The Effect of Performance Support and Training as Performance Interventions

Frank Nguyen and James D. Klein

For decades, training has been one of the most common interventions used by organizations to improve the performance of their employees and teach them new ideas and skills. But owing to the cost of developing and delivering training, organizations have adopted alternative ways to enable employee performance while reducing the cost and minimizing the time users spend away from the job. One alternative is electronic performance support systems (EPSS). The present study examined the effect of EPSS and training on user performance, time on task, and time in training. Results revealed that participants receiving only EPSS and those receiving training and EPSS performed significantly better on a tax preparation procedure than participants who received only training. Training-only users also spent significantly more time completing the procedural task than their counterparts in other treatment groups, leading to a negative correlation between time on task and performance. The implications of these findings for the design and development of performance support and training interventions are discussed.

For decades, training has been one of the most common interventions used by organizations to improve the performance of their employees and to teach them new ideas and skills. Training interventions typically involve delivery of predesigned and developed instruction, practice, and assessment activities with the goal of increasing learner proficiency on desired behaviors or attitudes. Examples of training include an instructor-led course to train new hires on organizational culture and policies, an individualized Web-based course to train existing employees in use of a new software application, or a virtual course to teach managers to develop and grow their employees. The critical commonality among all training interventions is the fact that employees are asked to learn and master the desired outcomes prior to applying the information to their work.

Organizations have come to rely on training interventions because they can increase user knowledge, performance, and the results these factors exert on the entire organization. Arthur, Bennett, Edens, and Bell (2003) conducted a meta-analysis of 162 published training research studies and found a medium-to-large effect size for training. Burke and Day (1986) found similar results. They conducted a meta-analysis of 70 published managerial training research studies and found that on average managerial training was moderately effective at improving learner achievement.

These training benefits come at a high cost. A study conducted by the American Society for Training and Development (ASTD) found that

PERFORMANCE IMPROVEMENT QUARTERLY, 00(0) PP. 00–00

Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/piq.20017

piq 20017

employees at top companies spent an average of 39.31 hours in training in 2005 (Sugrue & Rivera, 2005). The average monetary cost spent on this training was $1,435 per employee (Sugrue & Rivera, 2005). It is estimated that more than $51 billion is spent on formal training each year (Dolezalek, 2005). This estimate incorporates only the cost of designing, developing, and delivering training courses. It does not include the salary costs or the lost productivity while employees are pulled off the job to attend training.

To address these persistent costs, another technology has emerged over the past decade: electronic performance support systems (EPSS). EPSS gives users "individualized on-line access to the full range of … systems to permit job performance" (Gery, 1991, p. 21). In other words, EPSS can offer users the information and tools they need to do their job, on the job.

Common instances of EPSS include search engines that allow performers to look for information to solve a pressing performance problem, embedded help systems that deliver relevant and specific information to assist a performer in completing a task, a printed job aid with clearly defined steps to complete an infrequent task, or even systems that simplify or automate complex tasks for the performer. All of these examples share one key differentiator compared to training: EPSS interventions focus on supporting performance while the work is being performed rather than at some arbitrary point in time beforehand as with training.

This capability has led many performance technologists to pursue EPSS in the hope of reducing or eliminating the costs of attending class and delivering online training. For example, the eLearning Guild recently found that 69% of online training developers planned to embed performance support content directly into users' work interfaces and software tools (Pulchino, 2006). To guide performance technologists pursuing adoption of EPSS, it is important to examine what is currently known about these systems.

EPSS as a Performance Intervention

Gery (1995) asserted that performance support systems fall into three categories: external, extrinsic, and intrinsic support.

External systems store content used to support task performance in an external database. This content is not integrated within a user's work interface. As a result, users are forced to manually locate relevant information in the external EPSS. Common examples of external performance support systems include search engines, frequently asked question (FAQ) pages, and help indexes. In addition, external performance support "may or may not be computer mediated" (Gery, 1995, p. 53). Job aids or documentation are common non-computer-based performance support interventions.

Extrinsic "performance support … is integrated with the system, but is not in the primary workspace" (Gery, 1995, p. 51). In other words,

piq 20017

extrinsic systems integrate with the user's work interface in such a way that the EPSS can identify the user's location in a system or even the exact task that he or she is working on. With this contextual information, the extrinsic system can intelligently locate content that may be relevant to support the task at hand. Like external performance support systems, though, the content used to support a task is external to the work interface.

Intrinsic systems give users task support that is incorporated directly within their work interface. Because of this direct integration with the interface, Gery asserted that intrinsic EPSS offers "performance support that is inherent to the system itself. It's so well integrated that, to workers, it's part of the system" (Gery, 1995, p. 51). Under this rather broad definition, examples of intrinsic performance support systems can range from tools that automate tasks and processes to user-centered design of work interfaces that reduce complexity and improve usability, and to embedded knowledge that is displayed directly in the work interface.

A number of authors have asserted that more highly integrated intrinsic performance support systems are better than those disconnected from the user's work interface. From observations conducted during software usability studies, Carroll and Rosson (1987) argued that the users who need support the most, such as novices, are least inclined to use nonintegrated support systems. Raybould (2000) contended that "as support moves further from the tool, it becomes less powerful and more expensive to use" (p. 34). On the basis of these assumptions, Gery (1995) gave designers a guideline to implement 80% of their support systems as intrinsic, 10% extrinsic, and the remaining 10% external.

However, very little empirical work has been done to examine the guidelines. Nguyen, Klein, and Sullivan (2005) studied the most effective types of performance support systems by testing three types that aligned with Gery's intrinsic, extrinsic, and external EPSS categories. Results from the study indicated that users who were given extrinsic and intrinsic performance support systems performed significantly better on a software procedure compared to a control group with no EPSS. In addition, all users who were given an EPSS had significantly more positive attitudes than the control group.

In addition, authors have expressed their views on the future of performance support. Laffey (1995) painted a vision of performance support systems no longer being static systems with fixed access to fixed support content. Instead, "performance support systems will be tailored to the work environment . . . dynamic in their knowledge and expertise" (Laffey, 1995, p. 34). In other words, continually evolving technology will offer ways for performance support systems to recognize the user, identify what he or she is doing, and adapt content according to the user's needs.

Although the vast majority of the work done thus far is nonempirical, performance technologists have access to literature to help them understand the types of performance support systems that are possible, suggestions on the best type of EPSS, and a glimpse of where the field of

piq 20017

performance support may be heading in the future. At the same time, training professionals can draw from a long-standing body of literature from instructional design and technology, human resources, and other disciplines to assist in solving instructional problems. The same cannot be said for the intersection of these two fields.

EPSS and Training as Performance Interventions

A widely held belief about using EPSS and training is that by implementing a performance support intervention one can reduce or even eliminate the amount of training required to address a performance problem (Chase 1998; Desmerais, Leclair, Fiset, & Talbi, 1997; Foster 1997). Q1
This notion of reducing training through EPSS and enabling “day-one performance” has been a major attraction for performance technologists.

Two previous studies that attempted to validate this assumption produced conflicting results. Bastiaens, Nijhof, Stremer, and Abma (1997) Q2
explored the effectiveness of combinations of computer-based and paper-based performance support with computer-based and instructor-led training. The researchers conducted a study with insurance agents and found that they preferred the paper-based forms over the electronic software tool as well as the instructor-led training over computer-based training. These researchers found no significant difference on test achievement scores, performance, or sales results over a one-year period.

There are several issues with the design of this study that complicate interpretation of the results. The sample size (36) was relatively small, particularly for a study that included five treatment groups. The lack of significant differences or unexpected results from the study may be due to the lack of statistical power associated with such a small sample size. Another potential limitation is that the performance support system used was a computer-based training course coupled with a software application; an external EPSS design. Other research indicates that this nonintegrated form of performance support is not as effective as other integrated systems (Bailey, 2003; Nguyen, Klein & Sullivan, 2005).

Mao and Brown (2005) also examined the relationship between EPSS and training. One group of novice users were given one hour of instructor-led training on Microsoft Access while another group was provided with a wizard-type EPSS that could be configured either as an intrinsic system intelligently supplying content to users as they performed tasks or as an external system presenting content only when searched for. The users then completed self-paced practice activities where they attempted “exercises to be completed with the help of” the EPSS (Mao & Brown, 2005, p. 35). Results indicated that users who were given the EPSS performed significantly better on an achievement test than those who received training. They found no significant difference between the two groups on a procedural task.

However, there are several limitations in interpreting these results. The researchers did not adequately control for the quality of the content in the training and EPSS. The authors noted that "it is possible that the performance of the instruction group had more to do with the limitations of the instructor than with the instructional method" (Mao & Brown, 2005, p. 43). In addition, the EPSS group was furnished with practice activities to complete before attempting the performance task; an instructional method that would be more characteristic of training than EPSS. The authors admit that "ordinarily it is unlikely that learners would be given this type of direction to use online task support in the real world" (Mao & Brown, 2005, p.43).

Purpose of the Current Study

Although the literature examining the efficacy of training and performance support systems as individual performance interventions is somewhat robust, research examining the intersection between these two fields yields few clear and satisfying answers. Studies conducted to this point have produced conflicting results and are laden with procedural issues that cloud interpretation of findings.

The lack of concrete information on the relationship between performance support and training is problematic to performance technologists, instructional designers, and trainers attempting to combine interventions. As mentioned earlier, practitioners' reported interest in implementing EPSS is substantial (Pulchino, 2006). Because of the lack of substantive research, no evidence-based guidelines can currently be offered on how these practitioners can best combine performance support and training to maximize employee performance.

To address this gap, the research study examined the effect of implementing EPSS, training, and a combination of these interventions. Some have asserted that it may be possible to abandon training altogether when a performance support system is properly implemented (Chase 1998; Desmerais et al., 1997; Foster 1997; Sleight 1993). The researchers of this study sought to explore this assumption by addressing these research Q1 questions:

1. What combination of performance support and training maximizes user performance?
2. What combination of performance support and training minimizes the time to complete a task?

Method

Design and Participants

A posttest-only, control group design was used in this study. Participants were randomly assigned to one of three treatment groups: training-only, EPSS-only, and training and EPSS. One group received training prior to completing the performance task. Another group had access to an EPSS while completing the task but did not receive any prior training. A third treatment group received both the pretask training as well as access to the EPSS. Dependent measures included user performance on the task, time to complete the task, and time in training.

Seventy-eight employees from multiple companies completed the study. Direct managers at various companies identified some participants. Additional volunteers for the study were also solicited from local chapters of the ASTD and the International Society for Performance Improvement (ISPI). Participants involved in the study represented a broad array of educational backgrounds: 39 had obtained a master's degree, 28 held a bachelor's degree, six obtained a doctoral degree, three were high school graduates, and two held an associate degree. The participants represented a diverse range of job roles: 33 were involved in the education and training industry, 16 identified themselves as software developers or IT professionals, 15 were in human resources, six were involved in manufacturing, three worked in customer service, and five worked in other professions.

Materials

Materials in this study included a task software application, Web-based training course, performance support system, task scenario, and pretask demographic survey.

All participants in the study used a *Web-based software application based on a corporate tax return form*. As part of the process to submit a tax return, companies are required to submit data regarding revenue, profit, costs, and other financial information. These data are typically recorded on paper-based forms, but participants in this study were asked to record data and calculations into an online tax form.

As illustrated in Figure 1, the tax software application included a series of open text fields that required the participant to input relevant data using information supplied in the task scenario. In total, the corporate tax scenario required 58 participant inputs. Data entered into the tax software application were stored in an isolated database for analysis at the conclusion of the study.

In addition to the tax form, a *web-based training course* was used to teach processes, procedures, and principles that are required as part of the corporate tax preparation task. If the participants were assigned to the training-only or training and EPSS groups, then the tax software application required them to complete the Web-based training activity before attempting the corporate tax performance task.

The Web-based training course included in the study contained nine introductory screens, 49 information screens, 24 practice screens, and five concluding screens. In total, the course included 87 screens and took approximately one hour to complete. The course was divided into five modules; each one addressed a specific instructional objective. Each module began with an introductory screen informing the learner of the objective for the module. In addition, this screen referenced a diagram of

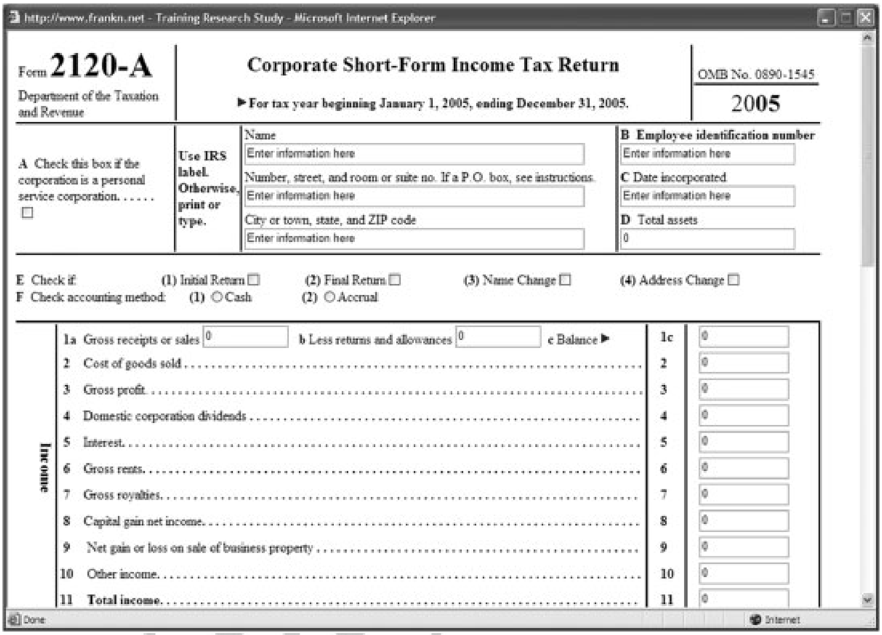

FIGURE 1. Software application.

the corporate tax process, which served as an advance organizer for the content (see Figure 2). One or more instructional screens addressed each line in the tax form. Instructional screens presented a brief amount of content, which includes tax concepts, rules, procedures that must be completed in the tax form, and examples where relevant. After the instructional sequence, each module featured scenario-based practice activities, with the exception of module 1, which offered matching and multiple-choice practice activities for factual objectives. All practice activities included appropriate feedback for correct responses or remediation feedback for incorrect responses.

The Web-based training course was authored in Adobe Captivate. Instructional screens included images, animations, and text. Audio and video were excluded from the Web-based training course owing to usability issues when the content was used for performance support and bandwidth concerns over the Internet. Participants navigated within modules using a VCR-like toolbar located at the bottom of each screen. They navigated between modules using a menu located on the upper left corner of the screen. This navigation sequence was chosen because it is a user interface design that is common among current learning management systems.

The tax software application was also equipped with a *performance support system* for participants in the EPSS-only and training and EPSS treatments. The EPSS is illustrated in Figure 3. The EPSS used was an extrinsic context-sensitive help system, which was found in previous studies to be an effective method to deliver on-the-job support (Bailey, 2003; Nguyen, Klein, & Sullivan, 2005). The opening screen of the tax

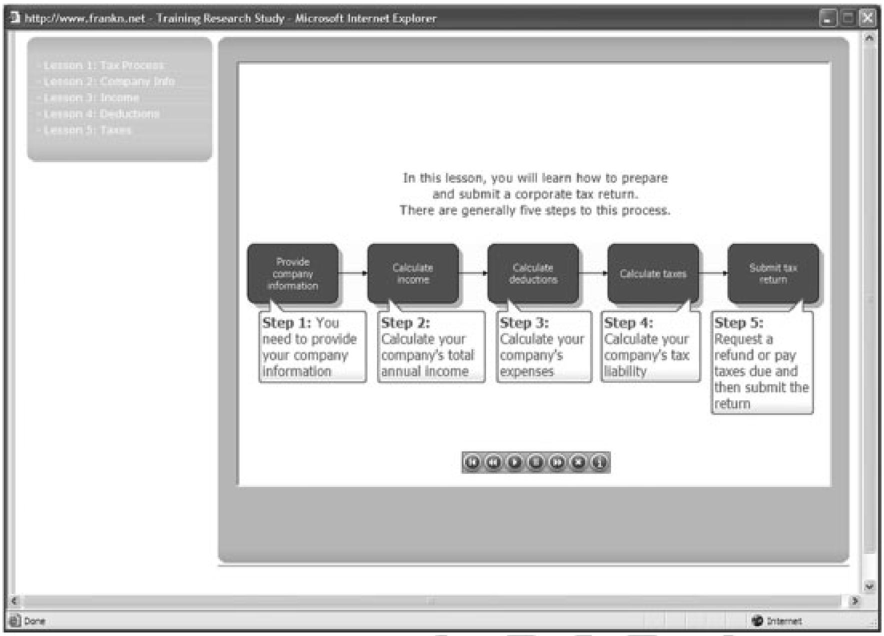

FIGURE 2. Web-based training course.

software application gave a brief set of instructions demonstrating how to access the support system. Help buttons in the form of a question mark were inserted throughout the tax software application. When participants clicked on the buttons, their request was recorded in a database and a new window opened displaying support information associated with the task.

To avoid any effects due to content differences between the training and EPSS, the content used for the EPSS was derived from the training course. Web-based training courses can be developed into modular, reusable learning objects. These learning objects are granular components of a training course, such as individual modules, lessons, screens, practice activities, and media elements. These objects can exist independently from the original training course, which then allows them to be accessed as isolated single learning offerings or combined to create new training courses.

As mentioned previously, the Web-based training course contained 49 screens where participants received instructional information. These information objects were linked directly to individual help buttons embedded in the tax software application. This concept of reusing the information objects to the EPSS is illustrated in Figure 4. By using this approach, identical components from the Web-based training course could be reused for performance support purposes. Because the actual learning objects were identical between the two treatments, any differences that were due to the quality of the content could be eliminated.

The *task scenario* portrayed a realistic issue that a new employee might face. It included information that a manager might furnish to a new finance employee in preparing federal tax submission for a company.

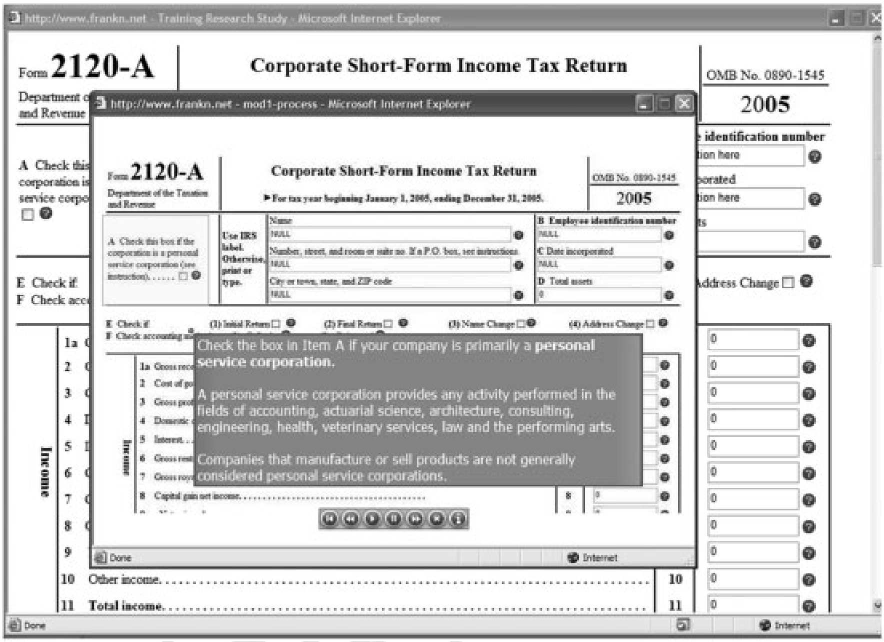

FIGURE 3. Electronic performance support system.

Corporate tax preparation was chosen as the basis of the scenario because of the complexity of the task.

Figure 5 shows an excerpt of the task scenario text. The first section prompted the participant to imagine having recently been hired as a financial analyst for a small manufacturing company. The second portion of the task scenario contained an e-mail that was sent to the participant from the imaginary new manager. In the e-mail, the manager asked the participant to prepare a tax return for the company. To support this task, the e-mail contained detailed financial information including income, expenses, payroll, and other company information. The participant used these data and any training and support information to complete the tax return using the tax software application.

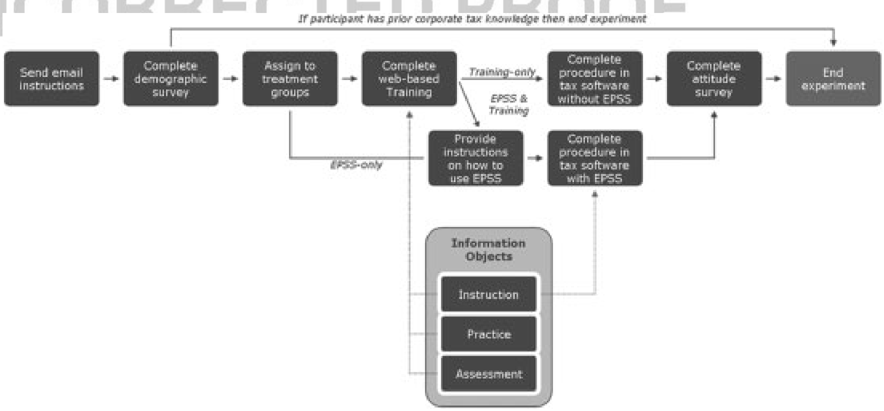

FIGURE 4. Use of information objects for both EPSS and web-based training.

-----Original Message-----
From: bob.d.bilder@qualitywidgets.com
Sent: Monday, April 3, 2006
Subject: 2005 Tax Return

Welcome to Quality Widgets! I need your help. We need to file an initial tax return for 2005. I wanted to give you copies of our previous tax returns for reference, but I could not find them. Here are our financial statements for the last fiscal year:

2005 Income	Amount	Quantity	Total
Dividends from Jamaican Bobsled Company shares based in Kingston, Jamaica	$50,000.00	1	$50,000
Dividends from Cheap Widgets Company shares based in Boston, MA	$200,000.00	1	$200,000
Income from Cheap Widgets partnership	$50,000.00	1	$50,000
Late payment from Ajax Cleaning Company for 2004 debt	$50,000.00	1	$50,000
Licensing payments from automation patents	$250,000.00	1	$250,000
Rent from 123 Main St facility	$4,791.67	12	$57,500
Type 1 widgets sold	$5.00	250,000	$1,250,000
Type 2 widgets sold	$7.50	200,000	$1,500,000
Type 3 widgets sold	$10.00	100,000	$1,000,000

FIGURE 5. Excerpt from the corporate tax scenario.

All participants completed a *pretask demographic survey* prior to participating in the study, as shown in Figure 6. The primary goal of the instrument was to determine the participants' prior knowledge about the task used in the study. The survey was also used to profile the participants' industry and level of education. Participants could also voluntarily submit themselves to a gift card drawing, which was used as an incentive to motivate participants to complete the study.

Criterion and Enroute Measures

Three measures were used in the study: user performance on the task, time in training, and time to complete task.

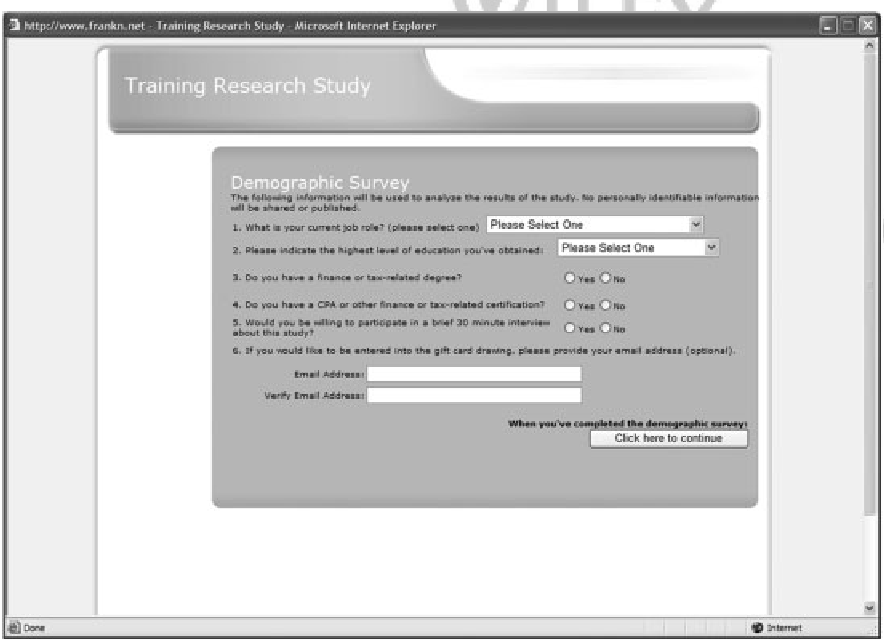

FIGURE 6. Pre-task demographic survey.

User performance on the task was measured by evaluating the number of correct items the participants submitted to the tax software application. As mentioned earlier, the tax scenario required 58 user inputs or selections. Data entered by the user into the tax software were stored in a database and subsequently evaluated by the researcher. Participants received one point for each correct input, with a maximum of 58 points possible.

The total amount of *time spent completing the performance task* was measured by calculating the difference between the time at which participants logged into and out of the tax software application.

The total amount of *time participants spent in the training* was measured by calculating the difference between the time at which participants logged into and out of the Web-based training course.

Procedures

Because the participants in the study worked in different companies and were geographically dispersed, various corporate training managers and local chapters of ASTD and ISPI were asked to recruit participants from their respective organizations. An e-mail invitation was sent to study participants. The e-mail instructions advised participants to allocate a two-hour block of time to complete the study. During this time, they were asked to avoid distractions from phone calls, e-mail, or co-workers once they had started the study. They were instructed to complete the task using only the information in the task scenario and any training or support that may be provided by the system. The participants were instructed to submit the information as soon as they felt they had completed the task.

The e-mail instructions directed participants to the location of the research study on the Internet. Prior to implementation of the treatments, participants completed a demographic survey that was used to screen for prior knowledge of corporate tax preparation. Any individual currently working in a finance-related role, with a finance-related degree, or with tax or accounting certifications was not selected to participate in the study.

If the participant did not have any finance background, the system randomly assigned him or her into one of three treatment groups (training-only, EPSS-only, and training and EPSS) and displayed the appropriate intervention. Participants were not aware that they were assigned to a different treatment group or that their system was configured with a training or EPSS intervention. If the participants were part of the training-only group, they were first directed to take the Web-based training course. If the participants were part of the EPSS-only group, the opening screen of the tax software application was presented, with a brief set of instructions demonstrating how to access the support system. If the participants were part of the training and EPSS group, they first took the training course and were then given the performance support system instructions. Once the participants completed the task and submitted the tax information, they were automatically directed by the system to complete the user attitude survey.

Data Analysis

One-way analysis of variance (ANOVA) was conducted on participants' performance on the task, time in training, and time to complete the task, followed by multiple comparisons where appropriate.

Results

Results reported in this section are for performance on the task scenario, time on task, and time in training.

Performance

The first research question investigated the effect of EPSS, training, and a combination of these two interventions on user performance while completing a tax preparation task. Table 1 shows the mean scores and standard deviations for performance on the task. The table reveals that the mean scores were 46.54 (80%) for the training and EPSS group, 43.92 (76%) for the EPSS-only group, and 39.92 (69%) for the training-only group. A Levene's test of equality of variances was significant, F (2, 75) = 4.49, $p = .01$. To account for the lack of homogeneity of variances between the treatment groups, a one-way analysis of variance using the Welch test was conducted on the performance scores. This test revealed a significant overall difference, F (2, 46) = 22.37, $p < .01$. The strength of the relationship between the treatments and the performance scores was large, $\eta^2 = .31$.

Post-hoc tests were conducted to determine significant differences in mean performance scores. Multiple comparisons conducted using the Tukey method revealed that participants in the training and EPSS group and those in the EPSS-only group had significantly higher scores on the task than those in the training-only group. The difference in the

TABLE 1
User performance by treatment

Treatment group	*M*	*SD*
Training & EPSS	46.54*	4.93
EPSS-only	43.92**	3.99
Training-only	39.92	2.54
Overall means	43.46	4.76

Note: Maximum total correct = 58.

*Significant difference between Training-only and Training & EPSS at $p < .01$

**Significant difference between Training-only and EPSS-only at $p < .01$

performance scores between the EPSS-only and training and EPSS groups was not significant.

Time on Task

The second research question investigated the effect of treatment on total time to complete the task scenario. This was measured by calculating the difference between the time at which participants logged into and out of the tax software application. The mean time on task is shown in Table 2. The table reveals that the EPSS-only group spent an average of 26 minutes, 39 seconds on the task; the training and EPSS group spent 31 minutes, 32 seconds; and the training-only group spent 1 hour, 29 minutes, and 58 seconds. A Levene's test of equality of variances was significant, F $(2, 75) = 49.99$, $p < .01$. To account for the lack of homogeneity of variances between the treatment groups, a one-way analysis of variance using the Welch test was conducted on the time-on-task data. This test revealed a significant overall difference, $F <$ $(2, 45) = 11.20$, $p < .01$. The strength of the relationship between the treatments for time on task was strong, $\eta^2 = .32$. The correlation between time on task and performance on the task scenario was significant at $-.36$, $p < .01$.

Post-hoc tests were conducted to determine significant differences in mean time on task scores. Multiple comparisons conducted using the Tukey method revealed that the training-only group spent significantly more time on the task scenario than both the EPSS-only and training and EPSS groups. The difference in time on task between the EPSS-only and training and EPSS groups was not significant.

Time in Training

The amount of time that participants spent in training was recorded by calculating the difference between the time that the participants logged into and out of the Web-based training course. The data revealed that the training and EPSS group spent an average of 42 minutes, 12 seconds in the Web-based training course while the training-only group spent 34 minutes, 48 seconds. A Levene's test of equality of variances was not

TABLE 2
Time to complete the tax scenario by treatment

Treatment group	*M*	*SD*
Training-only	1:29:58	1:05:24
Training & EPSS	0:31:32*	0:20:44
EPSS-only	0:26:39**	0:17:35
Overall means	0:49:23	0:49:40

*Significant difference between Training-only and Training & EPSS at $p < .01$

**Significant difference between Training-only and EPSS-only at $p < .01$

piq 20017

significant. As a result, a conventional one-way analysis of variance was conducted on time in training, which yielded no significant overall difference between the mean scores.

Discussion

Performance

Findings revealed that performance scores for the training and EPSS and EPSS-only groups were significantly higher than scores for the group that received only training prior to completing the task scenario. Participants who received training and EPSS on average completed the task with 80% accuracy; the EPSS-only group averaged 76%, while the training-only group 69%. Effect size estimates show that the strength of the treatments was rather strong. These findings support the notion that performance support systems can have a significant impact on user performance.

> **Findings revealed that performance scores for groups that received performance support were significantly higher than scores for the group that received only training prior to completing the task scenario.**

One potential reason participants who received only training had significantly lower performance scores that those in the other treatment groups may be a transfer gap between the training course and the task. The Web-based training course included instructional content that covered portions of the tax preparation procedure. These instructional sequences were followed by practice activities, which gave participants a scenario and asked them to complete that portion of the tax procedure. To minimize participant attrition, no additional practice activity or assessment was furnished at the end of the training course to tie the entire tax procedure together into one whole task. This lack of *part-task-to-whole-task* transfer could have had some effect on the training-only participants' lower performance on the task. Van Merriënboer (1997) suggested that designers should begin their instructional sequences with part-task procedural practice and then evolve into whole-task problem-solving exercises. In addition, "more and more complex versions of the whole cognitive skill" should then be introduced (van Merriënboer, 1997, p. 8). The use of this instructional design strategy could have increased the effectiveness of the training treatment.

Another potential reason for the lower performance of the training-only group is the volume of information that participants were required to memorize, recall, and apply at task performance. The Web-based training course used in this study contained 87 navigation, instructional, practice, and transitional screens, which included facts, concepts, and procedures on how to complete the corporate tax preparation task. Another compounding factor could be the participants' behavior while in training. Participants spent an average of 38 minutes and 44 seconds reviewing the content in the 87 screens of the training course prior to completion of the tax procedure; an average of 27 seconds per screen. This seemingly short period of time in the training course suggests that participants skimmed the training and learned the information at only a superficial level. This practice would put training-only participants at a disadvantage compared to EPSS-only and training and EPSS participants, who could quickly reference and apply information at the moment of need.

This highlights a major benefit of EPSS for procedural tasks such as the one used in this study: performance support aligns with the adult learners' preference for personal relevance. As part of his theory of adult learning, Knowles (1984) asserted that adult learners (1) are self-directed, (2) draw on their reservoir of experience for learning, (3) are ready to learn when they assume new roles, (4) want to solve problems and apply new knowledge immediately, and (5) are self-motivated to learn. These adult learning principles imply that participants would learn better if they could tie the information in the training course to previous experience and could immediately practice and apply their new learning to an immediate problem. Although all study participants had access to the same information, just the EPSS-only and training and EPSS participants could learn while performing in the context of the work.

Time on Task

The training-only group spent significantly more time completing the task scenario than participants in the training and EPSS and EPSS-only groups. In fact, participants who received only the training intervention spent roughly one hour more, or nearly triple their EPSS-equipped counterparts. A closer examination of the time-on-task data showed that a sizeable number of training-only participants spent two to three hours completing the task.

The tax software application was programmed to prevent participants from moving backward through the research materials. After the conclusion of the study, two training-only participants reported frustration with this design. In an attempt to obtain information to help them complete the task, these training-only participants (and potentially others) attempted to return to the Web-based training course for reference. Attempting to move backward in the software resulted in reported loss of information entered into the tax software application. As a result, certain training-only participants had to restart the tax scenario from the beginning even though they might already have spent a considerable amount of time in the task.

Participants in this research study completed the task scenario in their work setting, often in a private office, home office, cubicle, or meeting room. Many participants admitted that, despite the researchers' instructions to avoid distractions such as e-mail, phone calls, or co-workers, they attempted to address issues by phone or e-mail, or even in some cases complete other tasks while completing the study. This tendency to attend to other tasks while completing the tax preparation scenario was reported across the three treatment groups and is a potential hurdle in conducting

piq 20017

future research in a virtual, asynchronous manner as attempted in this study.

Time on Task and Performance

In considering the fact that training-only participants spent nearly three times as much time on the task as those in the EPSS-only and training and EPSS groups, it is interesting to note that the training-only participants scored significantly lower on the performance task than participants in the other two groups respectively. Correlation tests between the factors revealed a negative correlation between time on task and performance of -.36. In short, despite any additional time training-only participants might have invested in completing the tax preparation activity, they did not perform any better than their counterparts. In fact, they performed worse.

Recommendations for Training and Performance Support Interventions

The findings from this study have important implications for performance technologists who are considering training or EPSS as performance interventions. The increase in performance for the participants who received EPSS over their training-only counterparts suggests that performance technologists should consider performance support systems to help mitigate information-related performance problems.

Previous authors have suggested that performance technologists could implement the EPSS and then reduce or even potentially eliminate training (Chase 1998; Desmerais et al., 1997; Foster 1997; Sleight 1993). Q1 The fact that training-only participants in this study performed worse on the tax preparation task than the other two groups lends some credence to this notion. In addition, participants who were given both training and EPSS interventions did not perform significantly better than those given only the EPSS.

In considering EPSS and training as performance interventions, it is important to note that a performance technologist should consider the amount of time that is available to deliver prescribed interventions and the desired level of performance. For example, participants in the EPSS-only group spent an average of 26 minutes in the tax preparation task, with an accuracy level of 76%. Meanwhile, participants in the training and EPSS group spent an average of 74 minutes taking training, using the EPSS, and completing the performance task. Despite the additional time invested, they achieved a proficiency level of 80%; just slightly more than the EPSS-only participants. These data suggest that if a performance problem is critical and business conditions allow sufficient time to develop and deliver multiple interventions, then it may be worthwhile to invest heavily in both training and EPSS interventions. If time is a constraint or incremental increases in performance are not necessary, then the benefits derived from a robust training intervention may not be worth the time or cost invested.

piq 20017

It is also important to note that development of an electronic performance support system has been demonstrated to be costly from Q1 both time and monetary perspectives (Desmerais et al., 1997; Hawkins et al., 1998). In this particular study, integration of the EPSS into the tax software application added an additional 40–50 hours of work. This number does not factor in the cost to develop content for the EPSS. Because learning objects from the Web-based training course were reused for the EPSS, no specialized content development was required to deliver just-in-time support. When performance technologists are considering EPSS as an intervention, they should weigh the potential benefits on user performance and attitudes against the time and monetary investment that will be required.

In considering EPSS and training as performance interventions, it is important to note that a performance technologist should consider the amount of time that is available to deliver prescribed interventions and the desired level of performance.

Limitations

Several limitations should be considered in interpreting the results of this study. The task used in this research was tax preparation, which is largely a procedure supported by requisite background facts, concepts, and principles. One potential limitation is that these findings may not extend well to other work contexts; for instance, these findings may not be valid for other procedural tasks such as manufacturing operations or software tasks. They also may not apply well to principle-based tasks such as preparing an employee development plan or solving a supply chain problem. Additional research should be conducted to determine if the interventions used in this study transfer to other tasks, particularly those that are of longer duration or higher complexity.

Another limitation is that the study employed an extrinsic EPSS to support task performance. If another type of EPSS was used, such as an external search engine or an intrinsic automated wizard, the outcome would likely be affected. However, doing so could fundamentally change the tax software application and task so dramatically that it would make any comparisons between EPSS and non-EPSS groups difficult at best.

When this study was designed, a control group was consciously excluded. The researchers felt that introduction of a control group could potentially result in low participation and high attrition among the corporate employees who participated in the study. If a sample group could be identified that would better facilitate inclusion of a control group, the relative contribution of EPSS and training as individual performance interventions could be clarified.

Finally, the virtual asynchronous method that was used to collect data from participants introduced distractions during the data collection that were difficult to control. A number of participants reported answering phone calls or e-mail while completing the Web-based training or tax preparation task. Having a more controlled environment could yield different results, particularly for the time-on-task and time-in-training measures.

Future Research

These findings offer insight into the effect of EPSS and training as performance interventions, but many more practical questions remain unanswered. The dependent measures used in this study are a handful of many factors important to human performance technologists. Studies that examine a broader range of measures such as information retention, error rate, or transfer of knowledge to a job task would be valuable.

The present study focused on a tax preparation task. Human performance technologists are also applying training and EPSS to a broad spectrum of other performance problems. Examples are physical procedures such as aircraft repair, automobile repair, and manufacturing equipment operations, as well as soft-skill principles such as employee development, managerial and leadership skills, and corporate compliance. It would be useful to extend the current study to other settings to determine if the results can be transferred to these other work contexts.

This study measured the performance of participants immediately following completion of a training course or use of an EPSS. In reality, performance technologists rely on these interventions to inform and support employees for an extended period of time while they are on the job. Using a repeated measures design to determine the performance and attitudes of participants at some period of time after the conclusion of the initial data collection would permit valuable insight into the ability of EPSS and training to facilitate long-term retention and transfer of information.

Increased use of performance support systems in actual practice requires that human performance technologists conduct empirical research to determine the best ways to employ these interventions. As was done in the current study, additional research should examine the impact of knowledge support interventions such as EPSS and training on the performance of users in real-world settings.

Reference

Altalib, H. (2002). ROI calculations for electronic performance support systems. *Performance Improvement*, *41*(10), 12–22.

Arthur, W., Bennett, W., Edens, P. S., & Bell, S. T. (2003). Effectiveness of training in organizations: A meta-analysis of design and evaluation features. *Journal of Applied Psychology*, *88*(2), 234–245. Q3

Bailey, B. (2003). Linking vs. searching: Guidelines for use [electronic version]. Retrieved January 17, 2006, from http://www.webusability.com/article_linking_vs_searching_2_2003.htm.

Bastiaens, T. J., Nijhof, W. J., Streumer, J. N., & Abma, H. J. (1997). Working and learning with electronic performance support systems: An effectiveness study. *International Journal of Training and Development*, *1*(1), 72–78.

Burke, M. J., & Day, R. R. (1986). A cumulative study of the effectiveness of managerial training. *Journal of Applied Psychology*, *71*(2), 232–245.

Carroll, J. M., & Rosson, M. B. (1987). Paradox of the active user. In J. M. Carroll, (Ed.), *Interfacing thought: Cognitive aspects of human-computer interaction* (pp. 80–11). Boston: Bradford Books/MIT Press.

Chase, N. (1998). Electronic support cuts training time [electronic version]. Quality Magazine. Retrieved January 12, 2005, from http://openacademy.mindef.gov.sg/OpenAcademy/Learning Resources/EPSS/c16.htm.

Desmarais, M. C., Leclair, R., Fiset, J. V., & Talbi, H. (1997). Cost-justifying electronic performance support systems. *Communications of the ACM*, *40*(7), 39–48.

Dolezalek, H. (2005). The 2005 industry report. *Training*, *42*(12), 14–28.

Foster, E. (1997). Training when you need it [electronic version]. Info World. Retrieved November 17, 2004, from http://openacademy.mindef.gov.sg/OpenAcademy/Learning%20Resources/EPSS/c1.htm

Gery, G. (1991). *Electronic performance support systems*. Tolland, MA: Gery Associates.

Gery, G. (1995). Attributes and behaviors of performance-centered systems. *Performance Improvement Quarterly*, *8*(1), 47–93.

Hawkins, C. H., Jr., Gustafson, K. L., & Nielson, T. (1998). Return on investment (ROI) for electronic performance support systems: A Web-based system. Educational Technology, *38*(4), 15–22.

Knowles, M. S. (1984). *Andragogy in action: Applying modern principles of adult education*. San Francisco: Jossey-Bass.

Laffey, J. (1995). Dynamism in Electronic Performance Support Systems. *Performance Improvement Quarterly*, *8*(1), 31–46.

Mao, J., & Brown, B. (2005). The effectiveness of online task support versus instructor-led training. *Journal of Organizational and End User Computing*, 17(3), 27–46.

Nguyen, F., Klein, J. D., & Sullivan, H. (2005). A comparative study of electronic performance support systems. *Performance Improvement Quarterly*, *18*(4), 71–86.

Pulchino, J. (2006, April 3). Future direction in e-learning 2006 report. Retrieved March 29, 2006, from the eLearning Guild database http://www.elearningguild.org

Raybould, B. (2000). Building performance-centered Web-based systems, information systems, and knowledge management systems in the 21st century. *Performance Improvement*, *39*(6), 69–79.

Sleight, D. A. (1993). Types of electronic performance support systems: Their characteristics and range of designs [electronic version]. Retrieved January 12, 2005, from http://openacademy.mindef.gov.sg/OpenAcademy/Learning Resources/EPSS/c7.htm

Sugrue, B., & Rivera, R. J. (2005, December 6). 2005 State of the industry report. Retrieved March, 15, 2006, from the American Society for Training and Development database http://www.astd.org

Van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Upper Saddle River, NJ: Educational Technology Publications.

FRANK NGUYEN

Frank Nguyen, PhD., is an assistant professor in the Educational Technology program at San Diego State University. He has managed learning and performance strategies for various Fortune companies. He is co-author of *Efficiency in Learning* (Jossey Bass, 2006) and has written articles on e-learning, instructional design, and performance support. *Mailing address:* San Diego State University, 1520 Mirabelle Lane, Santee, CA 92071. *Phone:* (480) 707–1195. *E-mail:* frank@frankn.net

JAMES D. KLEIN

James D. Klein, PhD., is a professor and program leader in the Educational Technology program at Arizona State University, where he teaches courses on instructional design, research, and performance improvement. His most recent scholarly work includes the book *Instructor competencies: Standards for face-to-face, online, and blended settings. Mailing address:* Division of Psychology in Education, Arizona State University, Tempe, AZ 85287–0611. Phone: (480) 965–0349. E-mail: james.klein@asu.edu

piq 20017