as inertia, and second as transformation.

Agency as inertia of practice

One of the most influential contributors to an understanding of practice is Bourdieu (1977, 1990). For

Bourdieu, practice is governed by logics generated from habitus, a concept used to describe the rules for behavior appropriate to one's position in the wider social context, or field. Bourdieu views the essence of practice as the reinforcement of the logics of the habitus and field, with their hierarchical distinctions and uneven distribution of various forms of capital. Thus, the effect of habitus is to preserve practice in its current forms, which tends to favor those with greater accumulations of capital. Bourdieu maintains that social actors develop preconscious expectations through their past experiences, thereby creating the conditions for their reproduction (Emirbayer & Mische, 1998). Although actors may have the capacity for autonomous and strategic actions (agency), habitus effectively operates to constrain such actions almost completely (Sewell, 1992). According to Sewell, 'In Bourdieu's habitus, schemas and resources so powerfully reproduce one another that even the most cunning or improvisational actions undertaken by agents necessarily reproduce the structure' (1992, p. 15).

Several IS researchers use Bourdieu as a basis for a critical interpretation of IT and practice, arguing that IT helps to impede social change. For example, Richardson & Howcraft (2006) employ Bourdieu's concepts to support a critical interpretation of call centers, showing how work practices are tightly constrained by oppressive technologies and managerial practices. Likewise, Kvasny (2006) finds the concepts of habitus and field useful in interpreting the futility of community technology initiatives to bridge the so-called 'digital divide' separating urban social classes. Additionally, Schultze & Boland (2000) draw from Bourdieu's theory of practice to examine the reproduction of tensions inherent in the lives of outsourced system administrators. Thus, in Bourdieu's theory of practice human agency reinforces inertia rather than fosters change.

Like Bourdieu, Giddens (1984) offers the possibility for explaining both the reproduction and transformation of the structural properties of social systems with his theory of structuration. By conceiving of agency and structure as a duality, Giddens acknowledges their inseparability, except for analytic purposes. Thus, structures that enable and constrain agency are simultaneously constituted and reproduced through agency. Although often judged as emphasizing agency over structure (Archer, 1982; Jackson, 1999; Hatch & Cunliffe, 2006), Giddens has also been interpreted as privileging the inertial rather than the transformative effects of agency. According to Emirbayer and Mische, 'Giddens gives routinized practical consciousness a privileged place in the explanation of social reproduction, calling routinization the master key of his theory of structuration' (1998, p. 978).

Structuration theory continues to inspire expectations of inertia and habit associated with IT. Jasperson *et al.* (2005) offer a model for understanding post-adoptive behavior, defined as behavior 'after an IT application has been installed, made accessible to the user, and applied by the user in accomplishing his/her work

activities' (p. 531). This definition of post-adoptive behavior resonates with our interest in work practices, as affected by IT. Indeed, Jasperson *et al.* invoke Giddens' structuration theory to support arguments for both inventive activity by human agents as well as the creation of habits. However, the inertial effects of post-adoptive behaviors become the central notion of their model: 'central to our conceptualization of post-adoptive behavior is the notion that, over time, post-adoptive behaviors become habitualized unless interventions occur to disrupt the formation of these deep, non-reflective mental scripts' (Jasperson *et al.*, 2005, p. 535). In the absence of interventions that stimulate reflection, 'post-adoptive behavior likely transitions to a state of habitual behavior in which an individual engages in a recurring pattern of using a selected subset of technology features in his/her work' (p. 535).

In summary, theories of practice rooted in the work of Bourdieu and Giddens offer conceptual arguments for expecting the reinforcement of practice as well as its transformation. Although both theories note the central importance of human agency, human actors are not expected to break free easily from the constraints of habitual or routine practice.

Agency and the transformation of practice

The greatest emphasis on the capacity of human actors to transform work practices comes from rational choice theories. Rooted in teleological assumptions about social change (Van de Ven & Poole, 1995), rational choice theories view individuals as purposive and adaptive, capable of altering their environments to satisfy their needs. For example, Bandura's (1986) social cognitive theory suggests that people alter their behavior in a particular context in order to accomplish desired outcomes and prevent unwanted outcomes. Generally speaking, social cognitive theory posits a subjective view of structure and emphasizes the 'internal power' of personal agency to impose, select and create the physical and social environment. Bandura (1997) argues that people have leeway in how they construe and react to the social environment. Thus, actors may select and activate the potentialities of social systems to exert greater control over their lives. Bandura emphasizes the importance of personal efficacy in organizing, creating, and managing the environment to avoid becoming enmeshed in its punishing and debilitating aspects (Bandura, 1997).

As noted earlier, the structuration-based arguments of Bourdieu and Giddens have been used to emphasize human agency's inertial influence on practice. However, several structurational accounts in the IS literature emphasize the transformational capacity of human agency. For example, Levina & Vaast (2005) apply Bourdieu's idea of field to explain boundary spanning in practice, wherein agents negotiate and produce new joint fields of practice reflecting common interests. Levina and Vaast thus emphasize the transformational potential of practice, specifically the ability of human agents to overcome the constraints of formally designated roles and artifacts. Drawing from Giddens (1984), Orlikowski (2000) emphasizes the capacity of human agents to enact social structures through their use of technology. From Orlikowski's perspective, 'every engagement with a technology is temporally and contextually provisional, and thus there is, in every use, always the possibility of a different structure being enacted' (2000, p. 412). She presumes that human actors can exercise considerable discretion in how technologies are used, thereby enacting the effects that technologies have on work practices and organizational structures. Although Orlikowski entertains the possibility that users may fall into habitual patterns of practice, she emphasizes their capacity to enact, improvise and generally overcome constraints associated with IS design (Orlikowski, 1996).

Because human agency can both reinforce habits and transform practice, it is important to explain how and why different enactments of technology use occur. Orlikowski (2000) suggests a variety of interpretive, technological and institutional conditions to explain the different degrees of change in work practices that users of technology could enact. However, this range of potential influences on enactment is unsettlingly wide:

> Use of technology is strongly influenced by users' understandings of the properties and functionality of a technology, and these are strongly influenced by the images, descriptions, rhetorics, ideologies, and demonstrations presented by intermediaries such as vendors, journalists, consultants, champions, trainers, managers, and ''power'' users (p. 409).

Moreover, enactments of technology occur:

> …in response to various technological visions, skills, fears, and opportunities, influenced by specific interpretations and particular institutional contexts, and shaped by a diversity of intentions and practices to collaborate, solve problems, preserve status, improve efficiency, support work processes, learn, and improvise (p. 420).

Clearly, Orlikowski identifies influences involving both individual understandings and social influences. However, the number of potential influences is so large and their nature so diverse that it becomes difficult to generate specific expectations regarding the occurrence of particular enactments. Moreover, it is not clear why users of technology would respond to one or more of these influences. Orlikowski claims that '…people's use of technology becomes structured by these experiences, knowledge, meanings, habits, power relations, norms, and the technological artifacts at hand' (2000, p. 410). Unfortunately, it is difficult to locate specific theoretical mechanisms in these arguments that would explain why actors respond with specific patterns of technology use and why their responses might change over time.

Applying a temporal view of agency

Although there can be little argument over the value of research focused on practice, it is desirable to offer more

complete theoretical explanations for the choices that actors make when confronted with new technologies. Emirbayer & Mische's (1998) temporal theory of human agency potentially offers more complete explanation of changes in practice by disaggregating human agency into three temporal elements. They view human agency as '…informed by the past (in its habitual aspect), but also oriented toward the future (as a capacity to imagine alternative possibilities) and toward the present (as a capacity to contextualize past habits and future projects within the contingencies of the moment)' (p. 963). Thus, their theory includes both inertia and transformation along with a third, often neglected focus on the present, in which humans actually perform.

Researchers studying changes in work practice are attracted to Emirbayer and Mische's treatment of human agency and its inclusion of three temporal elements. For example, Howard-Grenville (2005) uses the theory to understand the exercise of human agency in the persistence and modification of organizational routines; Cousins & Robey (2005) use the theory to explain the variations in patterns of technology use enacted by mobile technology users; and Boudreau & Robey (2005) find the theory to be consistent with their model of users' enactments of a newly implemented enterprise system. In these prior studies, all three elements of agency are shown to play a role in explaining changes in work practices over time.

Because the temporal theory is largely unfamiliar in the IS field, we describe it more completely in the following section.

Temporal theory of human agency
Emirbayer & Mische (1998) define human agency as

> …the temporally constructed engagement by actors of different structural environments – the temporal-relational contexts of action – which, through the interplay of habit, imagination, and judgment, both reproduces and transforms those structures in interactive response to the problems posed by changing, historical situations (p. 970).

In more ordinary terms, agency is a temporally situated process in which actors reflect simultaneously on the past, present, and future implications of their potential actions. In considering the past, dispositions to continue known and comfortable routines are weighed along with desires to eliminate negative experiences. In considering the future, ambitions to change in positive directions are weighed along with fears of the unknown. Finally, the practical contingencies of the present may lead actors to adjust current plans to respond to emerging demands.

The temporal conception of agency helps to explain why actions are dominated neither by the inertia of the past (e.g., resistance to change) nor by the promise of the future. Rather, both past and future become elements of agency along with present contingencies. Thus, actors are influenced by past practice but are also '…capable of formulating projects for the future and realizing them,

even if only in small part, and with unforeseen outcomes, in the present' (Emirbayer & Mische, 1998, p. 964). The presence of multiple elements makes the prediction of actors' choices precarious. People do resist change, but they also seek change. Thus, agency involves working through emerging choice situations with eyes on the past and the future, while simultaneously responding to the practical contingencies of the present.

The three elements of human agency are named *iterational*, *projective*, and *practical-evaluative.* Table 1 summarizes the definitions of these elements.

Iterational element
Similar to Bourdieu's notion of habitus, the iterational element refers to 'selective reactivation by actors of past patterns of thought and action, as routinely incorporated in practical activity, thereby giving stability and order to social universes and helping to sustain identities, interactions and institutions over time' (Emirbayer & Mische, 1998, p. 971). Emirbayer and Mische suggest that past social experience is schematized and becomes manifest when actors recall, select, and apply schemas of action developed in prior interactions. The iterational element of agency represents the tendency to repeat past routines and habits, thereby reflecting inertia rather than transformation of work practice.

Projective element
The projective element of human agency refers to the 'imaginative generation by actors of possible future trajectories of action, in which received structures of thought and action may be creatively reconfigured in relation to actors' hopes, fears, and desires for the future' (Emirbayer & Mische, 1998, p. 971). In this aspect, human actors invent new possibilities and distance themselves from the schemas and habits of the past. Similar to rational choice theories, the projective element of agency reflects the potential of actors to transform work practices.

Practical-evaluative element
The practical-evaluative element of agency refers to the 'capacity of actors to make practical and normative judgments among alternative possible trajectories of action, in response to the emerging demands, dilemmas, and ambiguities of presently evolving situations' (Emirbayer & Mische, 1998, p. 971). This dimension of human agency entails the capacity of actors to make judgments in the present about past routines and future projects. Such choices are made in the face of considerable ambiguity, uncertainty and conflict, as means and ends sometimes contradict each other, and unintended consequences require changes in strategy and direction. Unlike prior conceptions of human agency, Emirbayer and Mische's articulation of the practical-evaluative element draws attention to the dilemmas that actors face in deciding how to act in the present.

Table 1   Elements of human agency

Element of agency	Description
Iterational element	• Relates to the past. • Assumes that past social experience is schematized and actors recall, select and apply these schemas to action. • Allows actors to sustain identities, meanings and interactions over time. • Provides social actors with reliable knowledge of social relationships. • Gives continuity and stability to action. • Reassures actors that actions in the past can successfully be repeated, and that other actors can be trusted to act in predictable ways.
Projective element	• Relates to the future. • Assumes that social actors imaginatively reconfigure and invent new possibilities in accordance with their hopes, fears, and desires for the future. • Assumes that actors may wish to distance themselves from schemas, habits and traditions, and reconstruct those traditions. • Generates alternative possible responses to the problems being confronted in accordance with evolving desires and purposes. • Actors construct changing images of where they think they are going, where they want to go, and how they can get there from the present.
Practical-evaluative element	• Relates to the present. • Entails the capacity of actors to make practical and normative judgments among alternative possible trajectories of action. • Responds to the emerging demands, dilemmas, and ambiguities of presently evolving situations. • Routine (past) and newly imagined (future) projects are adjusted to the present. • Choices are made in the face of considerable ambiguity, uncertainty and conflict, as means and ends sometimes contradict each other, and unintended consequences require changes in strategy and direction.

Bringing technology and structure back in

Like many grand sociological theories, Emirbayer and Mische's concept of human agency may be criticized for its neglect of the role that technology plays in explaining social change. The growing IS literature that incorporates a practice perspective has begun to redress this neglect by showing how IS both constrain and enable practice. For example, Orlikowski (1992; see also Orlikowski & Robey, 1991) conceives of IS as having structural properties, capable of constraining and enabling agency but not determining actions. DeSanctis & Poole (1994) also view technology's structural properties as embodying designer/sponsor intentions, but they also acknowledge human actors' capacities to appropriate technology and to generate unintended patterns of use. These contributions have included technology in discussions of agency and social structure, but theorizing technology's role remains imprecise. Specifically, the mechanisms affecting enactments of technology remain under theorized, and ambiguity remains over the nature of relationships among technology, agency, and structure.

Emirbayer and Mische have also been criticized for minimizing the influence of social structure on human agency. For example, Fuchs (2001) argues that sociology should explain what human agents actually do, rather how they potentially could exercise free will (p. 27). Calling for a renewed focus on social networks and structures in sociology, Fuchs argues that the concept human agency would be meaningless if separated from social influences and judgments about human action.

Emirbayer & Mische (1998) contend that human agency is an intrinsically social and relational process, 'by and through which actors immersed in temporal passage engage with others within collectively organized contexts of action' (p. 974). Nonetheless, their position clearly privileges agency over structure and is relatively silent about the mechanisms through which social structure influences human agency.

For these reasons, we augment our use of the temporal theory in this study with attention to the roles of technology and social structures as possible influences on human agency. The study reported below applies the theory to understand the actions taken by employees following adoption of an online learning system implemented in a health care organization.

Method

Research design

We applied the case study research strategy to investigate the use of an online learning system in a regional hospital in Taiwan. The choice of the hospital (given the pseudonym K Hospital in this paper) was based on the principle of theoretical sampling, which specifies that chosen cases should clearly represent the phenomenon under study in its natural social context (Yin, 1989; Mason, 2002). In accordance with this principle, we judged K Hospital to be an appropriate site for gathering retrospective data over the period of time (2 years) during which online learning was available for use. This

aspect of the case affords a temporal analysis of user responses to online learning. During the 2 years following implementation, the employees in K Hospital decreased their use of the system after being initially enthusiastic toward it. Users reported confusion and conflicts about using the online learning technology while accomplishing their regular work duties. The case setting thus provided an opportunity to explore changes in learning and work practices related to the use of online learning.

Within the case study, we identified three different occupational groupings (nurses, druggists, and administrative staff), and we decided to sample all three in hopes of discovering differences in the way that work practices changed across groups. This aspect of the research design is another principle of theoretical sampling called nested, within-case sampling (Miles & Huberman, 1994). It is typically undertaken to observe different instances of a phenomenon so that more theoretical sense can be drawn from the analysis. Although all groups were introduced to online learning at the same time, it was conceivable that each would behave differently because of different work demands and social influences. The opportunity to compare responses across occupational groups offered greater analytical leverage for explaining how learning and work practices changed.

Data collection
Data were collected by the first author between February and July 2004 using qualitative interviews with staff and internal documents from K Hospital as sources of data. Twenty-eight interviews were conducted with the top manager, clinical staff in two departments (nursing and pharmacy), administrative staff, IS project managers, and IS staff. Although all employees interviewed had access to the online learning system, employee duties, and working contexts differed across groups. For example, nurses worked in shifts and dealt directly with patient care, while administrative staff worked regular hours and supported both clinical staff and patients. Table 2 lists the roles of respondents and the number of interviews conducted.

The interview protocol contained a series of open-ended questions to encourage the discussion of topics relevant to work practice and online learning. Included

Table 2 Description of sampling

Respondents	Frequency
Top manager	1
Project managers	2
Human resource staff	2
IS staff	2
Learners from clinical departments	21
Clinical specialists (nurses and druggists)	11
Administrative staff (clerks, secretaries, and administrators)	10
Total	28

were questions about respondents' prospects for using online learning, their past work and training practices, the work pressures they experienced, and the choices they made regarding work and training. Table 3 summarizes the interview questions associated with the elements of human agency, technology, and work practices. All interviews except two were audio recorded and transcribed. At the request of respondents, two interviews were not recorded. However, the interviewer wrote notes during and immediately following each of these interviews. Interviews lasted approximately 45 min, on average.

Data analysis
We analyzed the data iteratively, alternating data coding with investigation of theories that fit the emerging interpretation. Mason (2002) regards this process as consistent with theoretical sampling, allowing for flexibility in empirical methods to accommodate theoretical ideas that emerge from the analysis of data. In our case, we began with preliminary theoretical ideas about rational choice (specifically Bandura's social cognitive theory) but found them to be inconsistent with empirical nuances emerging from the field investigation. We therefore engaged with different theories of practice (including Bourdieu, Giddens, and Orlikowski's practice perspective), seeking a more coherent fit between theoretical explanation and data. Iterations between data and theory required reanalysis of data at multiple points. For reasons stated earlier, we used Emirbayer & Mische's (1998) temporal theory of human agency and recoded data according to the theory's main theoretical categories. Given the theory's lack of emphasis on technology, we also coded the data for specific enabling and constraining features of the online learning application. Finally, we created codes that captured references to work context and learning context.

The first author translated transcriptions of the audio-taped interviews from Chinese into English. Text segments from the transcripts were then assigned codes as described above. Text segments ranging in size from one sentence to several paragraphs were tagged with one or more codes based on their content. Notes were made in the margins of the transcribed interviews in an effort to capture spontaneous thoughts about the phenomena. Both authors conferred on the meaning of statements made during interviews and compared interpretations with reference to the theory. These steps provided multiple opportunities to reflect upon the data, generating further insights. Table 4 provides a summary of the final codes applied to the data.

Results

Case overview
At the time of our study in 2004, K Hospital was a regional health care center located in southern Taiwan. Founded in 1998, K Hospital provided health services to 150,000 people living in the local community. In 2000,

Table 3 Protocol for data collection

Dimensions	Working definitions and key interview questions
Iterational element	*Refers to the past*. We focus on the participants' habits and comfortable routines about learning and knowledge acquisition process in their work practice. *Example questions*: How can a novice become a domain expert in your department? How do you request the answers when you have questions in operating daily duties?
Projective element	*Refers to the future*. We focus on the participants' desires to change in positive directions, as well as their fears of the unknown. *Example questions*: What are the benefits and drawback of the online learning system? What is your expectation toward using the online learning system? What will be the properties of an ''ideal'' online learning system?
Practical-evaluative element	*Refers to the present*. We focus on the actors' adjustments that respond to the emerging demands, dilemmas, and ambiguities of presently evolving situations. *Example questions*: How is the online learning system different from the system (or systems) used in your daily operation? How often do you use the system? What are the difficulties when you try to use the online learning system? Why?
Technology	Refers to the actor's understanding of technology. We focus on the actor's views about the technology, as well as the enablers and constraints of technology. *Example questions*: What is the online learning system? What has been provided in the online learning system? How can the technology features enable or constrain your learning online?
Work practice	Refers to the actor's understanding of their work practice. We focus on the actor's views about their work and their responsibility as the professional clinical persons. *Example questions*: Please describe your work. What are the unique properties of your work? How is your work relevant to others?

Table 4 Summary of interpretive codes

Codes	Description
Elements of human agency	
Iterational element	Habits and comfortable routines in learning and knowledge acquisition, including what shall be learned and how the learners acquire their skill and knowledge in practice.
Practical-evaluative element	The actors' adjustments which respond to the emerging demands, dilemmas, and ambiguities of presently evolving situations.
Projective element	The participants' desires to change in positive directions, as well as their fears of the unknown.
Work context	
Individual work	Job content and responsibility of learner.
Relation with others	How the learners interact or co-work with others in practice.
Technology	
Interpretation of technology	How the learners interpret the learning technology, in terms of the nature of IT and IT strategy, and IT use.
Content in IS	The contents provided in the learning platform.
Technology support	The features designed to support learning in the learning platform.

the hospital won an award for distinguished quality. To maintain high-quality service, K Hospital was committed to continuous renewal of employees' knowledge and skills through training.

Despite the commitment to staff training, it was challenging for K Hospital to provide training effectively. Traditionally, K Hospital offered training classes during the lunch break, before resuming the afternoon's work. However, this arrangement was inconvenient for many clinical workers who needed to remain on duty continuously in order to respond to patients' needs. At K Hospital, a relay system was employed for the nurses and other clinical specialists to care for patients by turns. This meant that employees worked different schedules. Some staff might be off duty in the daytime and begin work at midnight. As a result, it was practically impossible to assemble all employees for training sessions at the same time.

These issues led K Hospital's management to explore ways to deliver staff training on a more flexible basis. In July 2001, K Hospital initiated an online learning project for training their employees on the Internet. Using the slogan, 'Your PC, Our Classroom,' K Hospital's top administrators expected to leverage computer technology to provide more convenient training to physicians, clinical specialists, and administrative staff at lower cost. The hospital's IS staff developed the online learning system, called LearnNet (a pseudonym). LearnNet provided employees with asynchronous access to training courses, allowing learning at any time and anywhere a connection to the Internet could be established.

LearnNet was the first IS project that addressed non-clinical issues in K Hospital. The IS staff developed it with little worry that it might fail to meet its expectations. They viewed LearnNet as a natural progression of IT applications into areas beyond the support of clinical work, symbolizing the importance of IT to all aspects of hospital work. K Hospital's top manager had a vision to use IT to build a 'cyberhealth' environment that served both business and clinical needs:

> Technology can be used for increasing competitive advantage. In our hospital, we use technology to improve cooperation among three major dimensions: clinic, administration and human resource. In the past few years, we have successfully improved our service quality with the aid of integrated clinical information systems and administrative processes. Now, we try to leverage our intellectual capital by constructing the e-leaning system to provide our employees with an easy access, complete and costless training platform. (Top manager)

When LearnNet was implemented in K Hospital, the project manager chose the Nursing Department for a pilot test, after which the system was offered to all employees. K Hospital rewarded those employees who completed the most courses online. Through the ritual of commending the best learners in an annual ceremony, K Hospital encouraged rather than forced the employees to use online learning.

From our analyses of 3 years of training logs maintained in LearnNet, we identified a total of 397 users who repeatedly logged into LearnNet. Most of the users (55%) participated in online learning for at least 2 years. Among them, 129 users (32%) logged into the system regularly for 2 years, and 89 users (22%) were regularly engaged for 3 years. Table 5 presents the profile of system use from July 2001 to May 2004.

At the end of LearnNet's first year of use, K Hospital conducted a survey to evaluate its performance. According to an internal report, 88% of the employees had heard about LearnNet, and 65% had used it. Most of the users (about 61%) accessed it for an average of 20 min over a 5-day period. The survey also indicated that learners expressed high satisfaction with the system, especially on training flexibility and efficiency.

Two years later, learners continued to express positive attitudes toward LearnNet, but their usage declined dramatically. In the third year of implementation, frequency of use decreased to 91 users per month, compared to 129 per month in the second year. In 2004, most learners logged into the system only once every three or four months.

Technology enablers and constraints

LearnNet's primary advantage was its capability to support learning at times and places where learning did not conflict with the performance of regular duties. Learning materials could be downloaded by learners in remote locations. After completing a learning module, learning performance was assessed by means of an exam administered online. LearnNet kept logs of access frequency, duration of learning sessions, and test results for each learner. The log served as a learning profile of each learner as well as a metric for the project manager to assess the system's value.

The learning materials on LearnNet included general courses, specialized courses, and short essays and stories. The general courses covered general information about K Hospital, its organizational policies, and announcements for all employees. The specialized courses were designed for employees in different specialized fields and contained content relevant to clinical practice, medical treatment, patient care, and hospital administration. The essays and stories were chosen for their interest value and were included to relieve the pressure on employees engaged in online training. The project manager explained the goal of LearnNet:

> Our expectation of the e-learning system is to provide a platform which is not only for doctors but also for every employee in our hospital. For this vision, we need to provide very broad information and knowledge online. (PM)

All learning materials were prepared by members of the departments in K Hospital. Most of the learning materials were speeches, clinical information, discussions and conferences on clinical cases, and lessons learned from

Table 5 Profile of the use frequency for LearnNet

Year	1st year	2nd year	3rd year
Period	July 2001–June 2002	July 2002–June 2003	July 2003–May 2004
Total logins: entire hospital	3046	1554	1006
Nurse	1076	316	193
Pharmacy	181	74	75
Staff	1066	617	404

attending professional conferences. These learning materials were created as slides or video clips by the clinical specialists who had limited computer literacy, especially in multimedia. The project manager, a member of the business planning staff, collected the materials and organized them into appropriate categories.

Although these contents were key enablers of online learning, staff held differing opinions about their usefulness. The developers of the system confessed that they were not qualified to design very attractive interfaces for learning materials. An IS technician expressed this difficulty as follows:

> Our content is not attractive. We are not art designers. It is hard for us to create a rich content with multimedia or animation. Most of the learning contents are made in PowerPoint slides or video tapes. (IS)

In attempts to address this problem, content providers sought to create materials of greater interest. A librarian who was asked to provide useful content for promoting voluntary learning observed that 'hard' materials presented formally would reduce learners' motivation to use LearnNet:

> You can force people to use the e-learning system, but you can't force them to learn. Content is the most critical. You have to provide something directly relevant to learners, such as career path and planning… In addition, we have only formal documents and presentations in our system. It is boring. We can enrich it by adding some soft materials, such as stories or essays, to increase our motivation toward learning. (Lib)

However, the enrichment of learning content was not universally appreciated. One nurse expressed her confusion about the design of LearnNet:

> LearnNet is criticized by its boring contents. But, LearnNet should not be developed to be playful. If LearnNet is designed as an interesting platform, people will get involved too deep to perform their duties. For our clinical people, playing on the computer is something we should do in our free time. (Nurse, St)

A druggist's description of his LearnNet usage confirmed this concern:

> It is good to have LearnNet although there is nothing relevant to our work. You can find something interesting there, just like what you do on surfing the Internet. For example, I am curious about what the laboratory does in our hospital. We can also browse jokes while taking a break. (Druggist 1)

Furthermore, administrative staff expressed concerns about the way that information on LearnNet was updated. Because information contents were updated monthly, learners became less interested when they logged in within the month and found nothing new. One clerk explained:

> …the information update is very important. …Without continued information update and push for participation, people will gradually lose their patience and forget to log into the system. (Clerk 3)

In addition to the issue of content, LearnNet also presented constraints in terms of access, especially by nurses. Although providing unlimited access from places outside the hospital, LearnNet was not available on K Hospital's intranet, which was protected by a firewall. Only computers in the hospital's library and departmental offices could be connected to the Internet and provide access to LearnNet within the hospital. An IS technician explained the purpose of this restriction:

> The online learning system is set up on the Internet which is beyond our firewall. We're afraid that online learning may deteriorate the operation and performance of our clinical systems, which are critical to healthcare and patient safety. (IS)

This restriction made it infeasible for nurses to access online learning resources during their duty hours in the nursing stations.

In the following sections, we report an analysis of the three occupational groups that were expected to use LearnNet: nurses, druggists, and administrative staff. Each section includes a description of the group's work context, followed by evidence supporting our interpretation of each of the three elements of agency.

Nurses

Work context   Nurses comprised over half of the employees in K hospital. Their primary duties were to help physicians execute clinical treatments, communicate with patients and their families, and complete administrative reports. By any account, nurses' work was highly demanding and stressful. Nurses rotated among various clinical departments, such as outpatient service, health examination, and patient rooms. Typically, a nurse in outpatient services worked with more than 100 patients in a 4-hour period. When they rotated to inpatient services in patient rooms, nurses worked on three shifts – morning, evening, and midnight. While on duty, each nurse had to care for five or six inpatients based on the doctor's orders displayed on computer screens located in the nursing stations. Between visits to treat patients, nurses documented all treatments and patient reactions for the next shift. This allowed the nursing staff to provide continuous care across consecutive shifts. One nurse described her work as follows:

> Our job is very stressful because it is caring for human life. We need to concentrate and be very careful because we can't stand for any error in the process of providing service. It is particularly challenging when we take turns to care for patients. To accomplish our work successfully, we have to closely cooperate with our colleagues among shifts. It is important for us to document and to detail all the situations to the successors. (Nurse, St)

Projective agency The nurses understood the potential for LearnNet to provide an efficient way to obtain training in spite of their busy work schedules. Before LearnNet, the lunch time training arrangement was not appropriate for the nurses, who had to remain on duty to serve their patients. Nurses working in the evening and midnight shifts also could not attend training classes at noon unless they came to the hospital during nonworking hours. Consequently, nurses saw LearnNet as an important project that would allow them to receive training whenever and wherever they wished. One nurse's comment typified this expectation:

> [LearnNet] provides an effective way to learn when we can't go to training. It is impossible to attend training when we are on duty. They can put the training material or video in online learning for us to play back when we are free. It improves the flexibility of training. (Nurse, Leader 2)

The nurses also expected that LearnNet could provide an effective medium for storing learning content. One nurse's comment presented a typical example:

> In the [lunch time sessions], we come, hear and then leave. Nothing remains after the end of the training. Now, with LearnNet, we can find the video clip and review the training received. This platform can be beneficial for reinforcing our memory about important issues. (Nurse, St)

The online learning platform also provided standard material to maintain training quality. As one nurse explained:

> Clinical situations vary and happen randomly. It is impossible to rely on only experience for accumulating knowledge. For example, you might not have experience to do a CPR in your past experience. LearnNet can be very helpful for collecting and retrieving the standard process for typical clinical situations. (Nurse, Leader 1)

In addition, the nurses believed that learning online would become the major way to acquire knowledge in the future. In their perception, learning technology could open a new window for accessing information immediately and easily. One nurse's vision of online learning revealed a strong positive belief in the technology's social value:

> Learning online is a trend and a necessary way. Because people are always busy in their life, it is hard for them to keep up with new knowledge. The online learning system provides a new and flexible way for self-development in our free time. The force of learning is information pull rather than push. You can learn whatever you want by one key click. It is a learning revolution. (Nurse, St)

Iterational agency The iterational element reflects actors' routines and habits in both learning and working contexts. Traditionally, the nurse's learning routines and habits were naturally integrated with their work practice. Most nursing work involved patient care, and nurses' professional identities were developed through involvement in clinical routines for treating patients and providing health care services. In these routine practices, nurses acquired clinical skills and knowledge, which allowed novices to become experienced nurses. When novices began their nursing duties at K Hospital, they received general training on the nursing processes and policies before they were assigned to their clinical units. Once assigned to a unit, their knowledge and skill developed through apprenticeship in nursing practice, as a senior nurse advised the novices about nursing operations. It took about 3 months for a novice to become an experienced and capable nurse who could care for patients independently. Although there was no formal testing of knowledge gained through this process, lead nurses performed informal evaluations to assess whether novices were sufficiently capable to perform daily nursing routines. A lead nurse explained this conventional learning process:

> We have new nurse training which teaches them about the nursing process in our hospital and tests the level of understanding at the end of training. This kind of training focuses on both conceptual knowledge and particular issues which are not always encountered in working operations. For skill training, it depends on the situation the novice meets in the working context. The skill is usually trained in their working context and is very diverse in different nursing units. (Nurse, Leader 1)

Learning was acquired not only through direct experiences, but also from peer-to-peer sharing of nursing routines. Taking turns caring for patients, the nurses developed several ways to bridge the gap between different shifts. Writing nursing reports and holding discussions with successors were ways to ensure continuous health care. One nurse leader used a mechanical metaphor to describe the tight cooperation among nurses on different shifts:

> There are many and frequent interactions among nurses because of tight linkage of our work. It is like a gear. We need to collaborate closely to prevent any trouble which is related to patient safety. That is why we are always conscientious and interdependent. On the end of my shift, I need to tell the successor every detail about what treatment I gave and what situations had occurred. It is what we call continuous care. (Nurse, Leader 1)

Nurses also accumulated knowledge by vicarious learning. Every morning, nurses held short meetings, supervised by the team leader, to share their experiences about patient treatment. These meetings provided opportunities for the nurses to learn how to handle specific situations.

Practical-evaluative agency Although nurses saw LearnNet as a more flexible medium for training, they found it difficult to enjoy its benefits. As a platform for reviewing training content, the nurses found it not sophisticated enough to hold their clinical interest. One nurse noted:

> The LearnNet is supposed to provide the sophisticated clinical information for search. Like Yahoo, we can find the up-to-date and relevant training materials in an online

learning platform. We usually felt disappointed when we can't find what we are interested in. (Nurse, St)

In addition, nurses thought that learning with Learn-Net challenged their conventional professional development process, which involved cooperative group work. One nurse expressed a typical concern:

The LearnNet is good for increasing information gathering. You can have all the on-job-training materials there. But nurses can only develop their skill through performing the clinical tasks rather than watching the academic paper works. (Nurse, Leader 3)

In addition, professional norms were a strong influence on the dilemma surrounding nurses' use of LearnNet. Conventionally, nurses needed to stay near their patients and be available to answer any inquiry from the patients or their family members. Therefore, nurses always remained near their nursing stations. Because computers in the nursing stations were separated from the Internet by a firewall, it was hard for nurses to access LearnNet. A librarian corroborated this limitation:

Nurses need to stand by in stations to respond to the patients' various situations in a timely way. They can't leave and go to the library for network connection and participate in online learning. There is a similar situation in outpatient services and other clinical units. It is impossible for them to learn by e-learning even when they have free time. (Lib)

Although lack of Internet access posed a physical limitation on nurses' ability to use LearnNet while working, nurses also imposed a professional limitation based on their understanding of the role of a clinical specialist. Nurses maintained clear images about their work of providing health care, and they distinguished their work sharply from other jobs not related to health care. From their perspective, using LearnNet was not defined as work because it was not directly involved with serving patients. Browsing texts, graphs, and video clips at a computer was inconsistent with administering medicine or monitoring patients' vital signs. Nurses were also worried about being judged as truants if they did 'web surfing' while patients or their families were watching. A comment from a lead nurse reflected this common worry:

Learning is self-development, which is a personal affair. It might not be good to do the personal affairs in the office, especially for nurses in station. We are doing healthcare servicing. Surfing web-pages in front of the patients may not be an appropriate behavior. It may not respect them and deteriorate the image of profession. (Nurse, Leader 2)

Using LearnNet in their work context created a dilemma for the nurses. On the one hand, they appreciated the value and necessity of professional development and LearnNet's more flexible approach to training. On the other hand, pursuing training online was inconsistent with their conventional learning practices and professional development. Accessing LearnNet at the work place was not easy because nurses had to

remain near their patients and to present a professional image to them. The nurses resolved this dilemma by decreasing their use of LearnNet over time until the system was practically ignored and forgotten. One nurse, identified in LearnNet logs as a frequent former user, reported that she rarely used the system any more:

I am always tired after taking eight hours caring for patients. We only use it when we are off or we need to search for particular information. But, to be frank, we don't have much motivation for this. It is because we need to bear the pressure for more than eight hours of caring for human life, writing reports and passing all of the information to next shift. We are always tired out when we finish our shift. (Nurse, Leader 3)

In summary, nurses decreased their use of LearnNet over time. Their comments reflect positive views of LearnNet, and IT in general, as well as strong connections with professional norms and experience that valued learning through practice. These elements of agency, focused respectively on the future and the past, established contradictions that were resolved in the present. For the nurses at K Hospital, using LearnNet became inconsistent with established patterns of learning that were more integrated with work practice.

Druggists

Work context Workers in the pharmacy were licensed druggists, educated in pharmacology, and their daily work was drug distribution and management. For the pharmacy, it was vital to patient safety to avoid errors in dispensing drugs. To dispense correctly, druggists needed to distinguish drugs by their appearance (i.e., size, color, markings, and packaging), as well as recall the efficacies and constraints of using those drugs. These tasks were particularly challenging because almost 800 different drugs were used in K Hospital. The pharmacy had built a drug identification section on K Hospital's intranet to help the druggists, nurses, and patients to identify drugs, calling special attention to drugs that were easily confused with others.

Projective agency For druggists, LearnNet was seen as potentially useful for retrieving training materials and other critical information efficiently. One druggist recollected the value of the system during the SARS epidemic in 2003:

Online learning is good because it is a fast channel to distribute and receive information. It was particularly useful during the SARS time. We had rich and timely information about the disease and learned how to protect ourselves from being infected. For example, we learned how to wear the protection suit through video. It helps us to know more by providing up-to-date information and relieves part of our stress as a clinical person. It is very impressive. (Druggist 1)

Another druggist noted LeanNet's value as an information-tion repository:

> The online learning system is like an information repository. It is not vital for our daily operation but it acts as a backup. We can collect and leverage knowledge within our department. It is just like a search engine [with] which we can easily find information and a solution whenever it is needed. (Druggist 2)

Drug dispensers needed to update their knowledge about drugs used in K Hospital, especially when a new drug was introduced or when an existing drug was produced by a new manufacturer. In the latter case, identical drugs could appear in different shapes, colors, markings, or packages. LearnNet was seen as a potentially efficient platform for informing all of the relevant departments of these changes. One druggist described his vision of an ideal drug information resource:

> An ideal online learning system for us is the one which can quickly share drug information to the relevant units. Such information includes the change of drugs used in the hospital and new information about drugs. That information is closely related to the clinical work. For example, the druggists and nurses need to know which drugs are newly introduced, whether the producer is changed, or if its packages changed. It is also useful to let them know which drugs are easily confused with each other. (Druggist 2)

Iterational agency   The iterational element of agency is evident in the druggist's descriptions of learning routines and work practices. Usually, the pharmacy was crowded with impatient people waiting sometimes hours for outpatient service. Dispensing work needed to be fast in order to satisfy angry clients, yet mistakes certainly needed to be avoided. Combining accuracy with speed in dispensing drugs distinguished experienced druggists from novices. Like the nurses, druggists were accustomed to learning on the job and fulfilling professional expectations. The learning curve for becoming an experienced dispenser was not steep, as novices needed time to learn the dispensing process involving hundreds of drugs. One experienced dispenser recalled his learning process as follows:

> You learn by doing your job through accumulating experiences. In practice, it is important for you to have knowledge about medicines, including the specific location of each medicine, its effect, and indications. But it is not enough. You need to have physical touch on the medicine, to feel its size, shape, marks and packages. …The most critical part of our job is the speed of the dispensing process which involves the effective motions to distribute drugs. Learning by doing is the best way to learn such tacit knowledge. We are all trained by observing the senior ones, and trial-and-error practice. (Druggist 1)

To encourage skill development, the department head tested the druggists every month to see whether they had sufficient drug knowledge. One druggist stated the importance of having this capability:

We have about 800 drugs used in our hospital and some of them have similar appearance but with different efficacy. For example, these two medicines have the same appearance and the only difference between these two is package. [*Interviewer note: one medicine had no package and the other was packaged as individual tablets.*] But one is a hypoglycemic and the other is a hypertensive drug. Therefore, we need to have very clear idea about the shape, size, color, marks, and the package of the 800 drugs. (Druggist 1)

Practical-evaluative agency   Although LearnNet provided an efficient channel for distributing information, the druggists found that it was not vital to their daily work and had little to do with their learning routine. A typical comment from a drug dispenser revealed the concern:

> Online learning is good because it provides a lot of information. But the limited drug information makes it not directly relevant to our job. (Druggist 1)

Another druggist agreed with this concern:

> The materials are too broad to be understood. The needs and terminologies are different from department to department. For example, the contents for physicians might not be understood by us. It is hard to design a one-size-fit-all system. (Druggist 2)

In addition, their busy work practice distracted the druggists from using online learning. Typically, three dispensers needed to deal with more than 400 prescriptions from outpatient service in a 4-hour period. That is, each dispenser had to deal with more than 33 prescriptions each hour. One druggist reported the implications of his busy schedule for online learning:

> We will never have free time to use the computer in work hours. Druggists are always busy in the pharmacy. We even have no time to answer the phone when we are working. (Druggist 1)

Similar to the nurses, druggists also expressed their confusion between a good learner and a responsible hospital employee. One druggist's comment reflected this widespread concern:

> It is impossible for us to shut down the [pharmacy] counter, sit and watch the computer screen for half an hour. The patients will complain, and the image of the hospital will be hurt. Do you think the hospital image is less important than the individual learning? (Druggist 2)

The difference between LearnNet's potential as an information resource and the practical demands of ongoing work reflected the dilemma that druggists faced. On the one hand, druggists appreciated the benefit of fast accessibility of information in LearnNet. On the other hand, the busy work routines and factual contents were incongruent with their work and learning practices. The druggist solved the dilemma by using the system in the evening or midnight shifts. One druggist recalled his use of system:

I usually log into LearnNet when I work in the evening or at night. It is the only chance for us to use the system because we serve fewer patients in these shifts than the daily one. (Druggist 1)

In summary, much like the nurses, druggists saw great potential in the concept of online learning, especially as a repository for information about drugs. However, they found online learning not to meet their needs to learn clinical practice. It was also inconsistent with their work demands. In part, the pace and complexity of their work left little discretionary time to explore learning resources while working. More fundamentally, they viewed Learn-Net as less relevant than learning-by-doing. Like the nurses, they persisted in their traditional work practices and learning on the job rather than exploiting the features of online learning.

Administrative staff

Work context Most of the administrative staff at K Hospital supported clinical operations in various ways, such as communicating across departments, keeping clinical records, human resource management, accounting and finance, and library service. Unlike their clinical colleagues, most administrative staff worked regular hours and had no direct contact with patients. Some administrative staff faced more stress than others because they rotated to serve patients about 13 h a day and were responsible for processing health insurance claims.

Projective agency The opportunity to access LearnNet was particularly important for the clerks because they always sat in front of their service counters and often could not attend scheduled training sessions. The provision of training materials online compensated for their inflexible work schedules. One clerk stated the advantage that LearnNet offered:

We are tied down by our rotation schedule. It is even hard to ask for leave since we don't have extra manpower to cover our duty. Therefore, it is almost impossible to participate in training. Now we can browse LearnNet and play back training whenever we need. (Clerk 2)

Staff members also described the advantage of greater information transparency due to the ease of access provided by the technology. One clerk noted:

It is an effective way to deliver and to receive up-to-date information to workers in our hospital. Information can be retrieved timely and directly without mediation by any gatekeeper. To me, information transparency is its major benefit. (Clerk 3)

The staff also appreciated the content of learning materials, which helped them to develop work skills. One clerk recalled an online course that impressed her:

It talks about how to communicate with patients. We usually meet ill people who are in a bad mood. For us, it is important to be patient and to comfort them to prevent any potential

conflicts. It is a kind of crisis management because we have to help to maintain the customer relationship. (Clerk 1)

Another secretary confirmed this benefit:

It is useful for solving problems in our work. For example, I can easily find and learn how to write an official document, especially the particular key terms needed for my supervisors or to people in other organizations. You can also learn the clinical domain knowledge which helps for improving our communications to the physician within the department. (Secretary 2)

In addition, LearnNet provided a way for staff to understand administrative processes. Descriptions of work flows and business processes could be found easily online and could assist staff in their duties. A secretary in the laboratory recalled:

We can receive information whenever, as they put materials on the e-learning system. It provides a database to store whatever is important. It is like a search engine for us to find information needed without calling and disrupting others across departments. (Secretary 1)

The human resource staff greatly appreciated the flexibility of LearnNet. New staff members could find information necessary for their tasks without spending 3 days to attend group orientation. As a result, LearnNet could improve the effectiveness of human resource allocation. A human resource staff member described the resident doctor training program as an example of these potential benefits:

After SARS, for example, the resident doctors are required to receive a PGY1 [Pro-Graduated Year 1] training before they can have a professional license. They have to take courses and get credits required for the PGY1 training. However, it is a challenge if a resident doctor leaves to take courses in the situation that each of them cares for more than ten inpatients on average. If we can use the learning platform to provide these courses, we will not have to lose any labor power. (HR)

Iterational agency Participating in training was important for the administrative staff in K Hospital because it was required for promotion. Employees were evaluated not only for their work performance, but also for the number of training courses taken. A human resource staff member explained the design of the promotion system:

We use a system called 'learning passport,' which records the training history of an employee. When they attend each seminar, they can get credits to fulfill the requirement for promotion. (HR)

Administrative staff used close cross-department coordination and communication to fulfill their daily work. One clerk described her job:

Our task is very independent, but it needs lots of interaction with departments. For example, I have to check whether the treatment and prescription satisfy the stipulation of insurance for claiming money. It requires lots of communication with outpatient service when we find any violation. We also

have to inform laboratory when the patient doesn't want to do a particular examination. (Clerk 3)

For administrative staff, knowing the work flow across departments and finding the person-in-charge (PIC) were critical to complete even trivial tasks. The process of finding the information needed to solve problems also provided an opportunity for development. A secretary recalled her experience:

> You need to find the information by yourself. I learn by calling persons in the relevant departments. The typical situation is that I call several people in departments, but then finally know the PIC is the one who sits in the next door. But your knowledge is improved in that situation of solving problems. (Secretary 2)

Practical-evaluative agency In assessing LearnNet, staff expressed confusion about learning contents, which were seminar recordings with only indirect relevance to their cooperation across departments. Staff wished that Learn-Net acted as a more effective channel for information sharing and communication among departments. One clerk explained her attitude toward LearnNet use:

> For me, e-learning is like a website with examinations. To be frank, I don't think it is directly relevant to our daily job. It is good for us to find useful information here, but the

information is usually not something necessary. For example, we can find information or rules about rights and interests in the human resource department. We may not know these rules unless they tell every one of us. Through e-learning, we can actively find and freely access information we want to know. It is like information collection, rather than learning. (Clerk 3)

In addition, several side effects arose to restrict the use of LearnNet. In the busy work setting, clerks were expected to support the service counters when there were many patients waiting. Clerks who finished their own duty and browsed LearnNet instead of helping others were criticized by their co-workers. Clerks also worried about being assigned more work if they showed that they had time to use LearnNet during work hours. One clerk stated the concern:

> E-learning should not be done in our work hours. It may result in serious social sanction. Our colleagues may question why we can surf the Internet when they are struggling with their daily business. They may wonder: do you finish your work? Is your work too easy? Consequently, our duty would be adjusted to share the other's loading. That is why we always emphasize that we don't use e-learning in the office. (Clerk 2)

In summary, administrative staff used LearnNet more frequently than the employees in clinical service. How-

Table 6   Summary of the elements of agency

Element	Nurses	Druggists	Administrative staff
Projective	Positive expectations about more flexible training and real-time learning feedback. An effective way for review and recall. A compete and consistent training A learning revolution.	Positive expectations about real-time training, an information repository, improved knowledge delivery.	Positive expectations about flexible training and improved training efficiency.
Iterational	Knowledge is about clinical skill in practice. Learning is situated in practice and achieved by performing clinical treatment. Vicarious learning is obtained by sharing experiences.	Knowledge is about extensive drug knowledge Learning is acquired through direct experience.	Knowledge is about the work flow and PIC across the departments. Learning is developed through solving problems. On-the-job training is needed for promotion.
Practical-evaluative	Dilemma: Nurses desire training but are unable to get sophisticated information through LearnNet. Learning through technology is not consistent with conventional learning process. Internet use is inconsistent with professional norms. Nurses are too tired to learn after duty.	Dilemma: Druggists desire information on drugs but LearnNet content is considered irrelevant to work practice. The contents are too broad to be understood. Druggists are too busy to use LearnNet during work hours. Using LearnNet in the work hours is contradictory of being a good employee.	Dilemma: Administrative staff desire information but the indirect contents make LearnNet an information collection tool rather than a learning platform. More frequent use implies that staff have extra time that they could be working.
Resolution	Nurses gradually ignore and forget the system as it is not relevant for their work.	Druggists use LearnNet on midnight shift and for entertainment.	Staff use LearnNet more frequently than others, increasingly at their homes. Staff decrease use by batching visits when content changes.

ever, administrative staff also faced a dilemma. On the one hand, staff expected LearnNet to enable flexible training and to satisfy their training needs, thus leading to promotion. On the other hand, LearnNet did not fully support collaborative work practices. As a result, staff decreased their use by applying a strategy of logging onto the system every 2 or 3 months just to fulfill their training requirements.

Table 6 summarizes the results for each of the three groups of employees at K Hospital. Each of the three elements of agency is indicated in the table, and we identify each group's resolution to the agency dilemmas faced.

Discussion

This study seeks to explain why IT applications can be implemented with initial enthusiasm, only to be used in a limited and perfunctory manner following implementation. Through the lens of Emirbayer & Mische's (1998) temporal theory of human agency, we view the use of IT applications as an act of human agency simultaneously influenced by the promise of the future, the inertia of the past, and the practical contingencies of the present. By incorporating both the inertial and transformational perspectives on human agency, the theory's essential insight is that the conflicting temporal elements of agency pose dilemmas for actors who are presented with new IT applications. Actors' resulting patterns of use can be understood as resolutions to agency dilemmas in which temporal contradictions are reconciled, at least temporarily.

Like many grand social theories, Emirbayer & Mische's (1998) theory neglects specific consideration of technology as an influence on human agency. In the IS literature, technology's influence is addressed by studying 'technology-in-use' (Orlikowski, 2000). As human agents enact technology, its influence is realized as recurring work practices shaped in use rather than determined by technological features. However, the practice lens on technology use is not specific regarding the theoretical mechanisms shaping users' enactments, leaving unanswered the questions of how and why actors use technology. The temporal theory of agency provides a theoretical explanation of user's response to the online learning technology implemented in K Hospital. We found each learner group to be attracted to the potential benefits provided by online learning. The flexible retrieval of contents provided in the technology platform raised positive expectations for new ways of learning, corresponding to the projective element of human agency. Simultaneously, users recognized LearnNet's constraints on media content and accessibility, which conflicted with its positive features. Thus, technology features were implicated in learner's practical-evaluative dilemmas, which each group resolved by limiting their use of LearnNet over time.

It might be tempting to attribute the decline in use of online learning to the constraining features of the technology itself rather than to human agency. IS

research often draws such conclusions because of an implicit faith that usage problems can be resolved by improving IS design. In our case, such a conclusion would advocate the redesign of LearnNet to be more accessible and to include more relevant content. However, these recommendations would overlook the evidence that LearnNet's features remained constant throughout the period of study while the usage frequency for all three groups declined (see Table 5). Even the nurses, whose access to the online system was restricted the most, used the system frequently when the technology was implemented, and their usage sharply declined afterward. This evidence contradicts the argument that technological constraints explain the degree of online system use. Rather, our data point to human agents' temporally situated responses to unchanging technological features as a more satisfactory explanation.

A fair criticism of the temporal theory of human agency is its neglect of social structural influences (Fuchs, 2001). Although claiming that human agency is socially influenced, Emirbayer and Mische offer little detail on how such influence is exerted or experienced. One interpretation is that their iterational element of agency, with its focus on familiar behavioral routines performed in the past, supplants the role of social structure as an influence on repetitive patterns of action (Boudreau & Robey, 2005). However, the link between social structure and iterational agency remains neglected.

Our study locates structural influences as professional and occupational norms, which originate outside of specific organizational structures (Bechky, 2006). In K Hospital, the nurses and druggists were sensitive to their traditional learning and work practices, which were guided by professional norms relevant to health care. Resolving the dilemmas that each group of hospital employees faced required adaptations to the new technology that did not interfere with traditional work practices and professional norms. For example, although LearnNet helped the nurses to receive training at times convenient to them, learning from online media differed dramatically from the socialization to work practices learned on the job. Moreover, all three groups considered accessing learning material while in the presence of patients as unprofessional and inappropriate. Thus, users persisted in their traditional learning and work practices and decreased their online learning activities.

Our study contributes to emerging IS research on the use of technology following adoption, which arguably has become more relevant than the formerly predominant focus on adoption (Jasperson *et al.*, 2005). Indeed, our results suggest few problems with pre-adoption attitudes or beliefs, which were uniformly positive and reflected an eagerness to receive the benefits of online learning. The long legacy of adoption research supports positive associations between user attitudes and intentions to adopt new technologies (e.g., Davis, 1989; Mathieson, 1991; Taylor & Todd, 1995). However, research also shows a weak correlation between

pre-adoption intention to use and actual use following implementation (e.g., Bock & Kim, 2002; Kuo et al., 2003). Because the benefits of IT applications are ultimately captured in use (Strassman, 1990), we need to study the actual patterns of IS use in addition to pre-adoption attitudes and beliefs (Jasperson et al., 2005).

Given the importance of studying post-adoption behavior, research on work practice and human agency is appropriately focused on explaining how and why actors use IT applications in ways that differ from pre-adoption expectations. However, theories of work practice currently used in IS research point in different directions, depending on how they are interpreted. Our review of selected practice theories identifies theories that use human agency to explain either inertia or transformation of practice. By contrast, Emirbayer & Mische's (1998) temporal theory of human agency simultaneously considers both inertia and transformation and extends previous theory by also considering the practical contingencies affecting action in the present. By disaggregating human agency into elements simultaneously oriented to the future, past, and present, the theory draws attention to the tensions among past practices, future expectations, and the practical dilemmas of the present. The theory thus affords an understanding of why future plans may not be realized in action.

The theory also offers potential insight into changes in practice over time. Emirbayer & Mische (1998) suggest that particular elements of human agency may become dominant at different periods of time. In our case study, the projective element of agency appears to be more influential prior to IT implementation, as evidenced by the positive statements of hospital employees toward online learning. With limited exposure to LearnNet, expressions of anticipated benefits were stronger than expressions of doubt. During the period immediately following implementation, by contrast, users appeared to be more sensitive to the technology's constraints. The practical-evaluative element of agency appears to be more influential during this period. As dilemmas are resolved over time, users may establish new learning and work routines or revert to older ones, reflecting the iterative element of agency. The disaggregation of theoretical elements offers insights into the reasons why post-adoption behavior differs from pre-adoption behaviors, thus answering our research question. Overall, we contribute to the practice perspective by providing a more complete account of theoretical mechanisms that explain changes in the use of new IT applications following their implementation.

Conclusion

In conclusion, our research seeks an answer to the question: *why do work and learning practices change following the implementation of online learning?* In response to this question, a temporal theory of human agency provides useful insights that are not fully captured by other theoretical approaches. The theory helps to identify the dilemmas implicated in technology initiatives intended to change work practices. Actors face pressures to preserve traditional practices associated with professional norms while responding to the attractions of new ways of working and learning. Actors may resolve the dilemmas associated with conflicting pressures in ways that produce consequences unintended by the designers and sponsors of IT applications. Previous studies have shown how enactments such as inertia and improvisation overcome structural and technical constraints, reinforcing the value of adopting a practice perspective on technological change (Orlikowski, 1996, 2000). The temporal theory of human agency used in this study contributes to the practice perspective by explaining why agents act as they do.

The contributions of this research are limited in part by the research design, which provides a retrospective analysis of a single case. Retrospection is capable of capturing temporal dynamics, but retrospective reports may be cognitively distorted by subsequent events (Cowley, 2006). In terms of the temporal theory used in our case study, reports of pre-implementation attitudes might be revised to be more negative, given the limited use of LearnNet at the time data were collected. Our data reveal no such cognitive distortion, however, as the comments about online learning's potential were positive across all groups interviewed. Our use of a single case also poses potential limitations, notably the inability to generalize to other cases. This limitation is typically balanced against the traditional advantages of case study research, including attention to context and multiple stakeholders (Mason, 2002). The limitation is also mitigated by arguing for generalization through the theory to social settings sharing similar characteristics (Lee & Baskerville, 2003).

This study prompts practical observations on the design of online learning applications in work settings. As a learning technology, LearnNet did little more than replicate materials designed for classroom learning at K Hospital and deploy them on the Internet. LearnNet's slogan of 'Your PC, Our Classroom' revealed, perhaps inadvertently, designers' limited view of online learning as an activity that is separated from work practice. Our data show that offline learning was more apt to be situated in practice rather than consumed in the classroom. The distinction between situated and canonical learning is well established in the literature on organizational learning (e.g., Wenger, 1998) and technology-mediated learning (e.g., Leidner & Jarvenpaa, 1995). Learning situated in practice is not easily replaced by canonical learning delivered via formal training or online classrooms.

Certain aspects of online learning, however, might be more readily integrated with practice. For example, the druggists' need for information about new drugs might be satisfied by accessing online resources as the need for such information arises in the druggist's work. In this way, online learning could be more directly integrated

with learners' work practices. Online learning initiatives often underestimate the extent to which content must be adapted to online learning environments (Hsiao *et al.*, 2006). As such, online learning may appear discordant with regular work demands, thereby contributing to the dilemmas that prospective users face. Such issues may be overlooked prior to implementation when attention is placed on the future promise of new IT applications. The temporal theory of human agency helps us to explain the conflicts among future prospects, past practices, and the dilemmas facing users in the present. By reducing the discord between learning and practice, designers of online learning systems might reduce potential dilemmas.

The temporal theory of human agency and the practice perspective both emphasize the ability of resourceful human actors to exercise discretion to modify learning and work practices in response to situations they encounter when new technologies are introduced. Although new technologies may be implemented with the expectation that learning and work practices will change, the degree and nature of change is only realized through the actions of users. Human agency includes the capacity to stop using IT applications that were once viewed favorably, thus eliminating many of the expected benefits associated with IT. Our research is motivated by a desire to advance the emerging perspective on work practice in IS research by incorporating the explanatory mechanisms of the temporal theory of human agency.

As the practice perspective on technology use moves forward, it could potentially benefit from contributions by an even wider range of theoretical perspectives. For example, Lamb & Kling (2003) view IT users as social actors embedded in social networks and influenced by their affiliations, environments, interactions, and identities. Thus, social actors play multiple roles with multiple interests in multiple social contexts. The multiplicity of social action suggests that actual practice involves temporary resolutions to conflicts of interest or interpretation. By specifying the range of influences on action, Lamb and Kling explain why practice may differ from expectations. Similarly, Vaast & Walsham (2005) examine the ways that knowledge of work practices is represented and shared. They argue that cognitive shifts in representations surrounding IT may lead actors to change their work practices, yet those new practices may introduce dissonance when compared to former practices. Depending on how dissonance is resolved and consonance is restored, IT may or may not become implicated in novel variations in work practices.

These new theoretical directions have a similar aim as our own. Each offers a set of theoretical concepts that help to explain why work practices change following the implementation and use of IT applications. Our application of Emirbayer and Mische's theory is intended to extend the insights available from the practice perspective on IT use by focusing on the temporal nature of human agency.

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