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Toward an Integrative Understanding of Information Technology Training Research across Information Systems and Human-Computer Interaction: A Comprehensive Review

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Theory & Review

Toward an Integrative Understanding of Information Technology Training Research across Information Systems and Human-Computer Interaction: A Comprehensive Review

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Abstract

Researchers investigating issues in the domain of training and human-computer interaction share a common interest in ensuring that users are skilled in the use of Information Technologies (IT). When users have the necessary skills, they can utilize IT productively and also have a pleasant human-to-computer interaction. Over the past three decades, Information System (IS) researchers have made considerable efforts in identifying the most effective ways to develop users' IT skills. However, at this point in time, there are many changes taking place in the IT environment and organizations find it challenging to keep their employees trained and updated on IT skills. Hence, it is important for the IS community to respond by taking the lead in identifying and conducting research that can help organizations effectively address these challenges. We take the first step in conducting a comprehensive review of training research published in major IS and HCI journals over the past three decades so as to synthesize IT training research, provide an integrative understanding of findings, and propose directions for future research.

Our study indicates that while IS research on training has made steady progress in advancing our understanding of alternative IT training methods and cognitive learning processes, it also has several shortcomings. Past research has: a) focused primarily on the training program without sufficient attention to activities prior to and after the program, b) used a small set of theoretical foundations, and c) focused on a few topics and on single-user systems rather than integrated enterprise systems. Critical issues such as improving user motivations prior to training, transfer of training skills to the workplace, assessment of training, and supporting user learning that occurs after training have not been given adequate attention. We identify several research opportunities by tapping into relatively unexplored theories and urge researchers to continue research to address the gaps identified in this comprehensive review as well as to develop innovative methods to help employees learn through newer channels, such as e-learning and social media.

Keywords: IT Training, Computer Training, Computer Learning, Skill Acquisition, Human-Computer Interaction

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INTRODUCTION

Equipping users with adequate computer skills is a crucial element in enhancing human-computer interaction (HCI). In one of the first books on human-computer interaction in the Information Systems (IS) field, Te'eni, Zhang, and Carey (2007) highlighted the importance of users being proficient, and stated that a good fit between the users and technology can be achieved, not only by better design but also by user training. They categorically stated that "Training is part of creating effective HCI," (Te'eni et al., 2007, p. 9). From the perspective of organizations, this implies that employees must develop proficiency in using information technologies (IT) so that they can have smooth interactions with technology and fully realize the potential benefits expected from the technology. Hence, it is no surprise that organizations strive to enhance their employees' IT skills through in-house training programs and external certifications, with surveys on organizational practices persistently reporting that corporations invest a substantial amount of money in IT training programs (Allen, 2008; Dolezalek, 2005). According to a recent training industry report (Miller, 2012), U.S. organizations continue to invest in training with expenditures on employee learning and development of the order of $156 billion in 2011. In addition, there has been a substantial shift toward using technology, with almost a third of training delivered via technology tools.

Recent reports on training further indicate that investments are on the rise due to the emergence of new types of technologies as well as new methods for delivering training such as e-learning platforms (Allen and Seaman, 2011; Green and McGill, 2011). These reports also indicate that, in fact, businesses are finding it challenging to train and keep their employees' skills updated, as new technologies are rapidly introduced and new conduits such as e-learning and social media are widely available for training purposes. Also, it becomes harder for organizations to provide structures that help IT skill development of employees when they are spread all over the globe (Santhanam et al., 2010).

The Information Systems (IS) community has taken note of the critical role of training in facilitating interactions with technology, and for the last two decades has expended substantial research effort to investigate and develop recommendations on the design of IT training programs (e.g., Compeau et al., 1995; Santhanam et al., 2010). However, due to the lack of effort to synthesize disparate findings and provide a coherent overview of the accumulated research findings on IT training, the overall picture of its collective developments is mostly unavailable at this juncture of important changes in the IT training environment, preventing us from reflecting on the findings of the past decades and charting the courses of future research that can help cope with the changes (Webster and Watson, 2002). There is one published study that consolidates some of the IT training research but the focus is primarily on training methods (Gupta et al., 2010) and is limited to a synthesis of concepts, rather than a detailed in-depth literature survey focused on research findings and patterns. Moreover, while this study examined a few research studies in the education field, it did not take into account research in the human-computer interaction domain, where researchers have conducted a number of studies on computer training (e.g., Grudin, 2006; Olfman et al., 2006; Zhang and Dhillon, 2003; Zhang et al., 2004). Leading journals devoted to promoting HCI research, such as the *International Journal of Human-Computer Studies,* publish many research studies on IT training and a survey of HCI research includes topics in learning (Zhang and Li, 2005).

The goal of this study is to provide a comprehensive review of the literature that has appeared in major IS and HCI journals over the past three decades, as we focus on developing an integrative understanding of the findings. In the next section, we describe the framework used in categorizing and synthesizing the research articles included in our review. In the third section, we present a description of the research methods we employed for the selection of the articles. We then present a discussion of findings from our literature survey, a discussion of future research directions, and concluding remarks.

RESEARCH FRAMEWORK

Most large organizations have a full-fledged training department, typically housed as part of the human resources function, which develops and oversees all employee training programs. Its training programs commonly include IT training in addition to supervisory, sales, customer service, and interpersonal skill training (Training Magazine, 2011). Hence, some early research on training was conducted by researchers in the Management discipline, who have developed various frameworks that can be applied in general to any training program, some of which have been applied to IT training (e.g., Colquitt et al., 2000; Kraiger et al., 1993). In addition to developing employees' IT skills, IS researchers also noted that IT training can have a strong influence on employees' attitude toward a new system and the extent to which they will successfully use it in their work (Lee et al., 1995; Venkatesh, 1999). Because employees typically see and feel the new technology for the first time during training, their initial perceptions regarding its usefulness impact their acceptance and their extended use of the system, making it a very important organizational activity (Cooper and Zmud, 1990; Jasperson et al., 2005; Lee et al., 1995). Consequently, while early IS research on

training had a primary focus on methods to develop employees' technology skills, later research started to emphasize the development of affective outcomes as part of IT training programs, motivational aspects of training, and other contextual factors (e.g., Venkatesh, 1999; Venkatesh and Speier, 1999; Yi and Davis, 2003; Yi and Hwang, 2003). For our review, we wanted to adhere to such a holistic approach to synthesize training research; hence, we first present a framework developed to guide our literature survey.

Training Activities and Training Outcomes - A Framework for Synthesizing Research

Training is typically defined as an act, process or method of bringing a person to an agreed standard of proficiency by practice and instruction. This same viewpoint is echoed by governmental agencies, which describe it as a process by which an employee is enrolled in a planned and prepared program that can improve individual and organizational performance (Government Employees Training Act, 1958). One can view training as an organizationally designed activity or program that aims to develop specific skills and knowledge of employees in a systematic manner, as required at particular points in time. For example, a corporation like CISCO has a training program designed to develop selected employees' knowledge and skills on networking (Totty, 2005). Note that IT training is quite different from curriculum design and instruction, where the focus is on educating a student for a lifetime of learning about various topics; a research focus seen in education journals and books (e.g., Jonassen, 2001). In this review, we adopt the perspective of IS researchers who view training as a planned activity that can help employees obtain predetermined levels of knowledge and skills in IT. (Note: As a point of clarification, IT training has been called computer training, computer skill training, and IS training. We use "IT training" to represent these terms throughout this paper.)

In an IT training program, attendees must develop their conceptual knowledge of the new system, procedural skills to operate the system, integrative skills to orchestrate the acquired component skills, and motivations to apply these skills to organizational tasks; hence, training is a complex skill-development activity heavily dependent on cognitive processing of information (Davis and Yi, 2004). Furthermore, because technologies are constantly changing in forms and features, best training approaches cannot remain static either, necessitating constant research to identify ways to improve employees' understanding, skillsets, and use of IS in organizations.

The research framework proposed by Bostrom et al. (1990) is among the earliest on IT training and appears to have jump-started research on this topic. This framework suggests that three categories of factors influence two types of training outcomes: user attitudes toward the system and user learning performance. The three factors that influence the outcomes are the target system (characteristics), trainee characteristics, and training methods. These three factors influence training outcomes through the trainees' mental model, defined as a mental representation of the system. Bostrom et al. (1990) urged researchers to investigate the roles and effects of each one of the factors in the framework, which resulted in a host of research studies on training (e.g., Davis and Wiedenbeck, 1998; Olfman and Mandviwalla, 1995; Santhanam and Sein, 1994; Sein et al., 1993).

By adapting the general training framework proposed by Kraiger et al. (1993) to the IS context, other research studies were conducted that adhered to the perspective that training has to be designed to influence user changes in cognitive, skill-based, and affective outcomes (e.g., Davis and Yi, 2004; Marcolin et al., 2000; Yi and Davis, 2003). Cognitive outcomes are concerned with trainee comprehension of key knowledge elements and the relationships among them, and are evaluated by measuring verbal knowledge, knowledge organization (i.e., mental models), and cognitive strategies. Skill-based outcomes are concerned with the development of technical skills and are assessed by measuring skill compilation and automaticity. Finally, affective outcomes are concerned with motivational (e.g., self-efficacy) and attitudinal outcomes (e.g., attitude toward the target technology).

The learning outcomes in Kraiger et al.'s (1993) framework map broadly onto the outcomes specified by Bostrom et al.'s (1990) framework, while drawing more attention to evaluation of training goals. Extending Kraiger et al.'s (1993) work, Marcolin et al. (2000) showed that cognitive outcomes (software knowledge) and affective outcomes (self-efficacy) are different. Furthermore, Yi and Davis (2003) specified and empirically validated causal relationships between the three types of outcomes: cognitive, affective, and skill-based. They found that declarative knowledge (cognitive outcome) and self-efficacy (affective outcome) are distinct determinants of task performance (i.e., skill-based outcome). Collectively, these studies indicate that each of these three types of training outcomes has to be addressed in training design and assessment.

Several researchers have suggested that training must be viewed from a process perspective and have put forth stage-based training frameworks (Compeau et al., 1995; Sein et al., 1997). These frameworks view training as a continuous process where IT training activities are grouped into three stages. Activities taking place before a formal training workshop form part of the pre-training stage; the training program is part of the training stage; and activities after training belong to the post-training stage. Pre-training activities include the assessment of training needs, selection of trainees, development of training materials, design of training methods, and preparation of trainers/facilitators. Training involves the actual delivery and development of trainee skills. Post-training activities

include support of employees at work, evaluation of training program effectiveness, and assessment of transfer of training. These stage-based frameworks provide a comprehensive account of computer training activities and point to the importance of preparation for the training program and to the transfer of training outcomes to the workplace. The ultimate goal of any training program is to prepare a user to apply what has been learned to his or her work.

Based on the training frameworks discussed above, we present an integrated training framework in Figure 1, which will guide our review of extant studies on IT training. In this framework, we employ both process and outcome perspectives together. We look at training as a program that has to be planned and designed through the pre-training stage in which many activities have to be completed. During the training stage, the employees see the various aspects of the new technology and understand how to use it in work. Employees' understanding, knowledge and perceptions of the system obtained in this training stage have to be gauged. After training, employees use the system at work, and the extent to which they are able to use it effectively and the extent of use is gauged to obtain feedback on the overall effectiveness of training. Using this framework, we will synthesize the literature and organize the insights we have obtained on each of the stages, activities and outcomes of IT training.

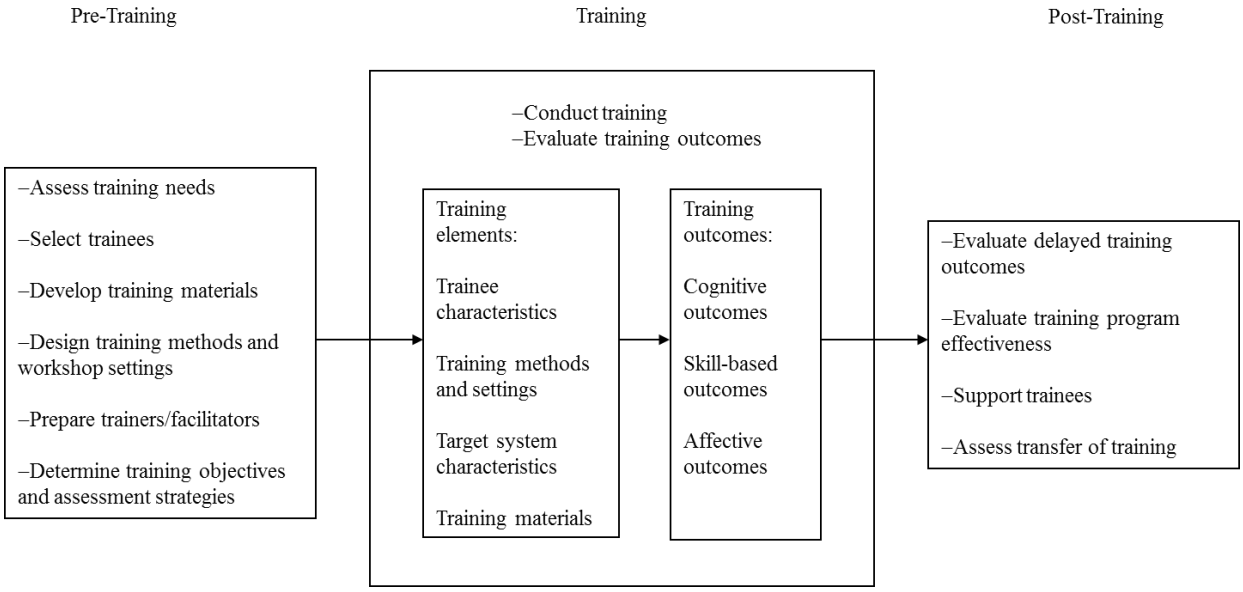

Figure 1: A Framework for Review of IT Training Research

LITERATURE SELECTION METHOD

We developed selection criteria to identify published research studies that would serve as primary objects of our literature review. First, as stated above, we were interested in IT training, which has the goal of improving or better understanding the acquisition of IT skills. Hence, IT training had to be the primary focus of a selected research article, not an incidental issue. Second, we considered the IT training research from its start in 1986 to 2012, a period that spans 27 years. Third, we determined that studies must be empirical and include quantitative data analysis so that we could identify training outcomes and study variable relationships. Finally, the studies had to be published in journals that were listed in the top 50 journals posted on the ISWorld website and the 16 journals listed in the HCI Bibliography website as these represented major IS and HCI journals (HCIBIB, 2011; Perlman, 2006; Saunders, 2006). Based on these criteria, two research team members searched computer databases and filtered results. The search results were compared, merged, and also supplemented by manual scanning of a number of premier journals. We identified 65 articles that met the above criteria adequately. Two researchers independently analyzed the 65 articles and summarized them in terms of their research variables, study settings, theory bases, and findings. The researchers then cross-examined their summaries. From the summaries, we found 66 differences (about 89% agreement), which were resolved through discussions between the researchers and reviewed by the two senior researchers. The full list of reviewed articles is provided in the Appendix.

DISCUSSION OF FINDINGS

General Observations

Our review of IT training research indicates that a diverse set of variables, measures, and system contexts have been addressed. We wanted to identify patterns in research and highlight specific issues that have not been resolved. Thus, we have developed frequency tabulations and highlighted key contributions and publications (Tables 1-7). We later provide a descriptive qualitative review.

As shown in Table 1, the most popular outlets for publishing quantitative IT training research were *International Journal of Human-Computer Studies* (10 articles), *Behavior & Information Technology* (9 articles), *Human-Computer Interaction* (7 articles), *Information Systems Research* (7 articles), and *MIS Quarterly* (6 articles). The first three are highly reputable journals in the HCI field (Valero and Monk, 1998) and the last two are the top two journals in the IS field (Saunders, 2006). With over 60 percent of IT training studies published in the journals that are identified as the top HCI and IS journals, it is evident that researchers and journal publishers accord a high value to IT training research. In total, 40 articles were published in HCI journals and 25 in IS journals. However, research in IT training appears to be showing a decreasing trend in the recent past, with 50 papers published between 1986 and 1999, and 15 papers between 2000 and 2012.

Table 1 – IT Training Research Publication Outlets

Journal	Number of articles
International Journal of Human-Computer Studies	10
Behavior & Information Technology	9
Human-Computer Interaction	7
Information Systems Research	7
MIS Quarterly	6
SIGCHI Bulletin (ACM SIGCHI)	5
International Journal of Human-Computer Interaction	4
Decision Sciences	3
Interacting with Computers (BCS-HCI)	3
Journal of Management	3
Journal of Management Information Systems	2
Communications of the ACM	1
IEEE Transactions on Professional Communication	1
Information Systems Journal	1
Journal of Information Systems	1
Journal of Organizational and End User Computing	1
TOCHI - ACM Transactions on Computer-Human Interaction	1
Total	65

As shown in Table 2, laboratory experimentation (52 studies, 80%) is the dominant research method employed to conduct IT training research, followed by field experiments (11 studies, 17%), a field study that surveys organizational practices and managerial perceptions, and a mixed approach. It should be noted that societies oriented toward practicing managers such as the American Society for Training and Development (ASTD) regularly conduct surveys and report results in trade magazines such as Training and Development (Green and McGill, 2011).

Table 2 – Research Methods

Method	Frequency	Selected Publications
Laboratory Experiment	52	• Truman 2009 • Uther and Haley 2008 • Yi and Davis 2003 • Lazar and Norcio 2003 • Yi and Davis 2001 • Davis and Wiedenbeck 2001 • Johnson and Marakas 2000 • Wiedenbeck 1999 • Gnisci, Papa, and Spedaletti 1999

		• Lim, Ward, and Benbasat 1997 • Galletta, Ahuja, Hartman, Teo, and Peace 1995 • Davis and Bostrom 1992 • Hicks, Hicks, and Sen 1991 • Sein and Bostrom 1989 • Kamouri, Kamouri, and Smith 1986
Field Experiment	11	• Coppola and Myre 2002 • Venkatesh and Speier 2000 • Shayo, Olfman, and Teitelroit 1999 • Simon, Grover, Teng, and Whitcomb 1996 • Webster and Martocchio 1995 • Olfman and Bostrom 1991
Field Survey	1	• Marler, Liang, and Dulebohn 2006
Mixed (Laboratory and Field Experiment)	1	• Bostrom, Olfman, and Sein 1990
Total	65	

Table 3 shows that a majority of studies (47 studies, 72%) dealt solely with activities in the training phase, a relatively small number of studies (13 studies, 20%) with pre-training activities, and very few studies (3 studies, 5%) with post-training issues. Of the 65 studies reviewed, only two (3%) attended to all three stages: pre-training, training, and post-training.

Table 3 – Training Activity

Training Activity	Frequency	Selected Publications
Training Only	47	• Truman 2009 • Uther and Haley 2008 • Yi and Davis 2003 • Lazar and Norcio 2003 • Coppola and Myre 2002 • Yi and Davis 2001 • Davis and Wiedenbeck 2001 • Johnson and Marakas 2000 • Wiedenbeck 1999 • Lim, Ward, and Benbasat 1997 • Compeau and Higgins 1995 • Sein and Bostrom 1989
Pre-training + Training	13	• Santhanam, Sasidharan, and Webster 2008 • Kettanurak, Ramamurthy, and Haseman 2001 • Galletta, Ahuja, Hartman, Teo, and Peace 1995 • Kerr and Payne 1994 • Webster and Martocchio 1993 • Davis and Bostrom 1992 • Matta and Kern 1991
Training + Post-training	3	• Simon, Grover, Teng, and Whitcomb 1996 • Olfman and Mandviwalla 1994 • Olfman and Bostrom 1991
Pre-training + Training + Post-training	2	• Shayo, Olfman, and Teitelroit 1999 • Webster and Martocchio 1995
Total	65	

Table 4 shows that social cognitive theory (Bandura, 1986) is the most frequent and dominant theoretical foundation that has been used in IT training research, followed by mental model theories (Craik, 1943; Johnson-Laird, 1983), learning theories (Bostrom et al., 1990; Gagné, 1985; Gorham, 1986; Kolb, 1976, 1984), assimilation theory (Ausubel, 1968), and information processing theory (Anderson, 1983). A large number of studies (34 studies, 52%) were anchored on a single theory. Given that a primary goal of training is to help employees learn, it is not surprising to see that the concept of knowledge structures described in mental models (Johnson-Laird, 1983; Sein and Bostrom, 1991) is often included in training design, as well as support for individual learning styles of trainees (Kolb, 1984).

Table 4 –Theories & Frameworks

Theory	Frequency	Sample Publications
Social Cognitive Theory	10	• Truman 2009 • Mao and Brown 2005 • Yi and Davis 2003 • Yi and Davis 2001 • Davis and Wiedenbeck 2001 • Bolt, Killough, and Koh 2001
Mental Model Theory	10	• Uther and Haley 2008 • Mao and Brown 2005 • Lim, Ward, and Benbasat 1997 • Sein, Olfman, Bostrom, and Davis 1993 • Davis and Bostrom 1992 • Koubek and Mountjoy 1991
Learning Theory	9	• Kettanurak, Ramamurthy, and Haseman 2001 • Koubek and Mountjoy 1991 • Davis and Davis 1990 • Bostrom, Olfman, and Sein 1990 • Sein and Bostrom 1989
Assimilation Theory	7	• Davis and Wiedenbeck 2001 • Wiedenbeck 1999 • Davis and Wiedenbeck 1998
Information Processing Theory	6	• Coppola and Myre 2002 • Webster and Martocchio 1993 • Ahrens and Sankar 1993

Training Subjects, Target Systems, Settings, and Outcomes

More than 5,700 individuals participated in the 65 training research studies. As shown in Table 5, a majority of studies (39 studies, 60%) employed students as study participants. A smaller number of studies used employees (12 studies, 18%) and general public participants (10 studies, 15%). In only one study, both students and employees were participants.

Table 5 – Subject Types

Subject	Frequency	Selected Publications
Student	39	• Truman 2009 • Santhanam, Sasidharan, and Webster 2008 • Mao and Brown 2005 • Yi and Davis 2003 • Piccoli, Ahmad, and Ives 2001 • Johnson and Marakas 2000 • Wiedenbeck and Zila 1997 • Lim, Ward, and Benbasat 1997 • Ahrens and Sankar 1993 • Bostrom, Olfman, and Sein 1990 • Black, Bechtold, Mitrani, and Carroll 1989
Employee	12	• Marler,, Liang and Dulebohn 2006 • Coppola and Myre 2002 • Shayo, Olfman, and Teitelroit 1999 • Agarwal, Prasada, and Zanino 1996 • Webster and Martocchio 1995 • Olfman and Mandviwalla 1994 • Webster and Martocchio 1993
General Public	10	• Lazar and Norcio 2003 • Venkatesh and Speier 2000 • Venkatesh 1999 • Simon, Grover, Teng, and Whitcomb 1996

		• Compeau and Higgins 1995 • Dayton, Gettys, and Unrein 1989
Combination of Student and Employee	1	• Black, Carroll, and McGuigan 1987
Not Specified	3	• Kerr and Payne 1994 • Cohan and Newsome 1988
Total	65	

As shown in Table 6, the target systems examined in the studies are overwhelmingly single-user individual level systems (52 studies, 80%), which are systems or software programs that were primarily designed to be used solely by one individual at a given time. As per Shelly et al.'s (2006) typology, those individual-level systems can be further categorized into 30 business applications, 6 communication applications, 4 graphics and multimedia applications, and 4 home/personal/education applications. Two articles indicated that their study examined the training of users involving a group communication system, Virtual Workplace. Nine studies examined organizational level multi-user systems, consisting of three studies that examined knowledge work systems, four studies that examined decision support systems, and two studies that examined office automation systems. Two articles examined individual and organizational level systems together.

Table 6 – Target Systems Studied

Level of Target System	Type of System	Frequency	Selected Publications	Total
Individual	Application Software (e.g., Excel)	44	• Truman 2009 • Uther and Haley 2008 • Mao and Brown 2005 • Yi and Davis 2001 • Bolt, Killough, and Koh 2001 • Charney and Reder 1986 • Yi and Davis 2003 • Johnson and Marakas 2000 • Compeau and Higgins 1995	52
	System Software (e.g., Windows)	6	• Gnisci, Papa, and Spedaletti 1999 • Davis and Bostrom 1992 • Agarwal, Prasada, and Zanino 1996 • Olfman and Mandviwalla 1994 • Davis and Bostrom 1993 • Cohan and Newsome 1988	
	Programming Software (e.g., LISP)	2	• Pirolli 1986 • Davis and Davis 1990	
Group	Group Communication Software (e.g., Virtual Workplace System)	2	• Venkatesh and Speier 2000 • Venkatesh 1999	2
Organizational	Knowledge Work System (e.g., Lotus Domino)	3	• Kontogiannis and Shepherd 1999 • Shayo, Olfman, and Teitelroit 1999 • Simon, Grover, Teng, and Whitcomb 1996	9
	Decision Support System (e.g., IFPS)	4	• Marler,, Liang and Dulebohn 2006 • Lin and Su 1998 • Pei and Reneau 1990 • Green and Hughes 1986	
	Office Automation System (e.g., IBM DisplayWriter)	2	• Carroll, Smith-Kerker, Ford, and Mazur-Rimetz 1987-1988 • Coppola and Myre 2002	
Individual & Organizational		2	• Sein, Olfman, Bostrom, and Davis 1993	2
Total				65

A popular topic of training research is the determination of most effective training methods. A list of these studies on

training methods/strategies is shown in Table 7. As seen in the table, there are frequent comparisons between alternative training methods, such as behavior modeling approaches versus other methods, different types of conceptual model-based training methods, exploration-based versus instruction-based methods, and self-paced versus traditional instruction-based methods. Much research has examined the relative effects of alternative training methods, and far less research has focused on understanding the effects of training environments such as class environment types, preview types, question opportunities, and training labeling types such as "work" versus "play." The role of feedback and the type of hands-on activities required in skill-development have been popular topics.

Table 7–Training Methods and Strategies Examined In IT Training Research

Training Types	Frequency[1]
Behavior Modeling vs. Other Training Methods	7
Conceptual Model Training (Abstract vs. Analogical Models or Abstract vs. Concrete Models)	7
Exploration-based vs. Traditional Training (Instruction-based)	6
Self-paced Training vs. Traditional Training	6
Human vs. Computer-based Instructor	5
Training Sequence or Training Order	5
Instructional Media Effects	5
Application-based vs. Construct-based Training Method	3
Conceptual vs. Procedural Method Training	3
Error Management Training Types	3
Game-based vs. Traditional Training Method	2
Minimal Manual vs. Traditional Help Manuals	2
Passive vs. Active Training Methods	2
Presence vs. Absence of Pre-training	2
Self-discovery vs. Co-discovery Training Methods	2
Types of Interface and Interactivity Levels	2
Presence vs. Absence of Hands-on Exercise during Training	2
Alternative Class Environment Types	1
Demonstration vs. Instruction-based Training	1
Input-Process-Output vs. Preventive-Detective-Corrective Training	1
Learning While Doing vs. Learning By Book	1
Massed Spacing vs. Distributed Spacing	1
Presence vs. Absence of Question asking Opportunities during Training	1
Presence vs. Absence of Elaboration In Training	1
Procedures Group vs. Analysis Group vs. Model Group	1
Labeling Training Activity as Work vs. Play	1
Training Preview Types	1
Training with Wheels vs. Training with Full System[2]	1
Total	75

[1] The total number of studies is greater than 65 because some of the research papers evaluated more than two training methods or strategies.

[2] "Training wheels" refers to a system whose interface has been modified to display only a small and selected set of system functions and options. This was proposed as a way to reduce the burden of learning the system when users see it for the first time. After becoming comfortable with a limited set of functions, users would gradually be exposed to other more complex functions and options.

Among the IT training studies reviewed, skill-based outcomes were the most frequently measured (49 studies), followed by cognitive outcomes (33 studies), affective outcomes (29 studies), and other outcomes (18 studies). Cognitive outcomes were typically measured by assessing comprehension of the training material, and skill-based outcomes were assessed using trainees' task performance (i.e., accuracy of procedural skill compilation). Affective outcomes were assessed using motivational constructs such as self-efficacy and attitudinal outcomes through measures such as perceptions of the system's usefulness and ease of use. Other training outcomes that were assessed include learning and practice time, reaction, and post-training usage behavior.

Qualitative Notes

While the above description of frequency counts reveals patterns in research topics and methods, we read these published papers to delve deeper into the content of the research studies. We now synthesize and elaborate on these studies. As we noted above, the relative effects of alternative training methods is one of the most researched topics in training. In these studies of alternative training methods, laboratory-based studies indicate more significant effects compared with field-based studies (e.g., Simon et al., 1996; Venkatesh and Speier, 2000; Webster and Martocchio, 1993). A large number of studies report inconclusive differences between alternative IT training methods (Ahrens and

Sankar, 1993; Bostrom et al., 1990; Olfman and Bostrom, 1991; Olfman and Mandviwalla, 1994; Santhanam and Sein, 1994; Shayo et al., 1999). Hence, it is noteworthy that among the often indecisive research outcomes, findings converge on the superiority of behavior modeling techniques developed from social cognitive theory (Bandura, 1977, 1986). Behavior modeling training methods in which users observe the modeling of desirable computer skills and reenact the modeled behavior have been found to be more effective than alternative training methods such as self-study (Simon et al., 1996) and lecture-based instruction (Bolt et al., 2001; Compeau and Higgins, 1995; Johnson and Marakas, 2000; Simon et al., 1996; Yi and Davis, 2001, 2003). Only recently, newer theoretical foundations such as structuration theory have been proposed for training design (Gupta and Bostrom, 2009), while social cognitive theory to this day seems to remain a dominant theory anchor even in newer computer-based training media such as e-learning because self-regulatory mechanisms as described in social cognitive theory are useful in designing these programs (Santhanam et al., 2008).

Several studies consistently support the view that a user's mental model of the target system plays an essential role in determining training outcomes. A mental model was originally defined as a representation that reflects a user's understanding and knowledge organization of a physical system but, in the training context, it is used as a proxy to gauge users' understanding of the target technology (Johnson-Laird, 1983; Lim et al., 1997; Mao and Brown, 2005; Pei and Reneau, 1990; Santhanam and Sein, 1994). However, even though these studies converge on the central role of mental models in IT training, no objective and standardized approach to measure mental models has yet been developed.

Individual characteristics, commonly referred to as individual differences, have been shown to play an important role in predicting and explaining training outcomes. Among the many individual characteristics identified, studies consistently indicate that age, computer experience, and computer self-efficacy are significantly related to cognitive outcomes. Therefore, it is critical to measure and control these individual characteristics in research studies that evaluate the effects of various training interventions. Further, prior research has found that learning goal orientation is an antecedent of application specific self-efficacy (Yi and Hwang, 2003) and pre-training motivation is an antecedent of observational learning processes, which then determines the level of declarative knowledge and application specific self-efficacy obtained after training (Yi and Davis, 2003). Yi and Hwang (2003) and Yi and Davis (2003), indicate that trainees' motivation to learn is an important variable related to subsequent training outcomes.

Because training outcomes include affective outcomes such as trainees' motivations to use a system, a number of studies have investigated the link between training and system usage by typically applying the technology acceptance model (TAM) (Davis, 1989; Davis et al., 1989), and found equivocal results. Varying comparisons between training methods such as application-based versus concept-based versus procedural methods do not exhibit strong positive effects in trainee perceptions of ease-of-use or perceived usefulness of the system (Bostrom et al., 1990; Davis and Bostrom, 1992; Olfman and Bostrom, 1991; Olfman and Mandviwalla, 1994). Galletta et al. (1995), however, found significant effects on behavioral intention to use a spreadsheet program from negative word-of-mouth manipulations. Venkatesh (1999) and Venkatesh and Speier (2000) found that game-based training methods resulted in higher levels of enjoyment, ease of use, and intentions to use the system. Yi and Davis (2001) found that subjects with higher cognitive and skill-based outcomes perceived the system to be easier to use. A synthesis of the above training research using TAM indicates that training interventions intended to increase user intentions to use the system do not always result in positive learning effects. Thus, *we still do not know clearly how to design training in a manner that can collectively enhance all three outcomes: cognitive, skill-based, and affective* (Santhanam, 2001; Venkatesh, 1999).

Variations in Research Publication Patterns among the Journals

We observed some differences between research studies published in what are generally accepted as IS journals, such as *MIS Quarterly* and *Information Systems Research*, versus typical HCI journals, such *as International Journal of Human-Computer Studies* and *Behaviour and Information Technology*. First, earlier IT training studies tended to appear more frequently in the HCI journals whereas later studies tended to appear in the IS journals. Before 1990, of the 17 papers published, only one, Green and Hughes (1986), was published in an IS journal. In the 1990s, of the 35 papers published, 15 were published in the HCI journals and 20 were published in the IS journals. After 1999, 7 were published in the HCI journals and 8 were published in the IS journals. IS journals have thus become a repository for reporting on IT training research, apparently because training is viewed as a key theme of inquiry in the IS discipline.

Second, while research questions and study variables overlap, studies in HCI journals focus relatively more on interface design, interactivity, usability, and comparisons of human-based versus computer-based instruction. IS research tends to focus more on alternative training methods including behavior modeling, training-environment factors (i.e., task labeling, virtual learning environment versus traditional classroom), pre-training interventions, and post-training influences, suggesting a focus on training that is relatively more organizational. In the HCI journals, a greater number of studies investigated the impact of "system design features" on training outcomes while in the IS journals more studies investigated "training design features," that is, the impact of different training methods on training outcomes. For example, in the HCI journal, *Behaviour and Information Technology*, Wiedenbeck (1999)

reported a study that examined learning to use an application software package that compared three different interface types (buttons with text labels, icons, and a combination of both) and found that perceived ease of use was higher for the combined interface than for the other two, and that perceived usefulness was higher for the icon-only and the combined interfaces than the label-only interface. In the same year, in the IS journal *MIS Quarterly*, Venkatesh (1999) reported the effects of a game-based training method versus a traditional training method, finding that the former led to higher perceived ease-of-use and intentions to use the system.

These findings reverberate with perspectives echoed by Te'eni, et al. (2007) that when contrasted with HCI research in computer science related disciplines, HCI research in IS adopts a greater task orientation to examining issues and tends to focus on topics that impact organizational tasks and outcomes. Our review finds these claims to be the case in IT training research. Even when IS researchers publish in HCI journals, they tend to focus on task support, decision-making processes, and usage patterns (Bolt et al., 2001; Green and Hughes, 1986; Mao and Brown, 2005; Venkatesh and Speier, 1999). For example, Bolt et al. (2001) try to identify how the complexity of the task on which users are trained moderates the effects, while Mao and Brown (2005) compare two different types of tasks (low-level versus high-level) in understanding the effectiveness of online help from wizards versus that of training from human instructors. While HCI researchers examine the role of intelligent tutoring systems in teaching programming skills (Pirolli, 1986), IS researchers examine the ability of these automated training systems to train in an organizational business task context, namely, production planning tasks (Pei and Reneau, 1990).

Finally, HCI training research is often theoretically grounded in theories from cognitive psychology (e.g., schema theory, dual code processing theory, cognitive complexity theory) while the IT training research is often grounded in theories from social psychology (e.g., social cognitive theory, social information processing theory, theory of reasoned action). However, as we discuss in the next section, these differences can be synergistically leveraged to improve the use of IT in organizations.

A ROADMAP FOR FUTURE IT TRAINING RESEARCH

While the substantive extent of research conducted in the past twenty seven years demonstrates the strong interest and contribution of IT training research, our review also points to several gaps and important questions that must be addressed in future research. In Figure 2, we list broad research questions that should be addressed. In this section, we elaborate on these issues and suggest potential theoretical foundations that could address these questions.

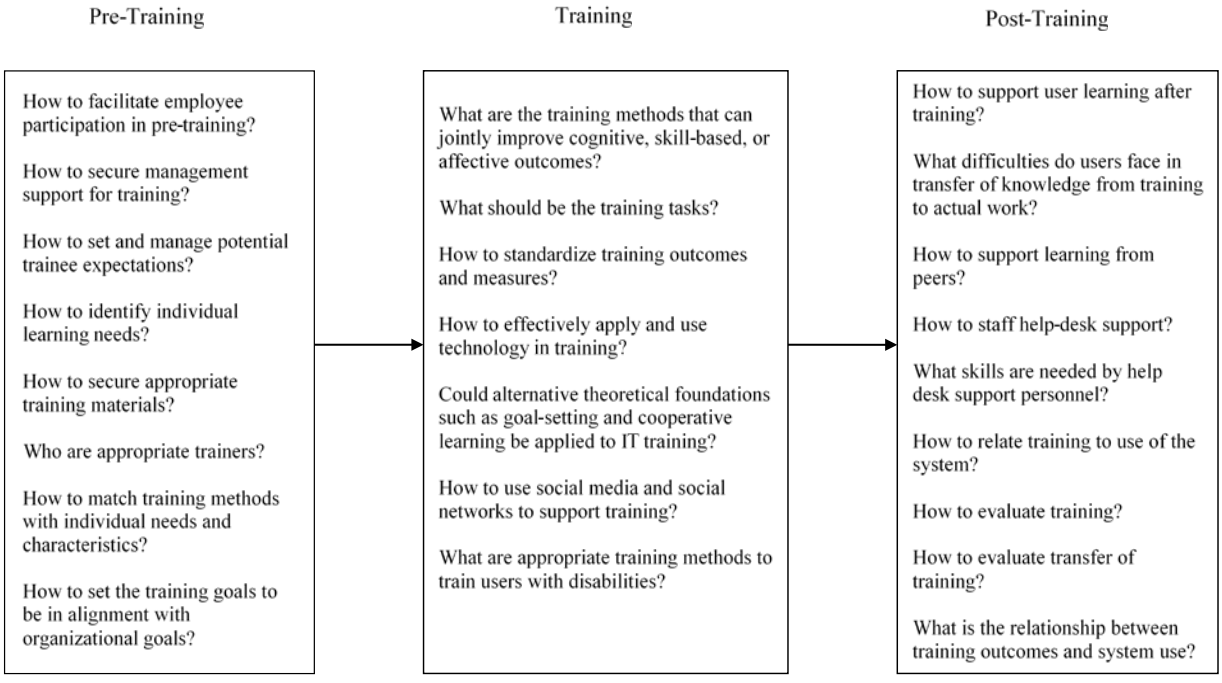

Figure 2: Future Research Issues for IT Training Research

Pre-Training and Post-Training

In terms of the stages of training, our review shows that researchers have tended to focus on training, but not paid much attention to pre-training or post-training issues. Despite continuing empirical evidence that pre-training activities strongly affect training outcomes and that users will not use the new system if they realize that the training program was not designed to meet their needs (Baldwin and Magjuka, 1997; Colquitt et al., 2000; Nelson et al., 1995; Salas and Cannon-Bowers, 2001; Shayo and Olfman, 1999), hardly any IT training research has addressed the design of pre-training activities. Our review findings indicate that key variables influencing training outcomes are employees' motivation to learn, prior experience, and self-efficacy beliefs. Therefore, we propose that if employees themselves participate in pre-training they can use their prior experiences to set training goals and design the training program, thereby setting the stage for a more effective learning opportunity. From the findings of goal setting theory (Locke and Latham, 1990), this process where training goals are set in a participatory fashion with employees collaborating with other employees would result in employees being more motivated to learn, with higher self-efficacy beliefs and increased goal commitment (Erez et al., 1985; Locke and Latham, 1990, 2002). Hence, studies could examine and test propositions, such as: *Employee participation in pre-training activities to develop training design and goals will lead to improved training outcomes through higher training goal commitment.*

In a similar vein, post-training assessment has not received attention even though very early on, researchers (e.g., Kraiger et al., 1993; Compeau et al., 1995) emphasized that evaluation of training is critical because it can provide valuable feedback to trainers and to organizations on how best to develop effective training programs. Our review findings highlight that research on the impact of training on the successful assimilation and continued use of IS is a shortcoming in current IT training research. This gap must be addressed, because as per generally held beliefs, and evidence from surveys and case studies (e.g., Lee et al., 1995; Robey et al., 2002; Sun and Bhattacherjee, 2011), it is clear that training bears a significant correlation to IS use and successful assimilation of large enterprise systems. Yet, hardly any research studies have attempted to show a direct link between investments in training, successful use of IS, and impact on organizational performance. This problem is similar to the issue of linking IT investment to corporate performance, which has been addressed by using resource-based theory (Bharadwaj, 2000) among others, to show that firms that make better IT investments exhibit superior corporate performance compared to others. Using the same resource-based theory, propositions such as: *Investments in IT training result in better corporate performance and the effects are moderated by quality of IT usage* could be tested. Such a study could be conducted creatively by applying multiple research methods such as using archival data on IT investment and corporate performance, and a field survey to obtain data on quality of IT usage. Such a study would be immensely useful to establish the value of training from both a theoretical and a practical perspective.

Another aspect from a post-training perspective that is worth investigating is the role of a help desk and its value within the climate of outsourcing of IS functions. A few studies have shown that help-desk personnel play a very important role in assisting users and act as brokers in conveying technical information while at the same time learning about the business processes (Haggerty and Compeau, 2003; Pawlowski and Robey, 2004). More recent studies have used social network theories and found that even if the training was effective, users rely and interact with many people in their organization to help them on the job (Sasidharan et al., 2012; Sykes et al., 2009). These studies could be extended, and using social network theory, propositions such as: *Close user interactions with help-desk personnel lead to improved system usage and satisfaction* could be tested.

Training for Integrated Systems

Our survey findings and the current level of changes taking place in the industry indicate that there are a host of topics in training that could be researched to inform practice and contribute to theoretical development on IT skill acquisition. We observe that most corporations, even small and medium-sized, have or are implementing large integrated systems, such as enterprise resource planning systems, which require users to learn collectively and have an understanding of other users' tasks. Our survey indicates that, excepting a few research studies, IT research has for the most part focused on individual learning and single-user systems. While we are not calling for the abandonment of research on training for single-user systems, we suggest that as per recent research, task interdependencies and shared cognitions essential to the use of multi-user integrated business process systems (Kang and Santhanam, 2003; Sein et al., 1999; Sharma and Yetton, 2007) be the focus of future training research. Hence, we must research and develop novel training interventions based on underutilized theoretical foundations that can address group cognitions and collaborative learning. For example, using cooperative learning theory (Slavin, 1994), employees could be trained in groups of 3–4 so that they collectively learn to use the system and develop inter-individual cognitive gains (Cohen, 1994; Sharon, 1990) to test propositions such as: *Training interventions based on cooperative learning approaches will lead to higher training outcomes compared with training interventions based on individual learning approaches when training users of multi-user business-process-oriented systems.*

Training Via E-Learning Methods

A topic that shows great promise is e-learning, which has become the platform of choice for corporations to deliver training to their globally dispersed employees. Several researchers have started to address the problems and highlight that one of the key challenges is to make e-learning interesting because the lack of face-to-face interaction can make e-learning boring and challenging to users (Alavi and Leidner, 2001; Gupta and Bostrom, 2009; Santhanam et al., 2008; Yoon and Yi, 2010). A few others have suggested that digital games, referred to as serious games, could be integrated with learning to make e-learning more interesting (Greitzer et al., 2007; Ritterfeld et al., 2009). Therefore, IS researchers could take up investigations on the integration of digital games within an e-learning context, and propositions such as: *e-learning delivered IT training with digital game interventions will lead to enhanced trainee engagement and improved learning outcomes* could be tested.

In addition to e-learning, researchers should pay attention to new mediums such as Twitter, Wikipedia, and other social media through which employees can obtain knowledge. Research questions such as the following could be addressed: To what extent do employees use social media to obtain help in using IT? How can organizations set up support structures to facilitate employee learning from social media? Do employees prefer on-demand learning from social media vis-à-vis traditional organizational structures such as a help desk? How do users obtain help to conduct their daily tasks with technology? We suggest that IS researchers, instead of solely focusing on research questions about how to design training programs, should also conduct research to answer questions about how users learn to use new IT on the job. Answers to these questions will help us address the question of how best to train users. They will also help organizations at a practical level by informing them of how best to support users in becoming proficient in IT in ways other than provision of formal training programs.

Additional Training Outcomes and Interventions

There are several aspects of training outcomes that should be addressed in future research. Affective outcomes are instrumental in improving user acceptance of technology, but our review finds that training methods aimed at improving users' cognitive and skill outcomes may not improve affective outcomes (Santhanam, 2002; Venkatesh, 1999; Yi and Davis, 2001). Therefore, need exists to develop training approaches that are geared toward enhancing affective outcomes. However, affective outcomes may impact other training outcomes. Therefore, its role has to be examined carefully. We propose that, as in the past, we should not focus solely on using TAM constructs, but we must use other constructs that may indirectly affect user acceptance of technology, such as computer self-efficacy, computer anxiety, enjoyment, and attitude toward the target technology (Taylor and Todd, 1995; Yi and Hwang, 2003). Social cognitive theory (Bandura, 1977, 1986, 1997) and attribution theory (Steiner et al., 1991) can help us manipulate these constructs to exert indirect positive effects on affective training outcomes.

Social cognitive theory (Bandura, 1986), postulates that self-efficacy is based on four principal sources of information: enactive attainment, vicarious experience, verbal persuasion, and physiological state (from the most influential to the least). Training can be designed to provide an opportunity in which trainees experience repeated success and, as a result, a strong sense of self-efficacy, which will then positively affect user acceptance of technology via enhanced perceptions of ease of use. In addition, modeling-based training techniques could be used to enhance trainees' self-efficacy by providing an opportunity for vicarious experience (Gist et al., 1989). Behavior-modeling techniques originating in social cognitive theory have already shown some promise in this direction but the full ramifications for IT skill acquisition and system usage have yet to be investigated (Compeau and Higgins, 1995; Yi and Davis, 2003).

We propose that attribution theory (Steiner et al., 1991), although not yet used in IT training research, could be applied to designing training such that it provides feedback to help users make positive attributions about their skills, reduce their computer anxiety, improve their self-efficacy beliefs, and enhance their attitudes. According to attribution theory, people tend to develop causal explanations for events and behaviors such as their performance on a given test or task. When a trainee completes training tasks successfully, through positive feedback the trainer could help the user make internal attributions such as "I have completed the tasks successfully because I am able to use the system effectively." In this manner, feedback-based training could be designed to help trainees develop a strategy to confront their doubts and build strong efficacy beliefs. Hence, using attribution theory, propositions such as: *Training that uses feedback to help users make internal attributions asserting that successful system use results from their actions will reduce users' computer anxiety, increase their self-efficacy and positive computer attitude, and enhance their intention to use the system* could be tested.

Other Training Related Research Topics

As indicated in Figure 2, there are many other related topics that could be taken up for investigation and would be very helpful to organizations. For example, a growing number of employees in business organizations have some

form of disability, and yet training research has not addressed special training requirements. Technology-based training methods should make it possible to research and develop personalized training for users with disabilities. Further, designing standardized methods to create and test training tasks and training outcome evaluation tasks should be viewed as critical to advancing training research. Currently, there exists a big bottleneck in advancing training research as we cannot adequately test and compare the effectiveness of training outcomes across studies. Addressing these issues will take us a long way toward improving training outcomes, comparing training results across research studies, and developing more comprehensive understandings of best training methods and practices.

Researchers must also pay immediate attention to understanding how transfer of learning to the workplace can be supported. More longitudinal studies must be conducted to fully understand the relationship between training outcomes and effective system use. In addition, more attention should be paid to potentially useful theories such as cognitive complexity theory (Kieras and Polson, 1985), dual code processing theory (Schneider and Shiffrin, 1977), and goal setting theory (Locke and Latham, 1990), which could be applied in future research.

We believe that more collaborative and synergistic research between IS and HCI researchers could help address important issues, paving a way toward a unified view of how to help users develop skills both via system design and training programs. For example, researchers in the HCI field proposed training-wheels-based training as an attempt to reduce users' computer anxiety by manipulating system design features (Carroll and Carrithers, 1984). As stated above, reducing computer anxiety and increasing self-efficacy could also increase users' behavioral intention to use the system. Therefore, IS and HCI researchers could combine these research findings to identify whether certain system-design-based methods for training, similar to training wheels, positively affect training outcomes. Already, a few cooperative efforts between IS and HCI researchers and topics have yielded significant results (e.g., Davis and Weidenbeck, 1998), and more efforts in this direction are encouraged.

LIMITATIONS AND CONCLUDING REMARKS

Our study reported on research presented in a key set of 66 journals. Thus, training research reported in conferences and in other journals was not reviewed. Our time frame for analysis was 27 years starting in 1986. There are a number of important dissertations and conference proceedings papers on training research that motivated subsequent research, such as Galletta (1984), but because they did not fit into our criteria of journal article and time frame, they were not reviewed. Barring these and other limitations, our review and synthesis of 27 years of published journal articles on training provide a broad landscape of IT training research. Another review method such as a meta-analysis could also be used rather than a qualitative analysis.

As our review indicates, training has been a major topic in both IS and HCI journals, but thus far no efforts have been made to synthesize and integrate accumulated research findings. Building upon prior IT training frameworks, we have developed an integrative framework that has been used to guide our review of research findings. A comprehensive review of the past three decades' IT training literature indicates that much progress has been made in our understanding of important issues in IT training, but also points to many unexplored and critical issues that should be tackled. We urge researchers in the IS and HCI fields to address the issues identified in this review so that we can continue to improve IT training practices. Many years ago, Grudin (1993) emphasized that despite differences in language and research focus between the two communities of HCI and IS, the potential is immense for collaboration to address important issues and improve IT use in organizations. Since then some collaborative work has been conducted, and the potential benefits of such integrative work have been further emphasized (e.g., Zhang and Dillon, 2003). For example, while IS researchers identify the features of systems and feedback that make them easy to use and learn, HCI researchers could help design these interfaces and testing could be undertaken in a collaborative manner. Similarly, IS researchers could identify potential interventions in e-learning/mobile training to improve its effectiveness, and HCI researchers could develop designs to apply these ideas.

Through a comprehensive review of IT training research published in both HCI and IS journals, our paper highlights the opportunities and responsibilities the two fields jointly share for the improvement of IT training practices and the realization of maximum benefits from IT investments.

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2007-2008: Weiyin Hong	2008-2009: Eleanor Loiacono	2009-2010: Khawaja Saeed	2010-2011: Dezhi Wu
2011-2012: Dianne Cyr	2012-2013: Soussan Djamasbi		