E-Learning: Implications of Training Theory & Research

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ABSTRACT

Many organizations both in the military and in private industry are using distributed learning (i.e., structured learning that takes place without the physical presence of an instructor) to train personnel. While distributed learning methods vary (e.g., computer based, video tele-training, correspondence courses), this paper will focus on "E-learning" (i.e., electronic courses delivered via CD-ROM or the internet). E-learning offers many potential benefits including the ability to train large numbers of people at the same time and reduced travel costs.

While some E-learning implementation success has been achieved, many challenges remain. For example, one concern is the student drop-out rate (Carr, 2000). Identifying the reasons for the dropout rate and developing methods to improve course completion is not easy. Fortunately, the science of learning literature may help. Recently, Colquitt, LePine, and Noe (2000) performed a meta-analysis of 20 years of training research and developed a model of training motivation. The model has a number of implications for the design and implementation of E-learning programs. This includes the influence of characteristics of the individual learners and the organization in which the learner works on how much is actually learned during training.

This paper examines E-learning in light of the Colquitt et al. (2000) model. The paper discusses the influence of self-efficacy, valence, job/career variables, situational variables, personality, and motivation to learn on learning outcomes and the implications for E-learning. Because the model is based on research on traditional classroom settings, however, some relationships between variables in the model may change in a E-learning environment. Thus, we will also discuss the implications of E-learning for the model and suggest directions for research.

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INTRODUCTION

At a Navy training facility, a sailor has the opportunity to take free courses on the internet to supplement his classroom training. He logs online and begins a course. Despite good intentions, he is distracted by life events, his buddies, and unstable system connectivity. After a few days, with a portion of the training modules completed, he drops out. Similar to other E-learning dropout cases, "without a dynamic instructor, powerful incentives, links to the job and fixed schedules, web learning is at a dramatic disadvantage in capturing and holding attention" (Rossett, 2000).

Many organizations both in the military and in private industry are using distributed learning (i.e., structured learning that takes place without the physical presence of an instructor) to train personnel. While distributed learning methods vary (e.g., computer based, video tele-training, correspondence courses), this paper will focus on "E-learning" (i.e., electronic courses delivered via CD-ROM or the internet). E-learning offers many potential benefits including the ability to train large numbers of people at the same time and reduced travel costs. For the purpose of this paper, we consider the terms distance learning and E-learning synonymous, and we use the terms interchangeably.

While some E-learning implementation success has been achieved, many challenges remain (United States General Accounting Office, 2003). As was the case in the situation described earlier, one concern is the student drop-out rate. Although exact dropout numbers are unknown, statistics reported by some studies are telling: a 20-30% higher drop-out rate than conventional courses (Carr, 2000). Most certainly, a prominent factor underlying the drop-out rate is learner motivation. Distance learning (DL) is a form of self-directed or self-regulated learning, and to succeed, learners require motivation, appropriate learning strategies, and time management skills (Kazlauskas, 2003). Motivation, however, is a complex subject. Identifying the factors underlying motivation and deciding how to address these factors in E-learning settings is not easy.

Searching the current DL literature for answers will not necessarily be fruitful. Indeed, Wisher et al. (1999) found thousands of DL articles available, but those were largely focused on education rather than training and were generally anecdotal or based on weak experimental designs. Salas, Kosarzycki, Burke, Fiore, & Stone (2002) assert that the current DL literature is not providing training practitioners in government and industry with empirical evidence to guide the use of DL.

The science of learning literature offers some guidance. Much is known about training effectiveness (e.g., Goldstein, 1993), and it is likely that the principles and guidelines apply to DL. However, the technology-specific opportunities and constraints of DL pose additional requirements for the trainer and instructional designer (Salas et al., 2002).

The purpose of this paper is to discuss E-learning motivation in the context of recent science of learning literature. We apply the results of a training model developed by Colquitt, LePine, and Noe (2000), and discuss the implications that the variables in the model have for E-learning designers and implementers. Since the model is based on research conducted in traditional classroom settings, some relationships between variables in the model could change in a DL environment. Thus, we discuss the implications that DL has for the relationships in the model and suggest directions for DL research.

TRAINING MOTIVATION

While a primary focus of DL research has been design of the materials (i.e., how to use technology and instructional design to best foster learning), the science of learning literature offers some recent research that indicates that the variables surrounding the training are also of crucial importance.

Model Overview

In particular, Colquitt et al. (2000) performed a meta-analysis of 20 years of training research that focused on *learner* characteristics and *situational* characteristics (as perceived by the learner). The result was an integrative model of training motivation. The model indicated that many learner and perceived situational characteristics play important roles before training (by influencing motivation), during training (by relating to learning), and after training (by relating to transfer and job performance). The factors are not redundant; they each contribute uniquely to training success. An adapted version of the model is presented in Figure 1.

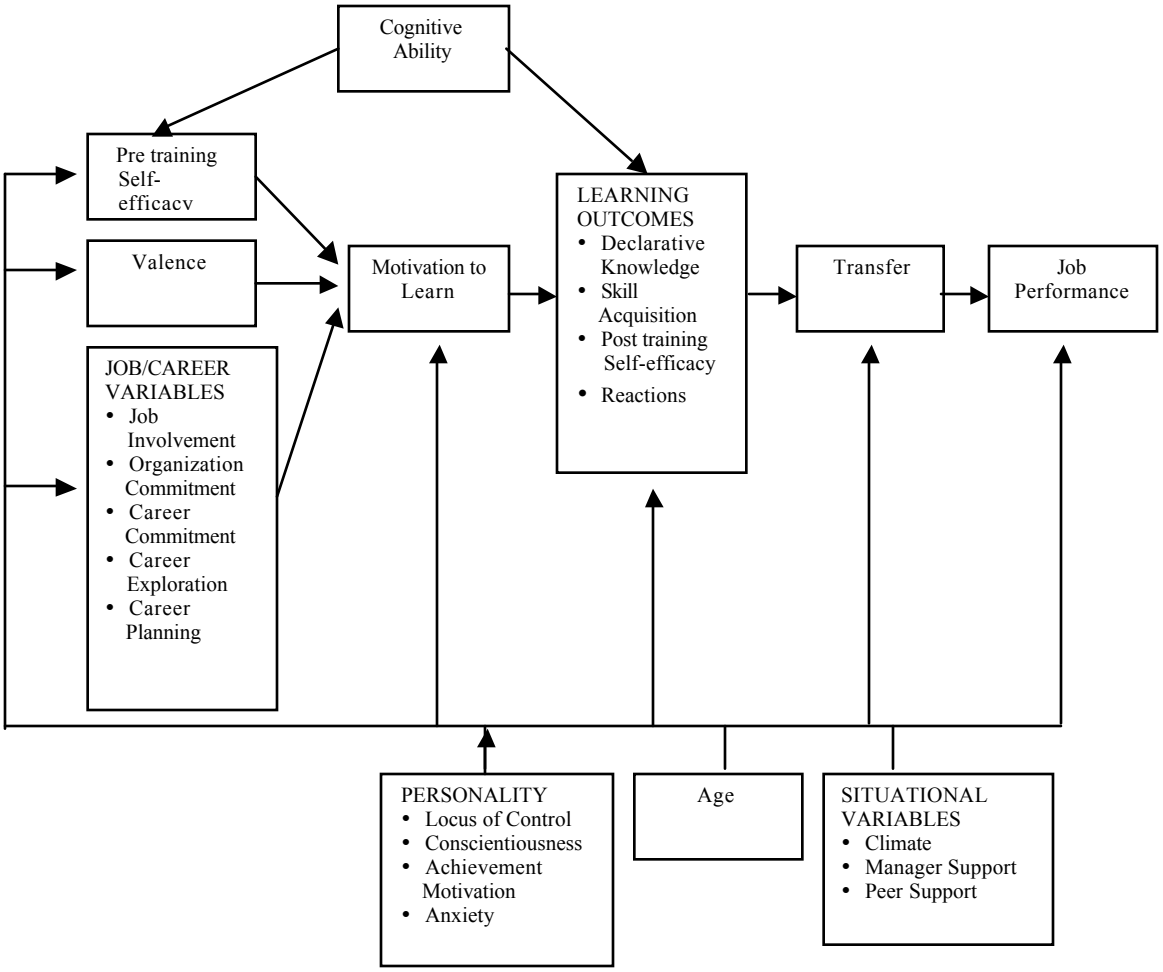

Figure 1. Integrative Theory of Training Motivation (adapted from Colquitt et al., 2000)

On the left side of the model are antecedents to motivation to learn (e.g., self-efficacy, valence, and job/career variables). That is, these factors influence a learner's desire to learn. In turn, motivation to learn influences learning outcomes such as knowledge and skills gained, post-training self-efficacy, and learner reaction. Next, the learning outcome variables influence the degree to which the knowledge and skills are transferred to the learner's job performance. Transfer (use) of newly acquired knowledge and skills on the job is related to overall job performance. At the bottom of the figure are personality, age, and situational variables. These factors have been found to have a direct influence on motivation to learn, learning outcomes, transfer, and job performance as well as an indirect influence via pre-training self-efficacy, valence, and the job/career variables. Finally, cognitive ability is shown at the top of the figure. It has a direct influence on learning outcomes as well as an indirect influence on learning and job performance via self-efficacy.

Applying the Model to E-Learning

It is important to note that the Colquitt et al. (2000) model does not include training method as a variable. In other words, without taking method into account, these are the relationships between the individual and situational variables. Furthermore, the model was based on research conducted on traditional classroom training. This includes training completed in short, consecutive time periods with traditional tests and quizzes.

We propose that aspects of the E-learning environments differ substantially from conventional classroom settings. Table 1 presents example differences between conventional and E-learning instructional settings (in particular, asynchronous settings). E-learning can take place over days, weeks, or months. Instead of an instructor telling the learners when, where, and how the instruction will take place, the learner often makes those decisions. This includes finding the time to take the course, operating the technology, and contacting the instructor for any questions.

For example, consider again the scenario described at the start of this paper. The sailor was accustomed to courses taught in the traditional classroom setting following a set schedule of lectures, discussions and simulations. In contrast, when taking the E-learning course the sailor found no visible instructor, no set schedule, little technical support, and no socialization opportunities. The when, where, and how was largely the sailor's responsibility.

IMPLICATIONS FOR E-LEARNING RESEARCH AND PRACTICE

As shown in Table 2, we have developed a number of predictions regarding how the relationships among the learner, situation characteristics, and learning outcomes may change in a DL setting. Table 2 lists each variable, its current correlation with various learning outcomes as reported in Colquitt et al. (2000), and our hypothesized changes in correlations with learning outcomes in a DL setting. Learning outcomes are measures of how much a person learned during the training and are strongly related to whether or not the transfer occurs and, in turn, results in changes in job performance. Colquitt et al. included the following learning outcomes in the analysis: declarative knowledge, skill acquisition, post-training self-efficacy, and learner reactions.

Interestingly, the Colquitt et al. (2000) meta-analysis indicated that declarative knowledge and reactions are not predictive of training transfer. Instead, measures of skill acquisition and post-training self-efficacy were strong predictors of transfer. The message is that future research (both traditional training and DL) must expand assessment methods and include the newer types of training outcomes (Kraiger, Ford & Salas, 1993). This may be particularly true for E-learning. For example, Colquitt et al. (2000) noted that potentially important learning outcomes include non-behavioral factors such as team commitment, acceptance of technology, customer focus, and willingness to work in a self-directed fashion. Potentially important cognitive learning outcomes include technical vitality (anticipating learning to meet changing job demands) and contextual knowledge (recognizing contextual influences on performance). Many of these variables speak to attitudes and skills that E-learning may foster. The remainder of this paper describes the learner and situational characteristics, discusses how variable

Table 1. Example differences between E-Learning and Conventional Training

Conventional Instructional Setting	**E-Learning Instructional Settings**
Face to Face Instruction	Students and instructors may never meet face to face
Students follow a set schedule, meeting times	Flexible scheduling
Training pace likely pre-established	Training generally self-paced
Opportunity for face to face socialization, networking, and peer support (e.g., study groups)	Little opportunity for face to face socialization, networking, and peer support (e.g., study groups).
Involves auditory and visual processing modes	Mainly visual processing
Easier to assess knowledge and skill acquisition	More difficult to assess knowledge and skill acquisition
Questions can be answered right away	Instructor responses to questions may be delayed
Limited to specific locations	Can be available simultaneously at multiple locations

Again, since E-learning is *learning,* we expect much of the previous research in learning and training to generalize to this new environment. However, given the differences between the characteristics of the two environments, we believe it is likely that some relationships described in the Colquitt et al. (2000) model will change.

relationships may change in an E-learning environment, and discusses the implications for E-learning design and implementation.

(2000) found a consistent and positive relationship between learning outcomes and the trainee's desire to learn the training material. Furthermore, their meta-analysis found that individual and situational factors accounted for a considerable percentage of training

Table 2. Example Variables Correlations in Conventional (actual) and E-learning (projected) settings

Variable	**Correlation with Learning in a Conventional Setting**	**Hypothesized Correlation with Learning in a Distance Learning Setting**
Cognitive Ability	r = .69 declarative knowledge r = .38 skill acquisition r = NS motivation to learn	No change expected
Motivation to learn	r = .27 declarative knowledge r = .16 skill acquisition	Correlation expected be higher because of the lack of external support in DL
Self-Efficacy	r = .30 declarative knowledge r = .32 skill acquisition r = .42 motivation to learn	Recent research indicates similar correlations in DL (e.g., Wang and Newlin, 2002).
Valence	r = .20 declarative knowledge r = .30 skill acquisition r = .61 motivation to learn	No change expected
Job / Career Variables	r = NS declarative knowledge r = NS skill acquisition r = .25 to .47 motivation to learn	No changes expected
Personality (Conscientiousness)	r = NS, declarative knowledge r = NS skill acquisition r = .38 motivation to learn	Higher correlation expected and in the opposite direction (positive) with knowledge and skill acquisition as the tendency to self-regulate would be more important in DL; No change expected with motivation to learn
Age	r = -.19 declarative knowledge r = NS skill acquisition r = -.18 motivation to learn	Correlations expected to be more pronounced and in the same direction for all variables because of the new technology
Situational Variables (Supervisor support)	r = .25 declarative knowledge r = .29 skill acquisition r = .36 motivation to learn	Correlation expected be higher with knowledge and skill acquisition, because of the lack of structure and external support in DL; No change expected with motivation to learn
Learning Strategies; Metacognitive Strategies; Self Regulation; Time management	Not in Colquitt et al. Model	Correlation expected to be positive and strong because of lack of structure and external support in DL

NS = not statistically significant

Cognitive Ability and Motivation to Learn

Fundamental to the model is the relative influence of cognitive ability, motivation to learn, and the other individual and situational variables on learning outcomes. General cognitive ability, or the ability to learn, consistently predicts success in training across a variety of jobs. This has led some to argue that "there is not much more than (cognitive ability)" (Ree & Earles, 1991). In contrast, Colquitt et al.

outcomes beyond that of cognitive ability.

The Colquitt et al. (2000) findings advance support for the Kanfer & Ackerman (1989) aptitude-treatment interaction model of cognition and motivation. Kanfer (1990) described this model in terms of knowledge acquisition: "the effectiveness of motivational interventions on task performance must be considered in light of individual differences in resource capacity and attentional demands imposed

by the task. As attentional demands imposed by the task decrease with learning, individual differences in general intellectual ability become relatively less important determinants of performance while proximal motivational processes that sustain on-task attention over time become relatively more important" (p. 150). In other words, a complex, yet predictable relationship exists between individual factors (cognitive ability and motivation) and situational factors (e.g., difficulty of material, length of time to complete; learning setting) that influence learning outcomes. Thus, the Kanfer and Ackerman (1989) model provides a framework for hypotheses about the impact of DL. In addition, we are cautious in applying the Colquitt et al. (2000) results to DL in light of the classroom instruction being held "constant" in the meta-analysis.

Hypothesized relationship in an E-learning setting. We propose that DL increases the variability in the types of personal and situational factors that Kanfer (1990) and Kanfer and Ackerman (1989) found to influence knowledge and skill acquisition. As researchers explore factors that influence dropout rates among E-learners they should consider the variability in cognitive and situational requirements over time. For example, E-learning courses typically require students to do a lot of computer-based reading and synthesis of information on their own, and in settings with many distractions (e.g., at home or at work). Therefore, DL may be more cognitively demanding than a traditional classroom course if the student does not have control over time to complete the course. On the other hand, by enabling students to influence course completion time (months versus weeks), and select a quiet location for learning, the need for self-motivation may be emphasized more strongly, with cognitive ability playing a slightly diminished role. In conclusion, researchers should adopt experimental methods and designs that account for the interaction between cognition, motivation, and situational factors in testing hypotheses about learning in a DL environment.

Implication for E-learning. In the near term, DL designers and implementers must consider and understand the multiple facets of the learner and the surrounding situation. Future research should assess aptitude-treatment interactions. Using good research designs will result in ideal recommendations for tailoring DL to optimize its overall effectiveness. If not, considerable resources could be used to begin a DL program for learners who will not be motivated to take the course seriously. This issue will be discussed in more detail throughout this paper.

Pretraining Self-Efficacy

Self-efficacy is an individual's confidence in his/her ability to succeed in a particular activity due to beliefs in one's skills, knowledge, and abilities (Bandura, 1982). An individual enters training with a certain degree of self-efficacy regarding his/her capability to succeed in that training. Research has shown repeatedly a positive relationship between self-efficacy and learning. That is, individuals who believe that they can succeed in training tend to succeed, and individuals who don't believe that they will succeed tend to have trouble (e.g., Gist, Schwoerer, & Rosen, 1989). The Colquitt et al. (2000) meta-analysis found correlations between self-efficacy and declarative knowledge, skill acquisition, and motivation to learn were moderate: r = .30, r = .32, and r = .42, respectively. Colquitt et al. suggested that pretraining self-efficacy has a direct relationship with motivation to learn and, in turn, an indirect relationship with various learning outcomes.

Hypothesized relationship in an E-learning setting. Researchers have begun to examine the influence of self-efficacy in DL settings, and the results are similar to those in traditional settings. For example, Wang and Newlin (2002) found Pearson correlation coefficients between course outcomes and self-efficacy that ranged from r = .24 to r = .34. Brown (1999) noted that training delivered via computers forces learners to learn the content (e.g., damage control) through a potentially novel medium (e.g., internet technology). Therefore, it is important to measure self-efficacy for both the course content and the technology being used (Brown, 1999). Additional research should examine self-efficacy in DL.

Implication for E-learning. In DL, designers must help students believe that they are capable of achieving the learning and performance goals of the course (Clark, 2003). This is particularly important if the material is expected to be difficult for the learners. Based on strategies proven effective for increasing learner self-efficacy in traditional classroom settings (e.g. Goldstein, 1993), possible strategies to build self-efficacy in an E-learning environment include: 1) cover easy material first and gradually increase difficulty; 2) present a case study of a learner with similar characteristics who succeeded in the course (e.g., 19 year old, high school diploma, rate in the Navy); and 3) include capacity for instructor-student interactions. See Goldstein (1993) for further information.

Valence

Valence refers to how strongly an individual desires a particular outcome. For example, an individual may have a strong desire to succeed in a training program because success in the program could lead to promotion, higher pay, prestige, or feelings of accomplishment. Colquitt et al. (2000), found moderate correlations between valence and declarative knowledge gained and valence and skill acquisition: approximately $r = .20$ and $r = .30$, respectively. A strong correlation with learning motivation appeared: $r = .61$.

Hypothesized relationship in an E-learning setting. We expect stronger correlations between valence and declarative knowledge and skill acquisition based on the influence of motivation on E-learning success. No change is expected for the already high correlation with learning motivation ($r = .61$), but the strong relationship should play a key role in establishing incentive systems for employees to complete E-learning. More research is needed.

Implication for E-Learning. While it could be difficult to change the degree an individual desires an outcome, DL designers should at least convey the potential outcomes. Examples could describe how course content will be useful on the job and how learning and using the information may lead to self-growth, increased responsibility, and/or promotions. If the learner values the outcomes described, then valence will likely increase. Learner analyses could identify what outcomes are valued.

Job/Career Variables

Job and career related variables include job involvement, organizational commitment, career commitment, career exploration, and career planning. Job involvement is the degree to which an individual identifies psychologically with work and the importance of work to a person's total self-image (Brown, 1996). The greater degree a person is involved in their job, the more likely they will be motivated to succeed in job related training (Mathieu, Martineau, & Tannenbaum, 1993). Organizational commitment refers to an individual's involvement in and identification with an organization. The same type of commitment can be directed toward an occupation (Meyer, Allen & Smith, 1993) (i.e., "Career Commitment"). Individuals with higher commitment to their organization and/or career, tend to believe training to be useful to themselves or the organization. Career exploration and planning has to do with self-assessment of skill strengths and weaknesses, searching for career information, and setting career goals. While Colquitt et al. (2000) found that these variables did not correlate directly with learning outcomes, the job/career variables did have moderate to high relationships with learning motivation. Correlations with learning motivation were found to be about $r = .25$, and with organizational commitment $r = .47$.

Hypothesized relationship in an E-learning setting. The relationship between valence and motivation to learn could play a key role in establishing incentive systems for employees to complete E-learning training. In addition, the job/career variables have moderate to strong relationships with transfer ($r = .22$ to $.45$) (Colquitt et al., 2000). If the transfer of knowledge and skills gained in E-learning is more difficult based on the lack of general support for learning in that environment, the influence of job and career variables could be even more important.

Implications for E-Learning. Without the presence of an instructor or peers, learners will need self-motivation. Before selecting a DL solution, the organization should assess the degree to which the targeted learners score highly on the job/career variables. Learners who achieve a high score on the job/career variables will likely be motivated to succeed. If the learners tend to score low on the job/career variables, the learners may not have enough internal motivation to succeed in the course.

Personality Variables

Research indicates that certain personality variables also play a role in training effectiveness. Personality refers to relatively stable characteristics of individuals (other than ability) that influence their thoughts and behavior (Colquitt et al., 2000). Personality traits that are linked to training motivation include achievement motivation, locus of control, anxiety, and conscientiousness. Those with a high desire to achieve tend to have more motivation for training than those with a low desire to achieve. Individuals with an internal locus of control (internals feel they are in control; externals feel their environment is in control) had more positive attitudes toward training. Those higher in anxiety (apprehensive, fearful, uneasy) had less training motivation than those with lower anxiety, and conscientious (careful, meticulous) learners had higher training self-efficacy and a desire to learn than less conscientious individuals.

Hypothesized relationship in an E-learning setting. The Colquitt et al. (2000) meta-analysis indicated conscientiousness was not correlated with declarative knowledge or skill acquisition. One explanation is that the conscientious tendency to self-regulate could actually detract from on-task attention (Kanfer & Ackerman, 1989). If this is true in E-learning, when

success may rely on individual internal learning strategies, the "pro" of self-regulation activity (good self-management during the course) may outweigh the "con" (detract from on-task attention). Hence, the correlation with knowledge and skill acquisition may be stronger and positive. No change is expected with motivation to learn. Again, research is needed.

Implications for E-Learning. Previous research in E-learning has focused on learning style rather than personality characteristics. Learning style is defined as the student's existing learning strengths or preferred manner of using his/her intellectual abilities (Sternberg, & Grigorenk, 1997), and is often used synonymously with cognitive style, learning strategy, and learning preference. Similar to personality, learning style is considered to be a stable and relatively permanent characteristic of an individual (Garger & Guild, 1984). An assumption of E-learning technologies is that these technologies will enable instructional adaptation to the user. Specifically, if users differ in style of learning, E-learning may provide alternative presentations of the course content. Some research indicates that learning style may explain variance in student performance, but contradictory results also exist (e.g., Douzenis, 1998; Shih, Ingebritsen, Pleasants, Flickinger, & Brown; 1998). Ambiguity in the research makes giving recommendations difficult, but DL designers should be aware that continued research in learning styles and personality may establish design guidance.

Age

Some research indicates a negative relationship between age and learning (Gist, Rosen, & Schwoerer, 1988). A variety of explanations for this relationship exist. These include decrease in cognitive processing, increased fear of failure, changes in self-perception, and manager perceptions of the employee's ability and training motivation. In contrast, Colquitt et al. (2000) reported that age had a weak negative relationship with declarative knowledge r = -.19 and with motivation to learn r = -.18.

Hypothesized relationship in an E-learning setting. Because completing an E-learning course involves mastery of new technology, older learners who have little experience with computers and with the internet may have difficulty working with the technology needed to complete the course and may learn less than those who do not have difficulty. Motivational issues (e.g., lack of confidence that he could use the technology and complete the course) may also occur.

Implications for E-Learning. It is crucial that organizations using a DL training solution know the targeted learner population. Learner support tools and interventions may be needed. For example, learners may need familiarization training with the technology and additional capacity for instructor-student interactions may be needed (e.g., telephone, in person meetings). Laws that govern interface design should be noted (e.g., compliance with Section 508 of the Americans with Disabilities Act).

Situational Variables

Situational variables are characteristics that employees perceive to be present in the organization. Situational variables that influence training effectiveness include climate, manager support, and peer support. Climate is the "atmosphere" in an organization. That is, employees' perception of characteristics of their workplace such as resource availability, consequences of actions, and opportunities. Climate seems to influence training transfer (Tracey, Tannenbaum, & Kavanagh, 1995). For example, if a newly trained person has opportunities to use new skills, receive feedback, and experience favorable consequences for using the new skills, that person will be more likely to actually use the new skills and knowledge on the job (Tracey et al., 1995). Perceived presence of manager and peer support also influences training effectiveness (Baldwin & Ford, 1988). Colquitt et al. (2000) reported that supervisor support was correlated r = .25 with declarative knowledge, r = .29 with skill acquisition, and r = .36 with motivation to learn.

Hypothesized relationship in an E-learning setting. One study of tele-training, Biner, Dean, and Mellinger (1994) found that seven factors accounted for 71% of the learner's satisfaction with a DL course: out of class communication with instructor, course management, promptness of material delivery, support services, technology, at-site personnel, and instructor/instruction. Many of these factors (promptness of delivery, support services, at site personnel) involve learner support. Thus, the results of the Biner et al. study indicated the importance of learner support in DL environments.

It may also be that the situational variables "manager and peer support" are more important for learners taking an E-learning course than for those in traditional courses. First, the nature of DL frequently means that a learner takes the course at his or her regular workspace. It could be nearly impossible to succeed in a course without being allowed to spend "work time" on the course. Management support may also be needed to ensure provision of the proper equipment and technical support, and provide encouragement to help motivate the learner. More research is needed in this area.

Implications for E-learning. Indeed, it is not uncommon to believe learners should engage in DL courses on their own time and after completing other work. This belief is held despite that, if taking the course in a classroom setting, the learner would not perform *any* job duties while taking the course! Even if managers allow the employee time to take the course, peers must keep noise and other distractions to a minimum. In addition, managers should help to ensure that the learner has the proper equipment and technical support. Finally, without the support gained through interpersonal interactions that occur naturally in a classroom setting, distance learners may feel very isolated. A supervisor and peers who takes the time to talk to the employee and emphasize the value of the training should help to motivate the employee. In DL, this type of support may be crucial.

CONCLUSION

The science of learning offers E-learning researchers and consumers insight into factors surrounding the effectiveness of E-learning. The Colquitt et al. (2000) meta-analysis described the relationships among learner characteristics and situational variables and their influence on learning and subsequent job performance. The analysis, however, was based on research done in conventional training settings. In this paper we have suggested some initial hypotheses regarding the impact of these relationships for E-learning researchers and practitioners. It is our hope that this paper has helped to lay out some important areas in DL research as well as to assist E-learning practitioners by interpreting findings from the science of learning as they relate to the characteristics of DL.

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REFERENCES

Baldwin, T. T. & Ford, J. K. (1988). Transfer of training: A review and directions for future research. *Personnel Psychology, 41*, 63-105.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist,37*,122-147.

Biner, P., Dean R., and Mellinger, A. (1994). Factors underlying distance learner satisfaction with televised college-level courses. *The American Journal of Distance Education*, *8*(1), 60 - 71.

Brown, S.P. (1996). A meta-analysis and review of organizational research on job involvement. *Psychological Bulletin, 120,* 235-256.

Brown, K. (1999, April). *Individual differences in choice during learning: The influence of learner goals and attitudes in web-based training*. Paper presented at the 14th Annual Conference of the Society for Industrial and Organizational Psychology, Atlanta, GA.

Carr, S. (2000, February). As distance education comes of age, the challenge is keeping the students. *The Chronicle of Higher Education, 46,* Article 00101. Retrieved February 20, 2002 from http://chronical.com/free/v46/i23/23a00101.htm.

Clark, R. (2003). What works in distance learning: Instructional strategies. In H.F. O'Neil (Ed.) *What works in distance learning*. Report supported under Office of Naval Research Award Number N00014-02-1-0179. Los Angeles: University of Southern California, Rossier School of Education.

Colquitt, J. A., LePine, J.A. & Noe, R.A. (2000). Toward an integrative theory of training motivation: A meta-analytic path analysis of 20 years of research. *Journal of Applied Psychology, 85,* 678-707.

Douzenis, C. (1998, April). The relationship between cognitive style and achievement in a distance education course. *Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.*

Garger, S., & Guild, P. (1984). Learning styles: The crucial differences. *Curriculum Review, 23*, 9-12.

Gist, M. E., Rosen, B. Schwoerer, C. (1988). The influence of training method and trainee age on the acquisition and maintenance of complex interpersonal skills. *Personnel Psychology, 44*, 837-861.

Gist,M. E., Schwoerer, C., & Rosen, B. (1989). Effects of alternative training methods on self-efficacy & performance in computer software training. *Journal of Applied Psychology,74,*884-891.

Goldstein, I.L. (1993). *Training in organizations.* Pacific Grove, CA: Brooks/Cole.

Kraiger, K., Ford, J. K., & Salas, E. (1993). Application of cognitive, skill-based, and affective theories of learning outcomes to new methods of

training evaluation. *Journal of Applied Psychology, 78,* 311-328.

Kanfer, R. (1990). Motivation theory and industrial and organizational psychology. In M.D. Dunnette and L.M. Hough (Eds.), *Handbook of Industrial & Organizational Psychology*, Volume 1, 2nd Ed. Palo Alto, CA: Consulting Psychologists Press.

Kanfer, R., & Ackerman, P.L. (1989). Motivation and cognitive abilities: An integrative/aptitude-treatment interaction approach to skill acquisition [Monograph]. *Journal of Applied Psychology*, *74*, 657-690.

Kazlauskas, E. (2003). What works in distance learning: Management strategies. In H.F. O'Neil (Ed.) *What works in distance learning*. Report supported under Office of Naval Research Award Number N00014-02-1-0179. Los Angeles: University of Southern California, Rossier School of Education.

Mathieu, J. E., Martineau, J. W., & Tannenbaum, S. I. (1993). Individual and situational influences on the development of self-efficacy: Implications for training effectiveness. *Personnel Psychology ,46,* 125-147.

Meyer, J. P., Allen, N. J., & Smith, C. A. (1993). Commitment to organizations and occupations: Extension and test of a three component conceptualization. *Journal of Applied Psychology, 78,* 538-551.

Ree, M.J., & Earles, J. A. (1991). Predicting training success: Not much more than g. *Personnel Psychology, 44,* 321-332.

Rossett, A. (2000, August). Confessions of an E-drop-out: 'Anytime, anywhere' turns into 'not now, maybe later'. *Training Magazine*. Retrieved June 5, 2003 from http://edweb.sdsu.edu/people/arossett/viewpoint.htm

Salas, E., Kosarzycki, M. P., Burke, C. S., Fiore, S. M., &Stone, D. L. (2002). Emerging themes in distance learning research and practice: Some food for thought. *International Journal of Management Reviews, 4,* 135-153.

Shih, C., Ingebritsen, T., Pleasants, J., Flickinger, K., & Brown, G. (1998, August). Learning strategies and other factors influencing achievement via Web courses. *Proceedings of the 14th Annual Conference on Distance Teaching and Learning, 14*, 359-366.

Sternberg, R. J., & Grigorenko E. L. (1997). Are cognitive styles still in style? *American Psychologist, 52*, 700-712.

Tracey, J. B., Tannenbaum, S. I., & Kavanagh, M. J. (1995). Applying trained skills on the job: The importance of the work environment. *Journal of Applied Psychology, 80,* 239-252.

United States General Accounting Office. (2003). *Military transformation: Progress and Challenges for DOD's Advanced Distributed Learning Programs*(GAO-03-393).Washington, D.C.: GAO.

Wang, A. Y., & Newlin, M. H. (2000). Characteristics of students who enroll and succeed in web-based classes. *Journal of Educational Psychology, 92*, 137-143.

Wisher, R. A., Champagne, M. V. Pawluk, J. L., Eaton, A. Thornton, D.M., Curnow, C. K. (1999). *Training through distance learning: An assessment of research findings.* (Technical Report 1095). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Science