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Army Institutional Training: Current Status and Future Research

William R. Bickley and Robert J. Pleban
U.S. Army Research Institute

Frederick Diedrich and Jason Sidman
Aptima, Inc.

Robert Semmens
IMPRIMUS, Inc.

Alexandra Geyer
Aptima, Inc.

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BARBARA A. BLACK, Ph.D.	**MICHELLE SAMS, Ph.D.**
Research Program Manager	**Director**
Training and Leader Development Division	

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14. ABSTRACT *(Maximum 200 words)*:

This document provides a listing of findings and issues resulting from an overview of current Army institutional training and, from the perspective and constraints of Army training, an overview of current learning theory and science. Findings and issues are categorized as "policy issues" and "research issues." Policy issues, such as training scheduling and availability or quality of training technology, are presented as items with relatively straightforward, direct potential solutions that can be analyzed and considered for adoption by Army institutional training management. Research issues, such as modifying training to address far transfer or integrating problem-centered instructional approaches into Army training, are presented as items with no direct solutions and that are suitable for further investigation, ranging from basic research in training and education to development and assessment of prototype Army training and education products.

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William R. Bickley and Robert J. Pleban
U.S. Army Research Institute

Frederick Diedrich and Jason Sidman
Aptima, Inc.

Robert Semmens
IMPRIMUS, Inc.

Alexandra Geyer
Aptima, Inc.

Fort Benning Research Unit
Scott E. Graham, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
2511 Jefferson Davis Highway, Arlington, Virginia 22202-3926

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ARMY INSTITUTIONAL TRAINING: CURRENT STATUS AND FUTURE RESEARCH

EXECUTIVE SUMMARY

Research Requirement:

The U.S. Army Training and Doctrine Command (TRADOC) and the U.S. Army Research Institute for the Social and Behavioral Sciences (ARI) conducted a "Science of Learning" workshop (Quinkert, et al.) in 2006. One purpose of the workshop was to address the availability of information on "new pedagogical techniques, procedures, and technologies." With regards to institutional training, the workshop recommended the Army exploit current and emerging training and learning technology and begin the exploitation of various learning and training theoretical models. Distributed learning (dL) and guided experiential learning (GEL) were specifically mentioned as technology and modeling examples for investigation.

Procedure:

The ARI Ft. Benning Research Unit conducted this overall overview of previous, extant, and emerging institutional training approaches and technologies from the point-of-view of compatibility and integrability with the Army environment. The overview fell into two general areas: a critical review of currently employed military institutional education and training, and a review and synthesis of previous and current training relevant research and technology.

The research team interviewed trainers, training developers, and training managers at seven Army proponent schools with regard to their usage of current training technology, with an emphasis on dL. The team also conducted a review of selected contemporary topics in learning technology and in learning science. The objective was to produce the current report as a "snapshot" of institutional training, both in general and as implemented by the Army, with a goal of subsequently analyzing the snapshot to glean researchable training issues from it. The snapshot was taken from two different perspectives: a survey of current institutional training practices and training issues in various Army schools and a review and a synthesis of the literature covering current training research and technology as applicable to the Army's institutional training environment.

Findings:

Findings and issues are categorized as "policy issues" and "research issues." Policy issues, such as training scheduling and availability or quality of training technology, are presented as items with relatively straightforward, direct potential solutions that can be analyzed and considered for adoption by Army institutional training management. Research issues, such as modifying training to address far transfer or integrating problem-centered instructional approaches into Army training, are presented as items with no direct solutions and that are suitable for further investigation, ranging from basic research in training and education to development and assessment of prototype Army training and education products.

Utilization and Dissemination of Findings:

Results of this work will be used to direct research in institutional training under ARI's current WP 360, Blended Learning Solutions for Army Training. Various TRADOC elements, including TRADOC G 3/5/7 Training, the Army Training Support Center (ATSC), various Captains Career Courses, and Noncommissioned Officer (NCO) Academies have expressed interest in both the policy and research issues, and in any research products that may result.

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ARMY INSTITUTIONAL TRAINING: CURRENT STATUS AND FUTURE RESEARCH

Introduction

The U.S. Army divides training into three domains: the operational domain, the institutional domain, and the self development domain. The institutional domain, which is the concern of this work, comprises the initial training, professional military education (PME), and functional training delivered at training base centers or schools (U.S. Army, 2008). Currently, and for the foreseeable future, this Army institutional training capability faces the problem of maintaining (and, in some cases, increasing) training capacity and capability while experiencing a marked decrease in training resources, in terms of training time, training funds, and training personnel. This decrease in resources is occasioned by the Army's re-allocating funds and personnel to address the current operating environment.

In recognition of and in anticipation of this challenge, the U.S. Army Training and Doctrine Command (TRADOC) and the U.S. Army Research Institute for the Social and Behavioral Sciences (ARI) conducted a "Science of Learning" workshop (Quinkert, et al., 2007) in 2006. One purpose of the workshop was to address the availability of information on "new pedagogical techniques, procedures, and technologies" that might be exploited to meet the challenge. Part of the output of the workshop was a set of recommendations for further investigation. With regards to institutional training, the workshop recommended the Army exploit current and emerging training and learning technology and begin the exploitation of various learning and training theoretical models. Due to their potential for increased efficiencies in instruction, distributed learning (dL) and guided experiential learning (GEL) were specifically mentioned as technology and modeling examples for investigation.

Partially as result of the workshop outcomes, ARI in late Fiscal Year 2007 initiated at its Ft. Benning Research Unit a program of research in Army institutional training. One of the first objectives of that program was to produce the current report as a "snapshot" of institutional training, both in general and as implemented by the Army, with a goal of subsequently analyzing the snapshot to glean researchable training issues from it. The snapshot was to be taken from two different perspectives: (a) a survey of current institutional training practices and training issues in various Army schools and (b) a review and a synthesis of the literature covering current training research and technology as applicable to the Army's institutional training environment.

The two different perspectives were seen as necessary because, in some cases, they have the potential for conflict. It was quickly realized that the Army institutional training environment has the potential to constrain what new or different training technologies and techniques might be adopted and then also to constrain how those technologies and techniques might be implemented. Also, even though a training technology or technique may be found to be a "fit" within the Army constraints, it cannot in general be immediately and capriciously "plugged into" the on-going institutional training environment. Any and all modifications within that environment must be as seamlessly as possible transitioned and integrated into on-going training (cf. Vandergriff, 2006). Thus, there is, in the discussion and recommendations section to this report, a conscious effort to temper recommendations for implementation and for research to fit within the constraints of the Army institutional training environment.

With these two perspectives in mind, this report examines the overall institutional training question in terms of two component environments: the environment external to institutional training and the institutional environment which exists within and is influenced by the external environment.

This report first examines the external environment. The enclosing external consists of the constraints, requirements, and options that may be placed on the institutional training environment. These include considerations such as the Army Force Generation (ARFORGEN) cycle, the student-relevant characteristics of the Army population, the training objectives resulting from analytical decomposition of mission essential task lists, training system effectiveness and efficiency assessments, and integration with TRADOC-level training management systems. In general, any "forcing" function which the institutional environment does not directly control is deemed an element of the external environment.

The second section addresses the institutional environment. It consists of elements such as training design, training development, training delivery, instructor preparation, course assessment, and student assessment. As would be expected, the major part of this section is devoted to consideration of the institutional environment and consideration of the applicable learning science and technology. To gain an appreciation of current Army institutional training, the authors visited a representative number of proponent "schoolhouses" and interviewed trainers, training developers, and training managers with regard to local current training practices (with special emphasis on dL), to local emerging training practices, and to perceived institutional training needs. Special effort was devoted to identifying commonalities across training entities. Also in this section appears a relatively detailed discussion of current learning science and technology from the perspective of Army institutional training.

Across both environments, three themes are given special attention: applications of learning science, methods of assessing learning, and methods of assessing transfer of learning. The interest in applications of learning science arises, of course, directly from the overall objective of this report. But, if the effectiveness of one application of learning science is to be compared to that of another, it is critical that there be some, preferably non-qualitative, method of measuring and assessing the effectiveness of both applications. Because differences in "effectiveness" of training are central to any discussion of training alternatives, its orientation toward measurement and assessment of effectiveness is central to this report. Even more critical is the definition of "effectiveness" – is the effectiveness of a course to train a given subject domain best measured by Soldiers' scores on an end of course test, or is it best measured by their subsequent performance within that subject domain? Army institutional training is for the most part applied training; that is, what is learned is to be applied to some set of Army tasks. If the Soldier is to apply the training, then the effectiveness of the training would best be expressed in terms of its eventual application, or in terms of how well the training transfers to the operational context.

Of these three topics, applications of learning science and assessment of transfer are deemed of highest importance and are emphasized in the following sections.

The External Environment

The external environment comprises those entities outside the Army institutional environment that may influence and are influenced by the institutional environment. Army-specific areas that are considered below include conditions or drivers that are imposed from TRADOC and above, characteristics of the source population upon which the Army may draw, TRADOC training management policies, requirements, and options, and, last, considerations for assessment of training effectiveness.

Major Training Drivers

Army Field Manual (FM) 7-0, *Training for Full Spectrum Operations* (US Army, 2008) defines the general external environment for institutional training. Noting that "effective training is the cornerstone of operational success" (p. 1-5), FM 7-0 expects Soldiers to be "lifelong learners" and to periodically spiral through the institutional domain to acquire skills and knowledge necessary for their current or their next duty assignment. In this way, institutional training is seen as a resource existing to support the operational domain.

In supporting the operational domain, Soldiers' institutional training must operate within the ARFORGEN process (Department of the Army, 2007c). Because the ARFORGEN process, as designed, schedules and re-cycles Brigade Combat Teams through a 3-year, 3-stage "re-set/train → ready → available" repeating sequence, TRADOC can in principle sync-up institutional training offerings with units' ARFORGEN schedules. The TRADOC Commander has listed "Posture TRADOC to support ARFORGEN implementation" as one of the current TRADOC Campaign Plan's seven primary objectives (Wallace, 2006). In a few cases, implementation of this objective has resulted in tailoring institutional course lengths to fit the "re-set/train" phase and also in, for some critical courses, modulating throughput rate of Soldier students to coordinate with units coming off "available" phase deployment (Wallace, 2006). The expectation is that TRADOC will continue to orient institutional training toward supporting ARFORGEN.

Soldier Population

The Soldier population that institutional training supports, being of age 18 years or older, would be classified as "adult learners" (Knowles et al., 1998) and as having corresponding adult learner needs and expectations. Various writers in adult education (e.g., Knowles et al, 1998, Wlodkowski, 1993) point out a number of these needs, but, most important for Army institutional training, a Soldier adult learner's training must be perceived as directly applicable to the Soldier's personal situation. The Soldier's personal environment is discussed in more detail later in the report, but one overall aspect of the Soldier's personal situation is experience level, especially academic experience level the Soldier brings with her or him on entry into the Army. Office of Army Demographics data (Department of the Army, 2007) indicate that in fiscal year 1995, 94% of non-prior service enlistees had earned high school diplomas, while, in fiscal year

2006, 81% of non-prior service enlistees had earned high school diplomas. These data indicate that different year-groups of Soldiers can differ in their expected academic baseline. Specifically, in 2009, Soldiers with approximately 14 years service (1995 accessions) on average have a public school background different from Soldiers with approximately 3 years service (2006 accessions). To a certain degree, Army institutional training must take into consideration not only changes in course content in response to the current operational environment, but also changes over time in the Soldier population that is served by the courses.

Although there is the possibility that cultural differences in the Soldier population could interact with institutional instruction (cf. Hofstede, 1986), the Army seeks to inculcate in its Soldiers a common culture of "lifelong learning" (U.S. Army Training and Doctrine Command, 2006). This specific acculturation begins at Soldier accession and continues through the Soldier's career. As indicated above, the Army expects Soldiers to continue to train throughout their careers, and institutional training is expected to provide a large part of that training. Soldiers, on the other hand, expect institutional training to be readily available and to be of benefit to their careers.

Given the current tempo of operations, availability and applicability of institutional training become of personal importance to deploying and returning Soldiers. With the ARFORGEN cycle force-fitted to the current tempo, Soldiers have a limited available period of time during which they are not deployed, and they feel they must wring maximum benefit from this time. Thus, from the Soldier's point of view, institutional training course lengths ideally are at most a few weeks in length and course content is ideally concise and relevant. The Soldier's expectation of "relevance" is that the course be up to date to reflect current operations and that the course content level be appropriate. Typical Soldier critical comments voice dissatisfaction that some courses appear not to have been updated for years and that some courses "try to teach me the job I've already been doing for the past six months" (M. Quirion, personal communication, May 4, 2007). TRADOC Pamphlet 350-70-10 (U.S. Army Training and Doctrine Command, 2004) emphasizes course content validation, with the unintended result that courses are not consistently validated against external criteria.

Training Management Considerations

Army Regulation 350-1 (Department of the Army, 2007b) outlines the Army institutional training system. By policy, institutional training is managed at the course level; in implementation, all institutional courses Army-wide are listed in and scheduled via the Army Training Requirements and Resources System (ATRRS). Course offerings and schedules are available via ATRRS, and prospective students almost with no exception schedule their attendance in a specific course at a specific location with specific course-start and course-end dates via ATRRS.

One of the unintended effects of managing training at the course level is the resultant difficulties in personalizing course delivery. For a specific course, Students first must conform their personal schedules to a course start schedule, and, then, once in attendance, must, in most cases, conform to the course end schedule. The fixed course end schedule constrains to a large extent the design of institutional courses: a true self-paced course or a course with a separate accelerated "fast track" presents administrative difficulties in managing how to accommodate the "left over" time of Soldiers who complete the course before its scheduled end. This problem is more acute in those cases in which a Soldier may be scheduled for two "back-to-back" institutional courses – if the Soldier completes the first course a few days early and the second course's start date is set at a fixed date, the institution is faced with the challenge of putting the Soldier's between-courses time to constructive use. The expectation is that TRADOC will continue, at least for the near future, to manage access to institutional training at the course level.

Training Effectiveness Assessment

Army training and education has the purpose of supporting the Army's mission of providing sustained land dominance across the full spectrum of conflict. Implied in meeting this purpose is the ability to assess the training's effectiveness in supporting the mission. This assessment happens outside the institutional environment. Measurement and assessment of knowledge acquired during training is admittedly important, but more critical is the measurement and assessment of the real-world application of that knowledge external to the institutional environment. So, for purposes of this paper, the Army's assessment of training effectiveness should aim at determining how much better the Soldier performs operationally (on the job or in the field) subsequent to institutional training. This subsequent, external performance improvement is termed transfer of learning or transfer of training.

Training transfer generally refers to the application of trained knowledge and skills back to the job (Burke & Hutchins, 2007). According to Baldwin and Ford (1988), two conditions must be met for transfer to have occurred: 1) learned behavior must be generalized to the job context, and 2) it must be maintained over a period of time on the job. Smith, Ford, and Kozlowski (1997) argued for a third condition or indicator of transfer: the extent to which the trainee can adapt to novel or changing situational demands, with its emphasis on developing effective problem solving skills.

The transfer problem. Facteau, Dobbins, Russell, Ladd, and Kudisch (1995) reported findings that organizations spend as much as $200 billion annually on workforce training. These costs will likely increase as the economy continues to expand in the high technology, service and information sectors. Rapid technological development will place greater demands on workers to improve the quality of services and products due to increased global competition. One result of this economic expansion will be the increasing need for organizations to better utilize the available workforce. To stay competitive, organizations will need to enhance their training activities for current employees.

Recent studies, however, indicate that the impact of training programs has not been very effective. Saks (2002) reports survey findings indicating about 40% of trainees fail to show transfer immediately after training, 70% falter in transfer one year after the program, and ultimately only 50% of training investments result in organizational or individual improvements. Transfer of learning continues to represent a core issue for human resource researchers and trainers focused on designing interventions to enhance individual, group, and organizational performance (Yamnill & McLean, 2001).

Issues related to transfer and transfer effectiveness can be grouped in three categories:

- Factors influencing transfer
- Assessment of transfer and transfer climate
- Training for transfer

These areas will be briefly discussed and key findings presented.

Factors influencing transfer. Since 1988, three comprehensive reviews have been performed (Baldwin & Ford, 1988; Ford & Weissbein, 1997; & Burke & Hutchins, 2007) concerning the factors influencing transfer. The reviews have focused, in varying degrees, on three primary factors – learner characteristics, intervention design and delivery, and work environment influences.

Learner characteristics. A sizeable body of work has sought to relate degree or quality of transfer as a function of the individual characteristics of the learner.

Cognitive ability. General mental ability has been extensively studied and shown to be a consistently reliable predictor of job and training performance. More specifically, far transfer (the application of learning to situations dissimilar to those of the original learning events, Yamnill & McLean, [2001]) is generally achieved by students with higher general ability scores (Clark & Voogel, 1985). Extensive meta-analyses based on 20 years of training research which examined the relationship between cognitive ability and training transfer yielded a correlation of .43 (Colquitt, Le Pine, & Noe, 2000). While the findings reported in this area have been impressive, cognitive ability is fairly resistant to training intervention strategies and its value may be limited primarily as a covariate for examining the impact of training interventions in groups of differing ability levels.

Self-efficacy. Self-efficacy (competency based judgment by trainees to perform specific tasks) has been found to be positively related to transfer generalization and transfer maintenance across multiple studies (e.g., Chiaburu & Marinova, 2005; Gaudine & Saks, 2004, cited in Burke & Hutchins, 2007).

Some interventions designed to increase learner self-efficacy have produced increases in training performance. For example, including mastery experiences and supportive feedback (Gist, 1986) or goal setting and self-maintenance-meta cognitive strategies (Gist, Stevens, & Bavetta, 1991) as part of post training interventions resulted in enhanced transfer. The findings suggest that unlike cognitive ability, self-efficacy is a malleable learner quality that should be considered in developing transfer intervention strategies.

Motivation. Motivation, or more specifically, training motivation, as defined by Tannenbaum and Yukl (1992), refers to the intensity and persistence of efforts that trainees apply in learning-oriented improvement activities, before, during, and after training. Two types of goal orientation have been identified. The first, mastery orientation, refers to the belief that effort leads to improved training outcomes. Individuals with a mastery orientation are focused on developing new skills, understanding learning tasks and identifying the most appropriate/optimum learning strategies. Performance orientation, in contrast, refers to the belief that ability is demonstrated by performing better than others. The focus of these individuals is to strive to do well on a task regardless of whether they have acquired all the skills to other settings (Ford & Weissbein, 1997). The challenge for trainers according to Ford and Weissbein (1997) is to develop interventions that support a mastery orientation and, thus, enhance the potential for transfer to the job setting. As noted by Noe (1986) and the present authors, trainee/Soldier motivation is critical if the new training interventions are to have any impact. Key factors impacting motivation will be described in the next section under design issues.

Personality. Increased focus of the role played by motivational factors in training transfer has advanced researchers'/trainers' understanding of how motivation impacts the learning process. Much less attention has been directed to other trainee characteristics such as personality factors.

Personality variables that have been studied in relation to their impact on various components of trainee motivation include anxiety, openness to experience, sociability, and conscientiousness (see Burke and Hutchins, 2007). Particular attention has been given to the "big five" personality factors and their possible roles in predicting or moderating future performance on the job. These factors include the three factors mentioned earlier, openness to experience, conscientiousness, agreeableness (sociability) in addition to extraversion, and emotional stability. Ford and Weissbein (1997) hypothesize that personality factors might not only be predictive of future job performance but also may impact an individual's motivation to learn, learning strategies used during training, skill acquisition rates, and training transfer.

The variable which may have the most impact on training transfer and is most malleable to intervention efforts is anxiety. The Colquitt et al. (2000) training meta analysis found anxiety produced negative correlations with every training outcome in their sample (e.g., motivation to learn, post training self-efficacy, declarative knowledge) including transfer. Anxiety has been linked to reduced training motivation which results in less transfer (or lower intentions to transfer). Less anxious individuals may be able to focus on the training tasks, and are less distracted, which could lead to higher transfer. Interventions designed to mitigate anxiety in trainees by enhancing confidence and improving individual levels of self-efficacy through some of the strategies mentioned earlier may warrant further consideration by trainers.

Perceived utility. While listed as a learner characteristic by Burke and Hutchins (2007), this factor is closely linked to motivation and the design factor, content relevance. To achieve maximal transfer, learners must perceive that the new knowledge and skills will improve a relevant aspect of their work performance (Baldwin & Ford, 1988). Increased utility will impact motivation to learn which should impact both learning and transfer.

Career/job variables. Another set of learner characteristics impacting transfer are job and career variables. Transfer has been found to be positively influenced by trainees' job involvement (Mathieu, Tannenbaum, & Salas, 1992) which refers to the degree to which an individual identifies with the job, actively participates in it, and considers job performance as critical to his or her self-worth. Similarly, organizational commitment (Colquitt et al., 2000) has been shown to produce a more interested learner who wants to gain and use the new knowledge at work.

While job involvement and organizational commitment can impact learning and transfer, interventions designed to enhance Soldiers' perceptions in these areas may be beyond the scope of the current research. It is possible, however, that interventions designed to improve perceived utility of the training may have indirect effects on these variables.

Intervention design and delivery. Perhaps the most commonly addressed factor in the investigation of transfer is the training intervention itself: how the training is designed, what it consists of, and how it is delivered.

Needs analysis. Effective training design/intervention addresses knowledge, skill, and ability deficits (Burke & Hutchins, 2007). Through established, formalized procedures such as instructional system design, or various survey feedback mechanisms which funnel information from the user to course developers, some mechanism is required to insure that the training provided Soldiers/trainees is timely and relevant. Inappropriate content, poor or nonexistent organizational support, and inadequate resources all impact Soldier/trainee perceptions of the relevance of the training received and the importance of demonstrating newly acquired behaviors and skills on the job or in operational units.

Transfer climate. In addition to conducting needs analyses, trainers must also look at work environment factors such as transfer climate (Holton, Bates, & Ruona, 2000). Transfer climate is seen by Holton et al. as a mediating variable in the relationship between organization/unit environment and individual's job attitudes and work behavior. Thus, even when learning occurs in training, the transfer climate can either support or inhibit application of learning on the job. These factors must also be assessed to provide the trainer with a complete picture of the transfer environment and whether other issues in the work environment must be addressed before embarking on a new training intervention. Specific factors are discussed in the section on work environment influences in the next main section.

Learning goals. Assuming the needs analysis indicates that a training/learning intervention is needed and that the work climate is supportive of the intervention, providing advance organizers in the form of clearly communicated performance objectives, conditions under which the performance will be expected to occur on the job, and criteria for acceptable performance can enhance transfer outcomes (Kraiger, Salas, & Cannon-Bowers, 1995). This suggests that trainees are more likely to exhibit transfer when they have a clear understanding of what knowledge and behaviors are required and when they are expected to demonstrate these actions.

Content relevance. For near transfer to occur (improved performance in one's current job), the more the training content and program reflect the actual work setting, the more successful the near transfer (Baldwin & Ford, 1988). Burke and Hutchens (2007) report empirical studies showing that the content validity of the training module was significantly correlated to transfer immediately after and at the one month mark following training. The findings reported indicate that trainees must see a close relationship between training content and work tasks to optimize transfer (immediate and sustained) in the work setting. A key implication from this research is that a thorough needs analysis and assessment of work environment factors must be performed to ensure that the new training is needed and will be viewed as relevant (by the trainee) for improving job performance.

Instructional strategies and methods. Key instructional strategies for improving transfer include practice, feedback, behavioral modeling, and self-management-metacognitition. These areas are discussed in the following paragraphs.

As noted by Bransford, Brown, and Cooking (2000), without an adequate level of initial learning, transfer cannot be expected, despite the relevance of the training to the individual. The work reported by Bransford et al. highlights the importance of establishing acceptable performance criteria that must be met by trainees to successfully meet course requirements to maximize transfer effects. Overlearning may be required (practice even after correct performance has been demonstrated) for skills not required on a regular basis (e.g., Fisk, Hertzog, Lee, Rogers, & Anderson,1994). Learning complex tasks requires extensive practice (Ericsson, Krampe, & Tesch-Roemer (1993). Trainees must be given sufficient time and varied experiences, as well as time to process information, to enhance transfer.

The type of learning emphasized during training has a direct impact on subsequent transfer. Memorizing a set of facts or procedures may not be conducive to transfer, particularly far transfer, without some time set aside for insuring deep understanding of the material presented during training. This requires establishing more active learning protocols involving increased emphasis on problem solving exercises, small group discussion, and feedback. (See Burke & Hutchins, 2007; Bransford, Brown, & Cocking, 2000).

Opportunities for feedback should occur continuously, as part of the instructional process by focusing on more formative, process oriented feedback during training which the trainees can use to revise their thinking as they are working on a problem. This is in contrast to providing trainees with primarily summative feedback in the form of test scores emphasizing the number of facts or procedures correctly recalled. The emphasis on formative feedback is designed to enhance deep understanding of the material and promote transfer (Bransford, Brown, & Cocking, 2000).

Behavioral modeling provides another potential transfer strategy by enhancing trainee self-efficacy (Bandura, 1997). Inclusion of different situations and/or levels of model effectiveness have been found to improve trainee retention and generalization of learned skills for higher level cognitive functions such as concept formation and problem solving, as well as interpersonal skills (e.g., Baldwin & Ford, 1988; Baldwin cited in Baldwin & Ford, 1988). In a meta-analysis of 117 studies, Taylor, Russ-Eft, and Chan (2005) found that the use of mixed (positive and negative) models produced greater transfer of training (changes in job behavior) than did only positive models.

Using a somewhat related instructional strategy, Smith-Jentsch, Jentsch, Payne, and Salas (1996) employed error-based examples, showing trainees what could go wrong if they did not use trained skills back on the job. Smith et al. (1996) found that this strategy promoted transfer in experienced trainees (pilots) who had encountered specific negative events related to the training. The effectiveness of this approach was attributed to the perceived value (instrumentality) of the training.

Other research (see Ivancic & Hesketh, 1996) has indicated that learning environments designed to be error-filled experiences can be quite effective for improving both learning and transfer. The effectiveness of this approach appears to come from enhanced vigilance in the trainees' produced by errors which results in a clearer mental model of the task to be learned.

Transfer can be improved by helping trainees become more aware of themselves as learners who actively monitor their learning strategies and resources and assess their readiness for specific tests and performances (Bransford, Brown, & Cocking, 2000). Strategies emphasizing self- regulatory/management behaviors (e.g., Frayne & Latham, 1987) and goal setting (e.g., Wexley & Baldwin, 1986) have been shown to improve transfer. Wexley and Baldwin reported enhanced positive transfer two months after receiving the original (goal setting) training.

Work and environment influences. The last two decades have seen an increased interest in this research area. Much of the previous research performed has focused on design factors. Relatively little work has been done to understand how work environment factors influence transfer of training. Organizations interested in increasing their return on investment from learning-training interventions must develop a clearer understanding of all the factors inhibiting transfer (Holton, Bates, & Ruona, 2000). Key factors impacting the overall transfer climate of the work environment are briefly summarized below.

Supervisor/peer support. The role of supervisors in influencing and supporting trainee transfer has been widely supported in both empirical and qualitative studies (e.g., Clarke, 2002). Key behaviors engaged in by managers include: discussing new learning with trainees, participating in training, providing encouragement (positive feedback) and coaching to trainees about the use of new knowledge and skill(s) on the job. These factors were most identified by trainees as positively influencing transfer of learning (see Burke and Hutchins [2007] for a thorough review).

Peer/colleague support. Peer and colleague support has been shown to be a more consistent influence on trainee transfer than supervisory support (Facteau, Dobbins, Russell, Ladd & Kudisch, 1995). Hawley and Barnard (2005) found that the most influential peer support behaviors on transfer were peer networking and sharing ideas about course content. These factors helped promote skill transfer six months after training.

Opportunity to perform. Limited opportunities to perform new skills back on the job was found to be the biggest training impediment to successful training transfer (Clarke, 2002). To insure long term transfer of training to the job, trainees must be provided the opportunity to use their learned skills. Supervisors/leaders play a key role in creating this opportunity (Axtel, Maitlis, & Yearta (1997). If possible, leaders should relook their subordinates' workload to allow them to practice new skills on the job (e.g., Clarke, 2002).

Assessment of transfer and the transfer climate. Transfer of learning is a complex process and involves multiple factors and influences. The transfer climate may either support or inhibit application of learning on the job and is viewed by some (e.g., Rouiller & Goldstein, 1993) as at least as important as learning in facilitating transfer. From a training investment perspective, it is important that the trainer or practitioner have the tools to accurately diagnose those factors inhibiting the transfer process and then intervene where appropriate (Holton, Bates, & Ruona, 2000).

Kirkpatrick's four level evaluation model. Evaluation of interventions is one of the most critical issues faced by training practitioners in the area of human resource development. However, as Holton (1996) points out, the dominant evaluation model currently in use (Kirkpatrick, 1998) has several flaws that may severely limit its value in providing trainers with insights for improving ineffective training interventions. Kirkpatrick's (1998) evaluation model consists of four levels (reaction, learning, behavior, and results) which are performed in sequence, from trainee reaction to results. Briefly, reaction refers to how the trainees react to the training e.g., overall like/dislike, instructor knowledge, course organization. Learning is the extent to which trainees change attitudes, improve knowledge, and or increase skill as a result of attending the program. Behavior is defined as the extent to which change in behavior (transfer of learning to the work place) has occurred because the participant attended the training program. Results refer to the final objectives of the program, e.g., increased production, improved quality, decreased costs, reduced frequency and/or severity of accidents, increased sales, reduced turnover, higher profits. As one moves from one level to the next, the evaluation process becomes more difficult and time consuming, but the payoff in information provided can be extremely valuable.

As noted by Holton (1996), the major limitation of the Kirkpatrick model is that it is primarily a taxonomy that does not fully identify all constructs underlying the variables of interest, thus making validation impossible. The implied causal relationships between each level in the model have not been fully demonstrated. Moreover, seldom is data collected on all four levels, particularly the last two levels. This may be due in part to the difficulty in collecting transfer and overall organizational performance data. Holton argues for a more comprehensive, psychometrically sound evaluation model that measures the major intervening variables that affect the learning-transfer process. Holton, Bates, and Ruona (2000) use the term transfer system which is defined as all factors in the person, training, and organization that influence transfer of learning to job performance. Accurate description and assessment of those factors affecting transfer of training is critical because it helps trainers move beyond the question of whether the training works to a deeper understanding of why the training was effective.

Attempts at measuring factors affecting transfer have been problematical. The measures used have ranged from single-item scales to multiple-item content-validated but situation-specific scales. According to Holton, Bates, and Ruona (2000), this presents several problems. First, the tendency toward custom-designed scales for each effort makes generalization of findings across studies suspect and conclusions about the underlying structure of the transfer climate difficult. Second, empirical evidence demonstrating the validity of the scale constructs either are not performed or are not included as part of the effort. Finally, scales employing single item measures have questionable psychometric properties.

The development of a set of transfer system scales with validated constructs and known psychometric qualities would enhance the chances of conducting meaningful cross-study comparisons, add significantly to understanding the transfer process (i.e., the how and the why) and provide significant diagnostic potential. For example, the scales could be used to identify when an organization is ready for a training intervention and provide information to guide pretraining interventions designed at increasing training effectiveness (Holton, Bates, & Ruona, 2000).

Training system inventory. To address the challenges described earlier, Holton and his colleagues have developed a validated instrument for learning transfer (Holton, 2008), the Learning Transfer System Inventory (LTSI). The LTSI contains 89 items assessing 16 factors which include two construct domains: 'Training in Specific' and 'Learning in General.' The first domain contains 63 items measuring 11 constructs representing factors impacting the training program attended. The remaining items (26) and constructs (5) assess general factors that are not program specific. Tables 1 and 2 list all 16 constructs and their definitions.

Table 1
Learning Training System Inventory: Training Specific Scales

Factor	Definition
Training Specific Scales	
Learner Readiness	Extent to which individuals are prepared to enter and participate in training.
Motivation to Transfer	Direction, intensity, and persistence of effort toward utilizing in a work setting skills and knowledge learned.
Positive Personal Outcomes	Degree to which applying training on the job leads to outcomes that are positive for the individual.
Negative Personal Outcomes	Extent to which individuals believe that not applying skills and knowledge learned in training will lead to negative personal outcomes.
Personal Capacity for Transfer	Extent to which individuals have the time, energy and mental space in their lives to make changes required to transfer learning to the job.
Peer Support	Extent to which peers reinforce and support use of learning on the job.
Supervisor Support	Extent to which supervisors/managers support and reinforce use of training on the job.
Supervisor Sanctions	Extent to which individuals perceive negative responses from supervisors/managers when applying skills learned in training.
Perceived Content Validity	Extent to which trainees judge training content to accurately reflect job requirements.
Transfer Design	Degree to which 1) training has been designed and delivered to give trainees the ability to transfer learning to the job, and 2) training instructions match job requirements.
Opportunity to Use	Extent to which trainees are provided with or obtain resources and tasks on the job enabling them to use training on the job.

Table 2

Learning Training System Inventory: General Scales

Factor	Definition
General Scales	
Transfer Effort – Performance Expectations	Expectations that effort devoted to transferring learning will lead to changes in job performance.
Performance – Outcomes Expectations	Expectation that changes in job performance will lead to valued outcomes.
Resistance/Openness to Change	Extent to which prevailing group norms are perceived by individuals to resist or discourage the use of skills and knowledge acquired in training.
Performance Self-Efficacy	An individual's general belief that they are able to change their performance when they want to.
Performance Coaching	Formal and informal indicators from an organization about an individual's job performance.

The LTSI enables trainers to more definitively answer questions about the nature of learning transfer in the workplace and about barriers and enablers of transfer. However, it does not measure transfer directly, which limits the types of inferences that can be made concerning relationships with transfer outcomes (Burke & Hutchins, 2007).

Assessing transfer. To fairly assess the impact of training interventions and related variables on transfer, transfer outcomes must be directly assessed. Burke and Hutchins (2007) reported in their review very few instances where researchers have directly assessed transfer outcomes (trainee behavior-performance). The majority of studies have, instead, assessed trainee self-reports of transfer intentions and motivations, e.g., motivation to learn, motivation to transfer. High ratings on these variables do not necessarily mean that the trainees have, in fact, transferred learning back to the job.

While direct assessment of transfer remains the gold standard, obtaining these measures as well as measures of organizational effectiveness presents significant challenges. Once trainees complete training and return to their jobs it becomes very difficult and costly to collect the relevant performance measures.

Facteau et al. (1995) argue in favor of using self-report measures and indicate that trainees can, in fact, accurately self-report training transfer outcomes. In fact, self-reports that assess tangible aspects of transfer versus "happiness questions" may provide an inexpensive first look at transfer effectiveness (Holton, 1996). The utility of self-report data can be enhanced by moving away from single source reports from trainees. Facteau et al. advocate a comprehensive assessment approach consisting of additional measures of trainees' skill transfer from other sources, such as ratings made by subordinates, peers and supervisors, measures of learning and, if possible, measures of behavior change resulting from training and organizational results measures (e.g., productivity, absenteeism, turnover). Limitations in self-reports can also be minimized by using highly specific items, and by emphasizing anonymous and confidential surveys (Facteau et al., 1995). Multiple assessments of performance at regular intervals up to 12 months has also been proposed as an additional strategy, in concert with those already mentioned, for providing a more accurate assessment of transfer interventions (Burke & Hutchins, 2007).

An alternative approach for assessing transfer. Bransford and his colleagues (e.g., Bransford & Schwartz, 1999; Bransford, Brown, & Cocking, 2000; Schwartz, Sears, & Chang, 2008) have proposed an alternative strategy for assessing transfer of learning. Bransford and Schwartz (1999) argue that current methods of measuring transfer work well for studying full-blown expertise, but they represent too blunt of an approach for studying the smaller changes in learning that lead to the development of expertise.

They note that one of the key features of most transfer studies is the use of a final transfer task that involves what they call sequestered problem solving (SPS). In SPS, there are no opportunities for trainees to demonstrate their abilities to learn to solve new problems, by seeking help from other resources such as texts or colleagues or by trying things out, receiving feedback, and getting opportunities to revise. Central to the SPS paradigm is the notion of transfer as the ability to directly apply one's previous learning to a new setting or problem. These conventional "one-shot" tests often seriously underestimate the amount of transfer that trainees display from one domain to another.

Bransford and his colleagues (Bransford & Schwartz, 1999; Bransford, Brown, & Cocking, 2000; Schwartz, Sears, & Chang, 2008) expand this view by focusing on other more subtle indicators of transfer including speed in learning a new domain and the quality of questions asked by trainees during tests of transfer. The key, from their perspective, is to look for evidence of initial learning trajectories. So, rather than an evaluation of whether people can generate a finished product, the focus shifts to whether they are prepared to learn to solve new problems.

A more sensitive way to assess the degree to which trainees' learning has prepared them for transfer is to use methods of dynamic assessment such as "graduated prompting" (e.g., Campione & Brown, 1987). This strategy can be used to assess the amount of help needed for transfer by counting the number and types of prompts that are needed before trainees are able to demonstrate transfer. For example, some trainees may demonstrate transfer following a general prompt such as "Can you think of something you did earlier that might be relevant?" Other trainees may require prompts that are more specific. According to Bransford, Brown, & Cocking (2000), tests of transfer that use a graduated prompting scheme can provide a more fine grained analysis of learning and its effects on transfer than simple one shot measures that assess whether the trainee could produce the final product. Bransford and Schwartz (1999) suggest that using a dynamic assessment approach of a trainee's ability to learn over a period of time (e.g., a month) may be a better predictor of long term success on the job than a one shot SPS assessment immediately following training on the job. Some examples of dynamic assessments (provided by Bransford and Schwartz) might include looking at the trainees' abilities to learn new sets of materials. Are they using what they know to define learning goals? Are they carefully evaluating new information rather than simple assimilating it to existing schemas? Are they able to work collaboratively with others? Are they reaching sound conclusions based on existing evidence? Are they able to reflect on their learning processes and strategies? Schwartz and

Martin (2004) present a design strategy that would enable trainers to conduct dynamic assessments to determine students' preparation for new learning and subsequent transfer of learning to new situations.

Training for transfer. As part of the objective/goal setting process, trainers must determine if the focus of the training is to improve near or far transfer (Yamnill & McLean, 2001). Near transfer is the application of learning to situations similar to those in which initial learning has taken place (on the job). Far transfer is the application of learning to situations dissimilar to those of the original learning events. According to Yamnill and McLean, whether one achieves near or far transfer appears to be dependent on which theory (Identical Elements Theory versus Principles Theory) of transfer guides the development and presentation of the training program. According to the theory of identical elements, transfer is improved by increasing the degree of correspondence among the training setting stimuli, responses, and conditions and those related factors operative in the performance setting (Thorndike & Woodworth, 1901). The principles theory suggests that that training should focus on the general principles necessary to learn a task so that the learner can apply them to solve problems in the transfer environment (Goldstein, 1986).

Holton and Baldwin (2003) introduced the Transfer Distance Model that depicts the concept of transfer distance (i.e., near versus far transfer) as the gap between the learning environment and application of knowledge and skills in the job environment. The model provides a useful means of integrating the notions of near and far transfer under a single continuum (see Table 3). The transfer distance concept provides practitioners and trainers a useful means of thinking about learning transfer systems by: 1) locating the type of learning event on the continuum; and 2) locating the type of transfer that is targeted.

Table 3
The Transfer Distance Conceptual Model (Holton & Baldwin, 2003)

Phase 1 Learning Process: From Knowledge to Performance Capability
• Event 1. Acquiring knowledge ("know that")
• Event 2. Acquiring knowledge for use ("know how")
• Event 3. Building performance capability through practice
Phase 2 Work Process: From Performance Capability to Sustained Performance
• Event 4. Application for job-specific proficiency (near transfer)
• Event 5. Repeating and maintaining application
• Event 6. Generalizing for far transfer

The transfer distance continuum progresses through two phases and six key events that are briefly described below. The first phase, moving from knowledge to performance capability, is the learning process and the traditional domain of training. Event 1 represents the starting point for most training, acquiring cognitive knowledge or "know that". For transfer to occur, requires that learning be expanded to event 2, acquiring knowledge for how to use the learning, or "know how." According to Holton and Baldwin (2003) events 1 and 2 represent the minimum learning required to make transfer possible. Event 3, building performance capability through practice is hypothesized to enhance transfer by providing trainees opportunities to practice what they have learned.

The second phase moves the learner from performance capability to sustained performance and represents the work process using the learning acquired in training. Event 4 symbolizes the traditional notion of what is meant by near transfer, i.e., the proficient application of learned material to the trainee's immediate job. Event 5 involves repeating and maintaining learned performance. Event 6 represents the final stage of the (far) transfer process, the generalization/adaptation of learning to jobs or tasks not originally anticipated by the training, but related in a way that allows the learning effects to multiply.

Enhancing near transfer. The following recommendations are provided for increasing the likelihood of near transfer (from Yamnill & McLean, 2001):

- The more the training content and program reflect the workplace, the more successful the near transfer (Baldwin & Ford, 1988).
- The greater the specificity about where and how the training is to be applied to the job, the more successful the near transfer (Clark & Voogel, 1985).
- The more overlearning of the task is encouraged, the more successful the near transfer (Noe, 1986).
- The more procedural nature of the task is emphasized, the more successful the near transfer (Clark & Voogel, 1985).
- The more the application of the training is restricted to only those areas for which the trainees are prepared, the more successful the near transfer (Clark & Voogel, 1985).

Near transfer would be the objective of short-term skill development that can be applied immediately to improve performance in one's current position (Spitzer, 1984). Near transfer is most critical when pursuing technical training because technical training (e.g., operating a machine lathe, small engine repair) usually teaches specific behaviors and procedures applicable to the individual's current job (Laker, 1990).

Enhancing far transfer. The theory of transfer through principles emphasizes the importance of creating variety and explaining the "why" that underlies what an individual is being taught. The following recommendations are provided for increasing the likelihood of far transfer (modified from Yamnill & McLean, 2001):

- The better the trainees understand the underlying principles, concepts, and assumptions of the skills and behaviors they are learning, the more successful the far transfer (Goldstein, 1986). Continuous, formative feedback provided throughout training is critical for enhancing deep understanding of learning materials (Bransford, Brown, & Cocking, 2000).
- To enhance trainees' understanding of critical features of new information, have them attempt to solve a representative problem first to allow trainees to

contrast their thinking with others, including experts in an area, and identify knowledge gaps (Bransford & Schwartz, 1999; Schwartz & Martin, 2004).

- Including direct instruction in training interventions can improve far transfer by providing explanations and efficient solutions devised by experts. To achieve this benefit without undermining transfer, direct instruction should be provided after trainees have first been allowed to grapple with representative problems (e.g., invent or generate solutions). This sequencing improves deep understanding by affording the trainee sufficient time to fully process the underlying structure of the problem and prepares them to better appreciate the deeper implications of the expert solutions (Schwartz & Martin, 2004; Schwartz, 2008).
- Scaffolding initial learning using contrasting cases and worked examples enhances deep understanding and prepares trainees for future learning (far transfer) (Bransford & Schwartz, 1999; Schwartz & Martin, 2004; Schwartz, Sears, & Chang, 2008).
- The more trainees practice in different contexts and use novelty in their practice exercises, the more successful the far transfer (Baldwin & Ford, 1988; Goldstein, 1986).
- The more encouragement trainees receive during training to discuss and apply the training in situations of their own choosing, the more successful the far transfer (Noe, 1986).
- The more encouragement trainees receive after training to apply the training to situations other than those for which they were trained, the more successful the far transfer (Goldstein, 1986).
- The more efficient trainees become in monitoring/managing their learning strategies/goals and resources, the greater the likelihood of sustained positive (far) transfer (Bransford, Brown, & Cocking, 2000; Wexley & Baldwin, 1986).

Principles theory is critical to far transfer because knowledge can be abstracted and connected to new problems. If trainees can understand the principles and concepts and if they have a chance to practice exercises and apply situations in training programs to their workplace, they are more likely to apply their newly acquired skills and behaviors when they are faced with new challenges and unfamiliar problems. Far transfer principles may be most appropriate for higher level cognitive skills such as leader development or creative problem solving (adaptability) since the focus is more to prepare trainees to better deal with unspecified problem areas in the future.

Near and far transfer can be viewed as a series of goals or objectives of training and should be reflected in the content and design of training. It is critical to identify in advance the situations in which training is to be applied. Yamnill & McLean (2001) underscore a point made earlier. No matter how well designed the training, the training program must directly address clearly identified individual and organizational problems. The relevance of the knowledge, skills, and attitudes taught in training to the trainee’s performance on the job is critical in determining transfer.

Training for efficiency versus training for innovation. Typically, near transfer involves two types of knowledge, replicative (declarative knowledge) and applicative (procedural). By focusing on repetitive practice of tasks that will be performed back on the job and providing experiences with classes and components of problems so that they become "routine" and easy to solve later, individuals can develop high levels of efficiency in task performance. However, an overemphasis on efficiency can result in functionally fixed behaviors which may restrict transfer to highly similar situations and limit innovation and creativity (Schwartz, Bransford, & Sears, 2005).

Designing environments to foster innovation and creativity (far transfer) requires that individuals have the opportunity to test out ideas, modify long established assumptions or beliefs about events or processes when appropriate, and for providing interactions that can reveal new information and orient learners to notice it. Schwartz et al. (2005) believe that it is important (from an educational standpoint) to balance efficiency and innovation within the same protocol. Balanced instruction would include opportunities to learn with understanding as well as becoming more efficient at performing the requisite processes underlying successful execution of the task. The key to this type of balanced instruction is to ensure that individuals are provided opportunities to experiment with ideas and, in the process, experience the need to change them. These kinds of experiences often require opportunities to interact actively with people and learning resources (Schwartz et al. 2005).

Initial research (e.g., Schwartz & Bransford,1998) has shown that one of the most effective design strategies for achieving both qualities entails combining opportunities for innovation - developing interpretive knowledge (e.g., analyzing data sets and graphing the results to identify 'interesting' patterns in the data) and opportunities for learning efficient solutions invented by experts. This (learning efficient solutions) was typically provided in the context of a class lecture *following* attempts by students to invent (graphically depict key findings from the data sets). Transfer was assessed by asking subjects to make predictions about the outcome of a novel experiment.

Intervention in the work place. To enhance the transfer process, there must be some form of intervention *following* the training. Axtell, Maitlis, and Yearta (1996) examined transfer of learning one month and one year following training. They found that trainee rated transfer of training at one month was a significant predictor of trainee-rated transfer after one year. Moreover, trainee rated levels of skill did not change appreciably between one month and one year, suggesting that the period immediately after the course may be critical in laying the foundations for future skill use. This indicates that leaders/supervisors may not only need to provide the opportunity and encouragement for skill use but also need to provide trainees with training-related goals to be attained in the first month back at work (See also Wexley & Baldwin [1986] concerning the importance of goal setting in sustaining performance.)

The issue of goal setting and subsequent rewards highlights another point. Goals must be tied to those of the organization. The most significant gains in transfer will come when learning is more tightly integrated into the process and reward systems relevant to the organization (Holton & Baldwin, 2003).

Practical implications. The research presented provided some useful guidelines for enhancing the transfer process. Development of effective training strategies requires careful consideration of the major intervening variables affecting transfer including individual, training design and organizational influences. This will entail continued development and/or refinement of existing instruments to assess these factors both pre (as a diagnostic) and post training. This will enhance trainers'/researchers' abilities to identify organizational and work environment factors negatively impacting the learning/transfer process and will allow for more effective tailoring of the intervention. Additionally, from a diagnostic perspective, these instruments could provide valuable feedback to unit organizational leaders on training climate factors that may need to be addressed prior to training.

Further work is also indicated with regard to assessing transfer. This may be particularly important for assessing far transfer effects. Current strategies for assessing far transfer should be scrutinized (e.g., sequestered problem solving) versus more refined approaches (e.g., dynamic assessments conducted over time) to identify the potential utility of these alternative strategies.

Finally, greater attention must be directed to understanding how to develop training interventions to enhance deep understanding and far transfer. Passive approaches involving lecture/Power Point presentations or "fire hosing" vast amounts of information to trainees with little or no opportunity to practice, reflect, and modify new behaviors are clearly ineffective for enhancing transfer of learning. Alternative approaches focusing, for example, on situating instruction within a problem (e.g., Merrill, 2002) or on active involvement by the trainees in the learning process by collaboratively solving problems, (e.g., problem- or inquiry based learning (Hmelo-Silver, Duncan, & Chin [2007]; Hemelo-Silver, [2004]) and general strategies for enhancing deep understanding, (e.g., sequencing of instructional events and tasks (Schwartz & Bransford, 1998, Schwartz & Martin, 2004; Schwartz, Bransford, & Sears, 2005; Schwartz, 2008) may offer a more viable solution for improving far transfer of learning. While these approaches may entail more initial work on the behalf of trainers to construct the appropriate training materials, the long term benefits may warrant the effort.

The Army Institutional Environment

The Army institutional training environment is viewed as being "contained" within the external environment discussed above and comprises elements associated with training development and design and with instructor preparation and instructor integration with the institutional environment. In the area of training development and design, the first section below treats the status of training, especially with respect to dL, in proponent schools, media/technology concerns, and the status of learning science in general. The second section treats the Army's training available for institutional instructors and how those instructors fit into the institutional training environment.

Training Development and Design

In 1999, President Clinton issued Executive Order 13111 (President of the United States, 1999), which outlined a plan to "… make effective use of technology to improve training opportunities for Federal Government employees." President Clinton described a vision for achieving this goal through the collaboration of the military, government, private industry, and academia. In addition to describing broad programmatic goals, some general responsibilities were assigned to different government and military agencies. For example, the Department of Defense (DoD) was given the responsibility for developing standards of effective distributed learning, while the Department of Labor was tasked with establishing training technology websites.

Nearly ten years later, it has become apparent that, while there have been many strides towards realizing the vision outlined in the Order, in many ways the collaborative spirit of the order appears to be withering. The services within the DoD have worked independently, with little evidence of collaboration, to develop effective distributed learning (dL) programs. Within the Army, this responsibility has fallen largely to the Training and Doctrine Command (TRADOC). As the organization responsible for recruiting, educating, and training Soldiers, TRADOC is the logical choice to manage the Army's dL program. However, TRADOC as an organization has not participated in any extensive collaboration with non-Army organizations. TRADOC's not being listed on the Advanced Distributed Learning (ADL) website's list of DoD component offices (http://www.adlnet.gov/Technologies/adlr/ADLRDocuments/Component%20Proponent%20 Offices.aspx) is an indication that there are collaborative opportunities that have not yet been actively pursued.

This approach may be particularly troubling given the major challenge presented to TRADOC: preparing Soldiers for deployment on limited resources. Funding challenges in particular seem to have largely driven TRADOC's distributed learning policy. For example, TRADOC initially stipulated that for any hour of distributed learning developed, a corresponding hour of classroom instruction be eliminated (Marlow, personal communication, 2008). While this zero-sum approach is an effective cost-cutting measure (one of the advantages of distributed learning over classroom learning should be cost), it will only be effective in achieving the goal of providing the highest quality training to Soldiers if serious thought and consideration is given to the science of learning. Reducing classroom hours is an administrative challenge; doing so while maintaining, or even improving, training effectiveness is a formidable scientific challenge.

Even as a cost-cutting measure, TRADOC's approach may be non-optimal. While distributed learning should be a less expensive alternative to standard training through the reduction of manpower and logistical costs, it is possible that the Army could achieve even greater monetary savings by collaborating with non-Army organizations. Such organizations may have tools, infrastructure, and/or processes that could be reused or shared so that the Army does not spend money "reinventing the wheel." There is one notable exploitation of this potential: the Ordnance Corps' Ordnance Electronic Maintenance Training Department at Ft Gordon, GA, and the Navy Center for Combat Systems Unit at Naval Station Great Lakes, IL, utilize a common, off-the-shelf blended learning package for training basic electronics (G. Holshouser, personal communication, 2008). TRADOC has issued Army-wide dL directives that do not mention collaboration with non-Army organizations. For example, the purpose statement in ALARACT 126/2007 (Department of the Army, 2007a) describes the need for an Army-wide process for developing, managing, registering, and delivering courseware. However, the process does not extend to include consideration of other services, industries or institutions. Executive Order 13111 initially tasked the Department of Labor with leading the effort to establish training technology websites. It is quite possible that failing to exploit non-Army dL efforts may result in unrealized return on investment.

Status in proponent schools. The budgetary constraints that TRADOC faces are real and formidable and emerge from the actual environmental conditions within which the Army is trying to develop and implement a distributed learning program. The purpose of this section of the report is to identify the status of current Army institutional training, and to provide comment on improving training effectiveness using distributed learning. The approach we promote contrasts with the zero sum approach described above, in which distributed learning and classroom learning are conceptualized as two distinguishable and separate parts of the same whole. Instead, we will describe a "blended learning" approach in which the *relationship* between distributed learning and classroom-based learning is emphasized rather than the distinction between them; the two reinforce and complement each other rather than replace each other. We believe this approach can help to save money while improving training effectiveness.

In the remainder of this section, we present our findings across seven training installations from interviews designed to assess the current state of Army institutional training. Based on these findings, we provide recommendations on how to improve institutional training by implementing a blended learning approach. These recommendations are based both on our findings as well as the perspective and expertise of the extended research team with their knowledge and experience in blended learning pedagogy, training development, and institutional training.

Our interview results describe the current state of Army distributed learning. Our main finding is that the program is lacking many of the basic capabilities and services required, and therefore hampers those involved in dL from exploring or implementing state-of-the-art approaches to training development, delivery, and management. We explore this finding through a number of common themes that emerged from our schoolhouse interviews, which are presented briefly here and then discussed in detail in our conclusions.

Schoolhouse interviews. Researchers travelled to seven Army training institutions to conduct interviews with a variety of personnel involved in distributed learning. The institutions were:

- Army Field Artillery School, Ft Sill, OK
- Army Medical Training Center, Ft Sam Houston, TX
- Army Intelligence School, Ft Huachuca, AZ
- Army Signal Center, Fort Gordon
- Army Maneuver Support Center, Fort Leonard Wood
- Army Aviation Center of Excellence, Fort Rucker
- Army Combined Arms Support Command, Fort Lee

Each visiting research team consisted of two or three interviewers with expertise in training and education and military service. This combination of backgrounds provided the pedagogical and operational expertise required to address the many aspects of the training problem. This approach of combining the technical expertise of training and education with the practical experience of those who have served in the military created an atmosphere which allowed for a free exchange of information among the interviewers and interviewees.

Interview materials. The research team developed a questionnaire to guide interview discussion (see Appendix A). The intended use of the questionnaire was not to provide a strict procedure of when to ask which questions, as certain questions would not be applicable to all interviewees. Rather, the questionnaire was intended to be used as a guide for interviewers to ensure that they were addressing key topics within the course of the interview discussion. These topics focus on course development, course evaluation, and general lessons learned.

Participants. In general, participants represented a wide range of backgrounds including training development, management, administration, and contracting. Participants were self-selected based on their availability when the research team was on post. The team interviewed anywhere from one to eight participants at any given schoolhouse.

Procedure. Interviews were conducted at convenient locations for the interviewees at the training institutions. In some cases, interviews were conducted in classrooms or conference rooms. In others, interviews were conducted in offices or common seating areas. The length of the interviews depended entirely on the availability of the interviewees. Several interviews lasted approximately 30 minutes, while others lasted two hours, or even over the course of a day (in cases of group discussion). Interviewers recorded notes in real-time via laptop computers or handwritten notes.

Interview results. Analysis of the interviews resulted in a number of common challenges facing Army dL programs. These challenges affected all of those involved in dL, from administrators to instructors to training developers to contract administrators. These themes are presented below and then discussed in greater detail independently.

- The Army is facing basic technological issues that impact the dL program.
- The Army is facing basic pedagogical issues that impact the dL program.
- The Army is facing basic organizational issues that impact the dL program.

The Army is facing basic technological issues that impact the dL program. Perhaps most crucial to a successful dL program is the necessary infrastructure to support the program. Two of the key functionalities that the infrastructure supports are 1) the student's ability to access material, and 2) the instructor's ability to update material. This is a most basic and fundamental need, yet it has not been satisfied in current Army training institutions. The consequences of a inadequate infrastructure are both immediate and far-reaching. Just as it is theorized that human beings must meet basic needs (food, security) before achieving higher-level ones (e.g., self actualization) (e.g., Maslow, 1943), a dL program's ability to achieve higher-level goals depends on its ability to first achieve basic ones. Because the basic infrastructure is not in place to support basic dL infrastructure needs, Army training institutions have not had the opportunity or the resources to address higher-level training issues such as training evaluation, theoretical training approaches, appropriate media selection, and so on.

In any dL environment, one key component of a solid infrastructure is system response time, or the end-user's perceived time lag between input and completed response. In general terms, system response time for on-line dL has three components: client (local PC) processing time, transport (network) lag, and server processing time. As system response time worsens, end-users experience longer and longer times for their inputs to be acknowledged and for pages to update or download.

Interviewees repeatedly cited system response time as being a major restriction on their ability to not only deliver dL, but also to develop it. The immediate effect of increased system response time on delivery (e.g., slowed or failed delivery) is somewhat obvious. Many trainees find that they have better response times outside classroom hours at their homes than when they are in schoolhouses. One reason for this may be that the current infrastructure is such that all servers for dL are based out of a single location, Fort Eustis. As such, Fort Eustis's servers are being accessed by all military personnel seeking dL. This strain on the system often results in very slow loading times. Interviewees described that during peak hours (usually after 1000), loading times through the ALMS can be extremely slow (they recall instances of ten minute loading times for a single page). Furthermore, if Fort Eustis experiences any problems at their facilities, the entire Army suffers. Interviewees recalled a time when Fort Eustis closed during severe weather, and no Army installations were able to conduct regular dL training.

However, the effect of long system response time on training development has an unexpected and far-reaching consequence. Interviewees described that they intentionally develop training in a different way than they would actually want to, just to develop a product that works. In other words, developers are being forced to make tradeoffs between pedagogy and functionality. For example, training media selection is sometimes compromised when more sophisticated media (videos, simulations), though desired and pedagogically appropriate in certain situations, are not selected because developers know that on-line training using real-time interactions and extensive downloaded content will become frustrating to the learner under conditions of long system response time. As a result, some interviewees felt obligated to develop simple "page-turner" courseware because it has the best chance of running properly.

In addition to system response time considerations, there are other factors that affect a student's ability to access training. For example, the student may not have a computer at work, or may not have permissions to install the software or some component to run the distributed learning material. If the material is web-based, the student may not have permissions to the site where it is located due to AKO security, or may not be able to find it easily or repeatedly. The material may have been created using a program that is no longer compliant with current web browsers. Additionally, the local Department of Information Management (DOIM) may place additional restrictions on websites or firewalls that prevent the student from accessing supplementary material on the internet. This last example was repeatedly discussed during interviews. For example, at one time, students at Fort Sam Houston were not able to search for sites using the terms "anatomy and physiology" even though they are studying medicine.

A second critical component of dL infrastructure is a Learning Management System (LMS). A LMS is responsible for managing and delivering training as well as tracking student progress and results. The Army is developing the Army Learning Management System (ALMS) to function as its own LMS. The ALMS has undergone several changes, and continues to do so. Interviewees expressed major dissatisfaction with previous and current versions of the ALMS.

Interviewees described how, in the past, both contractors and in-house developers often submitted courseware that failed ALMS compliance testing by the Army Training Support Center (ATSC) even though they had developed courseware to specifications. There were instances when courseware passed SCORM[1] 2004 compliance testing, but failed ALMS testing. Interviewees were encouraged that the Army recently agreed to add Blackboard to its list of approved systems to work with the ALMS. As an established LMS, dL developers have found that Blackboard is much more successful delivering courseware (already an improvement over the ALMS) and even promotes some collaboration functionalities, both among trainees and between trainees and trainers. To the extent possible, developers want to capitalize on Blackboard because of its reliability.

Instructors also suffer from basic infrastructure shortcomings. Instructors update their courses every time they teach the information. They are constantly learning from each other about which techniques worked well to explain a concept and which did not. They are also adapting to new doctrine as it is published, such as FM 3-0, Operations (Department of the Army, 2008). FM 3-0 has had a significant impact on the students in the Field Artillery Captain's Career Course, yet the instructors who teach the distributed learning portion to the reserve component do not have the ability to easily update or change the material. Therefore, they must commit part of the reserve component two week resident portion of the course to help the students "unlearn" the old concepts and grasp the new ones.

In sum, the lack of adequate infrastructure has both immediate and far-reaching consequences for the dL program. Long loading times or failed delivery negatively impact the training experience. Furthermore, dL developers restrict their pedagogical approaches based on expected delivery failures. Lastly, for instances in which training is developed and delivered, there is no simple and efficient way to update existing training material.

The Army is facing basic pedagogical issues that impact the dL program. An effective dL program requires not just the necessary technology, but also the necessary pedagogy required for effective training. It appears that much of the guidance given to instructors and training developers has been in the form of policies rather than education. The consequence in some cases is that reaction to the policy inhibits education on pedagogy.

As described above, TRADOC has gravitated to dL in part because of the potential for cost savings during a period of financial strain. Some costs are reduced by eliminating the logistical costs of transporting units to training installations, including providing transportation, lodging, and food. However, some costs are also reduced by reducing instructor hours. Recall

[1] Sharable Content Object Reference Model

that TRADOC mandated that a dL hour gained should correspond to an instructor hour eliminated. Consequently, many instructors feel threatened by dL in a number of ways.

First and foremost is the threat of job loss. While eliminating jobs is not always a goal when implementing a dL program, instructors are aware it can be an unintended side effect. The perceived threat of job loss is clearly not going to endear dL to some instructors. Second, instructors may feel put upon by having others tell them how to run their course. Instructors expressed that they have invested significant time and thought into their curricula, and the demand to do things differently may not be well-received.

Compounding the perceived threats dL presents to developers, designers, and instructors is the lack of guidance and education they have received on dL in general and the lack of guidance on how to incorporate it into their classes. Without any guidance and education, few see how they might use dL to their advantage in a course, for example as a remediation tool or as preparation for a subsequent classroom exercise, especially in cases where classroom time is reduced. Instead, in order to satisfy the dL mandate, they often assign lower priority topics to be developed into dL. These topics tend to address human resources issues (sexual harassment, for example) rather than focal points. This reinforces the "zero sum approach" in that it emphasizes the distinction between what is taught via dL and what is taught in the classroom rather than the potential relationship between the two. But furthermore, it may negatively impact student perceptions of dL if they are aware that the types of topics that are taught via dL may not be very highly valued.

If instructors are not receiving education on incorporating dL into their classrooms, they could consult with in-house dL specialists. However, instructors are sometimes unaware of the support that is available to them. If they do become aware of the in-house services and seek out personnel, they are often unprepared for delivering the materials that in-house personnel require to develop dL. Instructors seem to think that the same personal computer (PC) presentation slides that they use for lectures can be used for dL. In-house personnel must then explain how instructors will not be present to "talk to the slides", and must therefore adhere to certain formats and standards (e.g., writing out learning objectives, key teaching points, etc.) that promote asynchronous learning.

In many instances, creating the distributed learning product has not followed the traditional TR 350-70 (U.S. Army Training and Doctrine Command, 1999) approaches. The training developers have not built the storyboards or determined how the dL product will fit into the overall training plan for the target audience. Often a desire to have the latest technology, or Level 4 interactive multimedia instruction, increases cost with little demonstrated benefit. Instructors at Ft. Sill indicated that one highly interactive product allowed the student to practice interacting with an aiming circle, and this was very helpful as part of the overall instruction. They contrasted that with another program that was to help commanders with training management, and the program replicated a commander's inbox. While aiming is critical in the first example, dealing with your inbox is only a small and minimally relevant aspect of training management. Some tasks are better reinforced through practice, but the subject matter or method of interaction can make those tasks tedious or less effective, thereby reducing the overall value of the dL product.

Instructors do not have a good understanding of the requirements to develop distributed learning. At Ft. Sam Houston, they will often provide a set of slides without any additional material to the training development group. They are not aware of the need for the training development to be done in painstaking detail, because when the product is being delivered, an instructor will not be able to clarify questions the student might have. Many instructors have not received much training in TR 350-70's traditional training development processes, and while they have the requisite subject matter expertise, they sometimes balk at the suggestions of the training development community.

In sum, Instructors always aim to update their courses to provide the most effective training possible. In addition to facing technological challenges to updating their materials, they face pedagogical challenges as well due to the lack of training they have received on incorporating dL into their classrooms.

The Army is facing basic organizational issues that impact the dL program. There are organizational challenges that are preventing an integrated approach to distributed learning. Because training developers, information technology specialists, and subject matter experts all typically belong to different organizations and have demands independent of their consideration of distributed learning, it is difficult to form and maintain a team of individuals who represent the various stakeholders who could influence a change in the approach to distributed learning.

Distributed learning requires a multifunctional team that includes TRADOC leadership, government contracting administrators, instructors and subject matter experts, training developers, training delivery specialists, graphic artists, computer programmers, and a multitude of infrastructural-focused information technology specialists at various installations. Organizing a team with numerous stakeholders is a difficult undertaking. However, internal processes, with their own inherent frictions, can further obscure the possible solution space.

Leaders have not seen an example of how distributed learning has quickly provided the Soldier the knowledge, skills, or abilities he needs to measurably improve performance. For this reason, many are skeptical of the value of distributed learning. GEN Wallace, at the Army Training Support Center (ATSC) conference on distributed learning in March of 2008 stated, "I am neither a proponent nor an opponent of distributed learning." Some leaders view distributed learning only as a method of reducing classroom time rather than an additional means to convey concepts to students to maximize the value of the classroom instruction time. This limited view of distributed learning only exacerbates the decision making process. With regard to distributed learning, decision makers are more likely to consider the impact on the workload, the desires of their bosses, or their own experience with distributed learning products over the most practical or effective approach to learning.

TRADOC branch proponents are suffering from a lack of manpower to manage, participate in, and validate distributed learning projects that have been contracted to civilian companies. In the same way the impoverished technological infrastructure can have far-reaching consequences for dL (e.g., in affecting training media selection, as described above), so too can personnel components of infrastructure. Manpower shortages often place major burdens on current government contract administrators. They must monitor more contracts than is optimal, and consequently cannot devote the appropriate attention to any single project. Furthermore, a shortage of subject matter experts (SMEs) places the government at a disadvantage. SME's are required throughout the process to ensure that the contractor has the necessary government furnished information and is providing the desired product. They must review and contribute to dL development in order for a product to be integrated into a broader program of instruction. During a dL contract, the government and the contractor will typically agree to a detailed delivery schedule that includes cycles of Alpha and Beta reviews of courseware. If the government cannot (a) review the work in the agreed upon timeframe, or (b) review the work in great enough detail to provide quality feedback, then the contractor has grounds to proceed with development and delivery even if the government is not satisfied with the quality of the product. In combination with an ill-conceived dL subject, the contractor may deliver a product that is useless. One contracting officer at Ft. Sill indicated that while a company was developing a dL product for the Advanced Field Artillery Targeting and Direction System (AFATADS), the AFATADS program underwent two software upgrades, one of which had significant impact on the user interface. This resulted in a product that was instantaneously obsolete. Straus, Shanley, Burns, Waite, and Crowley (2009) present a more detailed analysis of issues surrounding dL contracting and assessment of dL products.

Training media selection. Training media that work well for traditional classroom learning may not always translate well into a distance learning environment. A basic approach to this selection criterion is to involve the school and appropriate personnel to determine what material cannot be taught via dL, rather than to decide what can be taught using dL. Application of this method will result in a blended learning environment which will accommodate for material that is most effective when delivered through residential classroom instruction and material that is compatible with the distance learning mode of delivery.

There are several potential advantages and disadvantages of traditional classroom learning and distance learning. Advantages of traditional classroom learning can include immediate feedback, familiarity of this approach to students and instructors, motivation to students, and cultivation of a social community (Zhang, Zhao, Zhou, & Nunamaker, 2004). On the other hand, disadvantages of traditional classroom learning can include being instructor-centered, time and location constraints, and higher costs. The potential advantages of distance learning include being learner-centered and self-paced, being flexible with regards to time and location, potentially being available to global audience, providing unlimited access to knowledge resources, and archival capability for knowledge reuse and sharing. Alternatively, disadvantages of distance learning can include the lack of immediate feedback in asynchronous e-learning, increased preparation time for the instructor, and the fact that dL is not familiar and comfortable to some people, which could bring about frustration, anxiety, and confusion.

In order to select the appropriate delivery medium, course designers must identify the required instruction methods for the learning objectives and the medium that can be the most cost effective for delivery (Abell, 2007). When doing so, course designers should consider the appropriate training delivery at the learning module level rather than at the course level (Quinkert, Morrison, Fletcher, Moses, Roberts, 2007). Three criteria for considering whether instructional material could be delivered through distance learning or on-site/residential learning include:

1) If sensory input, beyond audio and visual, is necessary (i.e., taste, touch, smell), a face-to-face environment is suggested
2) If complex conditions are required for instruction and electronic multimedia cannot depict the complexity of the conditions, a face-to-face environment is suggested
3) If an instructor must observe, evaluate, and provide feedback to a learner who is engaged in whole-task practice of a complex task, distance learning can be used if it allows synchronous observation of the learner and audio and visual feedback.

In the case when either environment could be effective, the course designer should account for motivation, media compatibility, and technology feasibility and utilize the four-step process below to capitalize on the best media for the type of learning environment (Yelon, 2006):

1) Think about purpose and strategies of training methods.
2) Assess motivation to restructure instruction.
3) Check media compatibility.
4) Account for resources.

After selecting the method to deliver the training, whether via school house or dL, the training media to deliver the instruction should be selected. There is very little evidence that supports the notion that some media are better than others for delivering training (Clark, 2001). In contrast, research suggests it is the quality of the instructional methods employed that most influences learning. Therefore, it is important to match the appropriate training media with a compatible instructional strategy.

There are several types of training media that could be utilized for both in-classroom instruction and DL. For in-classroom instruction, trainers may consider four traditional modes of media: print, audio, television, and computers (Holden & Westfall, 2005). With each medium there are strengths, weaknesses, and types of instruction in which specific media are most effective. Table 4 summarizes the strengths, weaknesses, and the types of appropriate instructional strategies and deliveries for the four traditional modes of media (Holden & Westfall, 2005). This table can be used to determine the conditions under which to use the designated media type.

Table 4
Properties of Traditional Media (adapted from Holden & Westfall, 2005).

Media	Characteristics	Strengths	Weaknesses	Interactivity	Instructional Strategies	Type of Deliveries
Print	• Augmented through use of multimedia • Instructor feedback can be facilitated via e-mail • Self-paced	• Do not rely on any technological infrastructure for delivery • Can reach widely dispersed students • Inexpensive representation of static visuals	• No instructor-to-student interaction • Limits instructional strategies that can be employed • Content changes, course update can be slow and time-consuming	Asynchronous	• Lecture • Case studies • Drill and practice	• Correspondence • Computer-based instruction • Web-based instruction
Audio	• Interactive environment between instructor and students • Students from different locations can use telephones, audio conference equipment	• Instructor-to-student interaction • Most effective when integrated with other media (e.g., printed text or graphic)	• Difficult for students to remain engaged • Limited to oral interaction only • Does not support visuals	Synchronous	• Lecture • Guided discussion • Case studies • Panel discussion • Demonstration • Drill and practice • Role playing	• Teleconferencing
Television	• One-way • Full motion video and audio transmission of classroom instruction	• Ability for live classroom environment • Not constrained to a specific media • High levels of synchronous oral interaction • Immediate feedback	• Special training of instructor • Satellite equipment needed for live classroom • Developmental and maintenance costs	Synchronous	• Lecture • Guided discussion • Case studies • Panel discussion • Demonstration • Drill and practice	• Instructional television • Video conferencing • Video teleconferencing • Recorded video
Computer	• Computer provides majority of the stimulus and the student responses • Self-paced	• Display large amounts of visual and aural information • Full-motion video and high resolution graphics • Students control pace • Students get immediate feedback to reinforce learning outcomes	• Instruction can be affected by bandwidth • No instructor-to-student interaction • Developmental and maintenance costs	Interactive, but not synchronous	• Lecture • Case studies • Demonstration • Drill and practice • Role playing • Tutorials	• Computer-based instruction • Web-based instruction

There are several modes of training media for dL instruction: classroom training, web-based training, computer-based training, webinars, websites, video, simulations, and chat and discussion communities. In addition to these different training media, traditional media used for classroom instruction may be used for dL (Simonson, 2007). Table 5 below is a description of each type of training media.

Table 5
Description of Training Media Used for dL

Type of Training Media	Description
1. Classroom training	Training delivered in the classroom.
2. Web-based training	Training delivered over the Internet.
3. Computer-based training	Training delivered through a computer program.
4. Webinars	Live meetings or presentations delivered over the Internet.
5. Websites	Documents accessible via the Internet.
6. Videos	Series of framed images put together in sequence, one after another, to simulate motion and interactivity.
7. Simulations	Computer programs used to simulate real or imaginary scenarios.
8. Chat and discussion communities	Synchronous and/or asynchronous electronic communications in a chat room or online community.

Each of these modes of media serves a different purpose for schoolhouse instruction and dL. However, the optimal approach to accommodate the training needs of instructors and learners is to provide all modes of media. This method, while most effective, is not always available. Additionally, as indicated in Table 6, access to all forms of media may not always be the most cost effective. When selecting training media, the following criteria should be considered:

- Cognitive processes necessary for trainees to acquire the task performance that is the target of the training (Sugrue & Clark, 2000).
- Attributes that can support the type, amount, timing, and control of methods selected for the training (Sugrue & Clark, 2000).
- Economical and convenient set of media that possess all of the required attributes (Sugrue & Clark, 2000).
- Bandwidth connectivity. Some students or training environments may be in remote locations without high bandwidth, therefore some content will not run (Bersin and Associates, 2003).
- Browser versions and plugins. Students may have different browsers and plugins so content standards must be set which specify browser version, plugins, bandwidth, memory, and CPU speed needed (Bersin and Associates, 2003).

Table 6
Instructional Value and Development Architecture of Training Media (adapted from Bersin and Associates, 2003)

Type of Training Media	Instructional Value	Time to Develop	Cost to Develop	Cost to Deploy	Assessment Capability
Web-based training	High	4-20 weeks	High	Low	High
Computer-based training	High	6-20 weeks	High	Medium	High
Webinars	Medium	3-6 weeks	Low	Medium	Low
Websites	Low	1-8 weeks	Low	Low	None
Video	High	6-20 weeks	High	High	None
Simulations	Very High	8-20 weeks	High	Medium	High
Chat and discussion communities	Medium	4-6 weeks	Medium	Medium	None

To select the appropriate training media and delivery methods for the intended task and audience, course designers should know the target audience's ability to access the Internet, consider their knowledge, skills, and ability to be trained, know which skills are trained better by specific media, and be cognizant of relevant training research (Wampler, Dyer, Livingston, Blackenbeckler, Centric, & Dlubac, 2006). Given the limited infrastructure and bandwidth found in many Army training environments, the delivery method and training media should be selected to work effectively within these constraints.

Current and emerging training technologies: games. A gaming approach to training is certainly not a new concept for the Department of Defense (DOD) community. The military has been incorporating gaming technology into the curriculum for about 30 years, beginning with the introduction of "Mech War" by Jim Dunnigan in the late 1970s to the Army War College. Currently, gaming and simulation are part of the curriculum of every U.S. war college and part of the operations of every command headquarters (Herz & Macedonia, 2002). The Marine Corps started with "Doom" and switched to "Operation Flashpoint." The Army included "Spearhead" and other games into the Armor School curriculum. "Full Spectrum Command", developed by the Institute for Creative Technologies, is used in the Infantry Captain's Career Course at Fort Benning. "Steel Beasts" is being used at the U.S. Military Academy, and the Navy introduced "Fleet Command" at the Naval Academy.

Anecdotally, training developers and administrators alike have supported the notion of using games for training because of the technology's appeal to this generation of Soldiers. There is some scientific evidence to suggest that games can be used as an effective training technology. For example, evidence suggests that presenting training in a game format engages learners and consequently increases the effectiveness of the training, including a 15-20 percent improvement of retention in certain cases (Belanich et al., 2005; Gopher et al., 1994; Prensky, 2001;).

In addition to being familiar and appealing to many of this generation of Soldiers, games do have the ability to recreate some of the conditions of today's network-centric warfare challenges, such as the robust networking of geographically or hierarchically dispersed forces. Massive Multiplayer Online Gaming (MMOG) provides trainees with practice in forming and managing large communities of participants, developing communication and collaboration networks, and re-organizing in order to handle new developments. In fact, in their review of games and simulations studies, Bonk and Dennen (2005) report that individuals who are attracted to MMOG are motivated by some of the key factors critical to success in network-centric operations: competition, collaboration, and potential affiliation with a global network of other players. The benefit of MMOG compared to a single-player gaming approach is that it forces participants to interact with each other in constructive ways, teaching collaboration, communications, and organization skills. Leung et al (2008) provided evidence that an MMOG- style training event could be used to provide immersive, web-based training to distributed participants to teach them organizational structure and navigation, information management, and interagency interaction.

Games also have the ability to integrate with or simulate weapons and equipment that require digital skills and technical knowledge to operate. Schaab and Dressel (2003) provided insight on the type of technological training Soldiers (in this case, operators of Army Battle Command System (ABCS) at Fort Lewis, Fort Hood, and Fort Bragg) view as most productive in developing expertise. Soldiers expressed a desire and need for more training that would allow them to integrate their knowledge of digital systems with their Army role. They also expressed willingness to use gaming technology to advance their training. Based on these and other similar findings, changes have already taken place. For example, Fort Huachuca is now integrating games with simulations of realistic missions into their training curriculum as much as possible, to allow Soldiers to receive hands-on training in a realistic setting.

Despite the appeal of training with games, there are still important scientific questions and practical challenges that need to be addressed. Most importantly, there is currently no consensus on what types of skills games are best used to train, nor is there convincing scientific evidence demonstrating gains in training effectiveness when using games over other training technologies. A potential drawback of using games for training is the cost of developing high-end gaming technology. If the Army were to invest in several gaming development efforts, which would certainly cost millions of dollars at least, it would be important to demonstrate training gains relative to simpler interactive or even didactic technologies. It is also possible that some of the training time when using games is used inefficiently. For example, Chen (2003) argues that excessive difficulty in learning the interface of the game and its rules may actually counter its value as a tool to train the skills of interest. In his research, Chen examined the usefulness of various tutorial techniques used in current commercial off the shelf (COTS) computer games in helping novice players reach an acceptable level of skill, which enabled them to play the game effectively. In addition, he investigated how instructional media (i.e., game tips and computer-based tutorials) affect the acquisition of basic computer game-playing skills. The results of the research demonstrated that depending on the game being learned, different instructional techniques should be utilized. For example, games that involve maneuvering and actions would require different instructions than games with predominantly cognitive components. This is just one example of the type of research that is required to fully determine when and how this promising technology can live up to its training potential.

Incorporating SMEs into training development. In order to ensure the selection of the most appropriate training methods and media in dL course design, it is critical to receive input from a variety of contributors. There is no one person that possesses all the skills to develop and deliver a distance-learning course. Therefore, SMEs, instructional designers, and media specialists are essential for every team (Simonson, 2007). SMEs play an important role in the instructional system decision process. They provide input on perspectives of different users and skill levels as well as knowledge about lessons learned from real-world operations. All this information could and should be incorporated in the design of dL courses. In addition, in the Army context, SMEs ensure that current doctrinal information and procedures are included in the training design, and correct military terminology is being used. They may also suggest potential uses and benefits of the system that might not be recognized by the course designer. Keeping in mind the benefits that SMEs could bring to the design process, collaboration between them and instructional designers is essential to the development of effective training.

Typically, SMEs are experts in a certain training topic, whereas course designers are experts in training development. Most likely, it would be difficult for a SME to play the role of a course designer and develop dL training modules. However, there are authoring tools such as Adobe® Captivate®, Camtasia®, Articulate®, and various Learning Content Management Systems that may help SMEs in the development of dL modules. In combination, these products provide tools to create SCORM-compliant e-learning modules, interactive content, videos, assessments, feedback, and surveys. Table 7 displays features the authoring software offers.

Table 7
Features of authoring software.

Type of Authoring Software	Overview	Interactive content	Videos	Assessments	Surveys	SCORM-compliant
Learning Content Management Systems	Provide rapid creation of e-learning modules and ability to reuse content for other courses	X		X		X
Adobe Captivate	Provides rapid creation of simulations, scenario-based training, and quizzes without programming knowledge or multimedia skills	X	X	X		
Camtasia Studio	Records screen captures and audio for video and scenario development	X	X			
Articulate	Provides rapid creation of e-learning modules from PowerPoint, quizzes, assessments, and surveys	X	X	X	X	X

These tools can serve as an interface between SMEs and course designers to help involve SMEs in the development process by transforming the knowledge content from SMEs into robust and interactive dL modules. However, to effectively integrate SMEs into the design process, it is necessary to teach them how to use the authoring tool. This could be done through one-on-one training with a course designer, self-paced web-based course, online seminars, or classroom training. Once SMEs are trained, the course designer could choose from two approaches to developing the training program: the individual approach or the team approach. The individual approach provides SMEs the authority to capture content for dL courses and the course designers to edit and enhance that content. Alternatively, the team process requires SMEs and course designers to work together on creation of storyboards and scripts prior to the capture of content by SMEs. With either process, utilizing authoring tools improves the cycle time for developing training program and reduces the number of iterations between SMEs and course designers.

With either process, course designers and developers should be aware that many times SMEs may inadvertently omit information which to them may be incidental or even automated (Clark, Feldon, van Merrienboer, Yates, and Early, 2007). The example authoring tools given above do not avoid the need for some sort of knowledge elicitation or validation function that will mediate this problem.

Considerations from learning science and technology. Any appeal to learning science and technology begs the question of whether Army institutional training can be made significantly more effective. The Army has been in the business of training Soldiers for decades using, in general, much the same instructor-led lecture training methods that are traditionally associated with public education. The issue arises: is there evidence to support the assumption that the effects of this training can be improved, and, if so, even more importantly, is the improvement of a significance that would warrant changing Army training? This is not a trivial question: in a similar learning environment, Dubin and Taveggia, as late as 1968, concluded, after an extensive re-analysis of more than 100 studies of college teaching methods, that there was no compelling empirical evidence to prefer one over another.

Although there have been since Dubin and Taveggia's caution numerous reassuring quantitative observations of the results of numerous modifications to conventional instruction, one of the most cogent and well-known was made by Bloom (1984). Bloom and his colleagues investigated the effects of conventional classroom instruction versus tutoring upon achievement measures for a given subject matter. On the final achievement measures, the average tutored student's performance was about two standard deviations above that of the average conventionally instructed student. In reporting this and other similar supporting studies, Bloom noted that the results indicate that (a) alternatives to conventional instruction can produce an effect as much as "2 sigma" (two standard deviations) above conventional instructor-led classroom instruction and (b) this effect can be achieved by the average student. The general implications for Army institutional training parallel Bloom's notes: (a) given the potential pay-off in effectiveness, it is reasonable for the Army to investigate alternatives to conventional instructional methods and (b) it is reasonable to assume that the effectiveness gains will apply across all Soldiers.

It goes without saying that Army institutional training is not resourced to provide a personal tutor for each Soldier – any changes to training must, at least initially, fit reasonably within the current training constraints and environment. Thus, although the Army can, in pursuit of something similar to Bloom's "2 sigma" effect, turn to learning science for solutions, the application of that science is perforce restricted to and constrained by the Army's institutional training environment. For example, learning science principles specific to public school grades K through 6 may be of questionable applicability to the Army school population of adult learners aged 18 and older. Similarly, implementation of some learning science principle involving continuous monitoring of some physiological variable, such as eye movements, would be of no direct use in the Army institutional training environment. In the considerations below, a conscious effort has been made to present findings against the background of the Army institutional training environment.

Summaries or snapshots of the status of learning science appear from time to time for education and learning in the public school system (e.g., Bransford et al., 2000) and also within the military context (e.g., Driskell et al., 1995; Curnow et al., 2006). From these and similar works, it becomes evident that within the science of learning, there are several principles of learning about which nearly all researchers are in agreement, and there are several theories of learning about which there is considerably less agreement.

Merrill (2002) makes the assertion that, theoretical viewpoint notwithstanding, there are principles of learning that obtain "regardless of the instructional programs or practices involved." Merrill claims these principles of learning have been reliably demonstrated in learning research literature to facilitate learning, and further hypothesizes that the effectiveness of any approach to learning will be affected to the extent that the approach incorporates all these principles. Merrill's principles are outlined in Table 8 below. As might be expected, most learning theorists agree with all the principles; the disagreement arises in their interpretation and implementation.

Table 8
Principles of Learning (adapted from Merrill, 2002)

Problem	The learner must be engaged in solving real-world problems associated with the learning goals. The problems must have a range of difficulty. The learner must explicitly compare problems one with another
Activation	The learner must activate applicable knowledge from past experience for use as a foundation for the new knowledge
Demonstration	The learner must be shown rather than told and must be shown multiple representations of the problem. Demonstrations must be relevant to the learning goals and must direct the learner to relevant information. The learner must explicitly compare alternative representations.
Application	The learner must use the new knowledge to solve problems consistent with the learning goal. The learner must be guided by coaching that is gradually withdrawn and must be shown how to detect and correct errors.
Integration	The learner must verbalize and demonstrate the new knowledge or skill. The learner must generate new, personal ways to use the new knowledge or skill.

Although he purports to be more pragmatic than theoretical (personal communication, 2008), Merrill maintains that, to be successful, any theory of learning must account for all five principles.

Merrill's pragmatism is no doubt driven in part by there being no single consensual "Grand Theory" of learning (cf. Duchastel, 1998; Jonassen, 2003). However, there has been through the 20^{th} century a progression of general paradigms of learning that can be characterized as roughly paralleling that of the progression of theories and models of general psychology. Mayer in 1996 outlined this progression as three "metaphors":

- 1900s – 1950s: Behaviorism
- 1960s – 1970s: Information processing
- 1980s – present: Constructivism

with information processing and constructivism both arising from cognitive psychology. Others (e.g. Clark in Quinkert et al., 2007) propose similar categorizations, although with some variation in category labels. An abbreviated characterization of the three appears in Table 9 below. Mayer (1996) was careful to point out that the progression is cumulative in the sense that no earlier metaphor has been completely replaced by a later metaphor. As Kirschner, Sweller, and Clark argue as late as 2006, there is still lack of consensus within the field of learning theory that "constructivism" has displaced "information processing" as a more effective model of learning -- Kirschner et al. forcefully argue the case that "constructivism" is still at best an unproven alternative contemporaneous with "information processing."

Kirschner et al.'s 2006 paper echoes the discussions currently taking place in learning theory. Arguments, theoretical and empirical, abound as to the relative effectiveness of the three, with the majority of discussion addressing the merits of an information processing viewpoint compared to a constructivist viewpoint. As background to an understanding of the current state of learning science, some of the specific tenets of the information processing and the constructivist viewpoints are given in Table 9 below.

Table 9

Characterization of Mayer's (1996) learning "metaphors"

	Behaviorism	Information Processing	Constructivism
Philosophy	"Learning" is manifested in specific recurring behavior under specific conditions. Recurrence of behavior depends on the quality of its immediate consequences.	Meaning/knowledge is present in and extracted from the environment; it can be selectively stored in memory (learned) and retrieved.	Meaning/knowledge is cumulatively constructed by the individual as result of actively making sense of problems within the environment
Instruction function	Supply consequence when learner emits specific behavior under specific conditions	Actively guide student's processing of well-structured information	Facilitate student's construction of meaning/knowledge as necessary during sense-making activity
Learner role	Strengthen association between specific behavior and specific conditions	Actively select and encode information for subsequent retrieval	Actively construct and assimilate individual version of information relative to problems
Learning outcome	Specific behavior reliably recurs in response to appropriate conditions	Learner can at will retrieve the learned information.	Learner can autonomously make sense of problems
Learning assessment	Observe likelihood of learner emitting specific behavior in response to appropriate conditions	Observe degree to which learner accurately retrieves information presented in instruction	Observe ability to make sense of problems similar to those encountered during learning

The information processing "metaphor" . As mentioned above, the information processing point of view is based in cognitive psychology. The structure typically espoused is based on Baddeley's (e.g., 1992) elaboration of Atkinson and Shiffrin's 1968 sensory store – short term memory – long term memory model and on Miller's 1956 work in short term memory capacity and unit of processing. The processes typically espoused involve:

1. Attending to and selecting relevant information from sensory memory into short term memory.
2. Organizing the information in short term memory into some sort of meaningful whole
3. Connecting the "meaningful whole" in short term memory to some knowledge structure already existing in long term memory.

Short term memory processing. Miller's capacity results are applied to the short term memory construct: it is posited that short term memory has a capacity of, at best, an average of seven items, or, at worst, an average as low as four items (Cowan, 2001; cf. Unsworth and Engle, 2007). Items in short term memory may be selected from sensory memory and may also be retrieved from long term memory. Because these items of information must be held in short term memory for some amount of time as they are being organized, it becomes critical that the processing capacity of short term memory not be overloaded by either (a) the rate at which items are presented via sensory memory or (b) the number of items that must be simultaneously held while being organized in short term memory . The learner is assumed to control the short term memory items drawn from long term memory, but if the presented load from sensory memory exceeds short term memory processing capacity, then some items are in some manner "missed" and learning becomes less effective.

Since short term memory capacity is perceived as a bottleneck to the model, considerable attention (e.g., Sweller, van Merrienboer, and Paas, 1988) has been devoted to that aspect of the information processing model. All information arriving at sensory memory must be in some manner sorted by the learner so that the relevant may be attended to and submitted to some sort of information organizing activity. Researchers (e.g., Sweller, 1994) have classified the presented cognitive information load into three types: intrinsic, germane, and extraneous load. Intrinsic load refers to the load presented by the information that is to be learned. Germane load refers to the load presented by the information that serves to assist in assimilating the intrinsic load. And extraneous load refers to the load presented by the information that is irrelevant to the information to be learned.

Note that the intrinsic/germane/extraneous distinction is opaque to the naïve learner; absent any elucidating instructions from the external environment, all incoming information is potentially intrinsic to the learner. This implies that to the extent the instructor or training designer can, within the limits of short term memory capacity, direct the learner's attention to the appropriate (intrinsic) information, can optimize the germane information, and can minimize extraneous load, efficiency of the organizing function in short term memory should increase.

Long term memory processing. Similarly, the existing long term memory knowledge structure with which the learned information is to be integrated may not be obvious to the learner. This implies that to the extent the instructor can specify the long term memory knowledge to which the newly learned information is related, efficiency of retrieval of information from long term memory into short term memory and the transfer from short term memory to long term memory should increase.

Miller's (1956) unit of processing for short term memory is applied to the knowledge structures in long term memory. Similar to Miller's promotion of the idea of "chunking" in short term memory, the information theory approach appeals to the construct of a "schema" (cf. Bartlett, 1932) in long term memory. Learners in some meaningful way combine related items into a schema which then becomes an information item itself and available to short term memory. For example, by combining appropriate elements of information, learners may create a schema for the "quadratic formula,"[2] and then, in turn, use the quadratic formula schema as an information element in solving general quadratic equations.

At a high level, the more generalized course of learning is characterized as

1. Subject to short term memory capacity limits, information items from sensory store and/or schemata from long term memory are selected into short term memory.
2. The learner organizes the information into some meaningful whole.
3. The resulting product, a new schema or a modified schema, is associated with some knowledge structure already in long term memory.

Considerations relative to efficiency. From this general architectural and process model of learning, several principles enhancing learning effectiveness and efficiency can be derived:

- Organize learning to progress from simple elements to more complex elements
- Sequence learning in a logical order
- Avoid introducing too many new items at once.
- Use discretion in introducing explanatory or supporting material
- Allow the learner opportunity for reflection during instruction
- Point out relationships between the to-be-learned material and material already learned
- Accentuate the new items that are to be attended to during learning

[2] Generic form is: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. We will return to this result later on in a following discussion.

- Minimize extraneous distractions during learning

These principles remain the foundation of most information processing based approaches to learning. In addition to these principles, current approaches have accommodated additional features not directly derivable from the information processing model, such as casting learning in the context of problem solving and allowing for the cumulative effects of learning task repetition. Examples of current information processing approaches include:

- ISD/ADDIE (instructional systems design/analyze-design-develop-implement-evaluate) (e.g., Gagne and Briggs, 1973; Branson, 1975)
- GEL (guided experiential learning) (Clark, 2004)
- 4C/ID (four component instructional design) (e.g., van Merrienboer, Clark, and de Croock, 2002)
- Army SAT (systems approach to training) (U.S Army Training & Doctrine Command, 1999)

All these approaches adopt a position of all relevant information or knowledge being marshaled up and transferred or transmitted to the learner from the external environment via instructor, text, etc.

The constructivism "metaphor." While the information processing approach derives from a characterization of the process by which information or knowledge is input, the constructivist approach derives from a characterization of the internal structuring of knowledge. Constructivism holds that the learner, through purposeful, active experience with the environment, constructs his or her own personal representation of the to-be-learned material. This new construction is necessarily built upon and mutually supportive with the learner's own existing knowledge structures. The implication is, since each learner's existing knowledge structures are different, that, across learners, each learner constructs his or her own personal version of the to-be-learned knowledge (cf. von Glasersfeld, 1984). This process of cognitive construction can also be termed as one of "sense making" or cognitive dialectics. That is, the learning process is the process of cognitively assimilating and making personal sense of the to-be-learned material and of reconciling it with existing personal knowledge.

From the constructivist point of view, learning inescapably occurs within and is influenced by the social environment (von Glasersfeld, 1997); from this it can be inferred that, for the current Army institutional environment, learning is mediated not only by the instructor, but also by classroom peers. But, even though it is grounded in the social environment, it is, at the individual learner level, purposeful. The learner may engage in the learning process merely to pass an end-of-course exam, or the learner may engage in the learning process to gain an understanding of some concept. In either case, the learner has a purpose, and, more importantly, the purpose plays a determining role in how the knowledge is assimilated. The purpose of learning can be facilitated by its being cast in terms of being based or situated in some common referent or context (e.g. Cognition and Technology Group at Vanderbilt, 1993) or in terms of some relevant to-be-solved problem or task (e.g., Savery and Duffy, 1995). In the extreme constructivist point of view (cf. von Glasersfeld, 1984), the learner would be provided at most just the initial context or problem conditions and access to information relative to the context or to constructing a solution to the problem. Within this environment, the learner is faced with "making sense" of the situation or discovering solutions. As result of this increased cognitive activity, the learner is thought to gain a deeper, more elaborated understanding of the problem area. Ostensibly, as the product of such an instructional environment, a student faced with solving the "quadratic formula" (footnote 1, page 45) for the constant value *c* would have the deeper understanding that, since the quadratic formula is derived from the quadratic equation $ax^2 + bx + c = 0$, the solution can be directly found as $c = -ax^2 - bx$, thereby bypassing the more obvious but algebraically torturous route of deriving *c*'s value by working directly from the quadratic formula. Within the pure constructivist instructional environment, because the learner is to construct his or her own personal learning via interacting with the situation in a real world context, the instructor's role changes from one of direct instruction to one of at best indirect monitoring and mentoring of the learner's progress.

As Mayer (2004) has pointed out, there is scant empirical support for the effectiveness of such an extreme stance – "pure" constructivism is generally an inefficient approach for achieving specific training outcomes. As an example, Dolmans, Gijselaers, Schmidt, and van der Meer (1993) found in one case that learner-generated issues failed to address as much as 30% of the instructor's intended objectives. The conclusion drawn is that, although a constructivist approach can eventually be effective, without considerable intervention it will never be efficient.

Taking a different perspective, several (e.g., Airasian and Walsh, 1997; Bransford et al., 2000; Kirschner, 2009; Jonassen, 2006) have taken pains to point out that there is a distinction to be made between, on the one hand, a constructivist epistemology characterizing what we know and how we know it and, on the other, the pedagogical methods that comprise the strategies and techniques used to promote construction of knowledge. That is, from a practical point of view, constructivism in and of itself does not absolutely pedagogically proscribe any assistance being given to the learner.

Scaffolding. This perspective leads to one of the more vociferously pursued current issues amongst learning theorists. At issue is the amount of assistance to be given the learner and, much more importantly, the nature of that assistance. While the information processing approach prescribes directly providing unsolicited proactive assistance to guide the learner in constructing knowledge, the constructivist approach would say to indirectly provide reactive assistance only as needed by the learner during knowledge construction. Typically, constructivists build on Vygotsky's (1978) idea of a personal *zone of proximal development*. This zone is defined as the space or difference between the learner's current problem solving ability (actual development level) and the learner's problem solving ability under instructional guidance or collaboration with peers. As learning progresses, the locus of the zone changes – "the zone of proximal development today will be the actual developmental level tomorrow" (Vygotsky, 1978, p.

87). To the extent that the learner can maintain position at the edge of this zone and can access external guidance as needed, learning will be efficiently effected.

Maintaining the learner at or near the edge of Vygotsky's zone of proximal development is implemented via *scaffolding*. First named by Wood, Bruner, and Ross in 1976, the concept of scaffolding was originally developed within the environment of tutors instructing pre-school children. Wood et al. noted that the tutors provided, as needed, focused, individualized support to the learners, and, when the support was no longer needed, abandoned it, similar to temporary scaffolding used in support of constructing a building. Scaffolding was characterized as any action which "recruit[s] … attention, reduces degrees of freedom in the task to manageable limits, maintains 'direction' in the problem solving, marks criticial [sic] features, controls frustration and demonstrates solutions when the learner can recognize them" (p. 99).

With the acceptance of scaffolding into constructivist methods, constructivism began to proliferate a variety of pedagogical models, all at least loosely associated with the tenet that learners learn most effectively within the context of a to-be-solved problem or task. TRADOC Pamphlet 350-70-4 (in preparation) lists a spanning set of these constructivist models (p. 31) and subsumes them under the term *problem centered instruction* or PCI. For this paper, "PCI" will be used as short-hand for constructivist models.

PCI learning theorists and practitioners were quick to generalize the concept of scaffolding from pre-schoolers to learners in general, from tutor-student interactions to teacher-class interactions, and from individualized learning support to group-level learning support. Also, with the introduction of automated teaching systems (e.g., intelligent tutoring systems), interest turned to scaffolding delivered via technology. One recent popular educational psychology resource finishes up a defining characterization of scaffolding with "…or anything else that allows the student to grow in independence as a learner" (Woolfolk, 2007, p. 48). As Davis and Miyake (2004) point out, conceptions of and investigations of scaffolding have become divergent to the extent that communication among different researchers within the field can become problematical. Woolfolk's (2007) "… or anything else…" could present a daunting array of scaffolding material for consideration.

Scaffolding, in the PCI model, is the most effective and, hence for this paper, one of the most important vehicles by which the learner interacts with instruction. Accordingly, for purposes of development of this paper, it is necessary that it be explicitly defined and differentiated from general instructional activity. Drawing on Vygotsky's model and terminology, for this paper scaffolding will be considered to be the reactive employment of instructional activity appropriate to the learner's current zone of proximal development. Under this definition, scaffolding (a) is seen more as a process than an object or instructional medium, (b) is employed in a manner tailored to the learner's current zone of proximal development, and (c) changes as the learner's zone changes. Thus, whether the scaffolding action consists of hints, worked examples, or breaking the problem into smaller pieces (just a sampling of objects or media which have been offered as scaffolding instances) is not a question of interest. The real interest lies in (a) whether the action is appropriate to the stage at which the learner may be in constructing knowledge, and (b) whether the action is discontinued when no longer needed or no longer appropriate.

The discontinuation, or "fading," of scaffolding in PCI once it is no longer needed by the learner has received considerable attention (cf. Davis and Miyake, 2004). At debate are issues such as: What does it mean to "gradually" fade scaffolding? If an instructional object is not faded, is it truly scaffolding? For purposes of this paper, if scaffolding is understood to consist of employment of appropriate instructional activity, then rate of fading of the object or removal of the object become incidental; the issue is whether the current instructional activity is appropriate to the learner's current zone of proximal development.

If scaffolding is cast in terms of its appropriateness to the individual learner's current situation, then an obvious issue arises in the classroom environment: if all learners are building their own personal knowledge structures at their own rate of learning, then how can the instructor match scaffolding across a class full of learners who at any single point in time presumably have different zones of proximal development? A parallel issue arises in blended learning situations using single-student automated teaching systems (e.g., intelligent tutoring systems): does the teaching system have the "intelligence" to determine what scaffolding is appropriate to the student and when that scaffolding is appropriate?

In the case of classroom scaffolding, as part of the social aspects of knowledge construction, classmates are assumed to engage in something approximating peer scaffolding. Vygotsky (1978) initially posited the possibility of peer scaffolding, and Lai and Law (2006) and Fawcett and Garton (2005) have found evidence for the efficacy of peer scaffolding.

Fawcett and Garton's (2005) results can be taken to indicate that peer scaffolding can result, at some level, in a "leveling" of a class's learning: absent instructor intervention, low scoring students who verbally interacted with other low scoring students showed no change on a post-test, whereas low scoring students who verbally interacted with high scoring students subsequently increased their post-test scores. It should be noted that Fawcett and Garton's results were obtained from a contrived experimental setting; the real world conditions that promote peer-to-peer scaffolding and the optimal conditions for its efficacy (cf. Surowiecki, 2004) deserve additional investigation.

However, the results do add credence to an assumption that is many times implicit in PCI classrooms: members of a group of learners can be considered to progress as a group, and, in addition to personal scaffolding, the instructor can successfully invoke scaffolding at the group level. But, in turn, this leads to issues regarding group size and composition. Army Regulation 350-1 (Department of the Army, 2007) assumes group leader to student ratios ranging from 1:6 to 1:16 (para 3-5.a(2)). Wyss, Tai, and Sadler

(2007) found indications that when group size exceeds 10, effect of training may decrease, while Lou et al. (1996) found group sizes of 3-4 to be more effective than group sizes of 5-6. The issue of group size remains open; there are strong indications of an interaction between group size and different subject matters (Raimondo, Esposito, & Gershenberg, 1990) – larger groups may be effective for learning lower level cognitive skills while smaller groups may be more effective for learning higher level cognitive skills. An associated issue which does not appear to have been addressed is that of characterizing the number of small groups that an instructor can effectively and efficiently supervise at one time.

Problem generation. Another consideration associated with subject matter is the composition of the problems, issues, or questions that an instructor may use to form the impetus for a PCI training event. Dabbagh et al. (2000) characterize the composition as being "a collection of carefully crafted, ill-structured problems that reveal the underlying principles and concepts of a knowledge domain through descriptions of real life events and experiences and serve as the stimulus and focus for student activity (p. 63)." Although there appear to be no generally accepted problem generation rules, Jonassen and Hung (2008), summarizing across several sources, posit the following principles for designing a PCI problem. The problem should be:

- open-ended and moderately ill-structured
- complex to the degree that it
  - is challenging and motivating, and engages the learner's interests
  - provides learners opportunities to treat the problem from multiple points of view
  - is integrated with learners' prior knowledge
  - is appropriate to learners' cognitive development and readiness
- contextualized to the learners' target workplace

Hung (2006) goes beyond these principles to directly address handling problem content. First, the problem should be aligned with the course learning objectives. The course learning objectives should both limit and define the content of the problem. In addition to being aligned with course objectives, each problem should be of scope proper to the learning objectives. As an Army example, a problem on "creative writing" would be much beyond the scope of an intended training objective to write acceptable and effective officer evaluation reports.

Outcome measurement and assessment. Associated with the issue of problem content is the issue of assessing learners' outcomes at the conclusion of an instance of PCI. As indicated previously in the discussion of transfer of learning (Bransford and Schwartz, 1999), assessing the effectiveness of a learning experience depends very much upon that learning experience's objective. Depending on whether the objective of the experience involves (a) learning factual knowledge, (b) learning principles that link together elements of factual knowledge, or (c) learning procedures and conditions for employing the procedures (cf. Sugrue, 1995; Gijbels et al., 2005), what is measured and assessed should be appropriate to the objective. For example, if the objective were to learn effective tactical machine gun employment, then an assessment of the learner's ability to load, fire, and reduce stoppage on an M240B machine gun would not be directly appropriate to the objective.

Gijbels et al. (2005) and Sugrue (2005), for each of the three levels given immediately above, suggest guidelines for developing multiple choice, open-ended, and hands-on based assessments, tailored to the level of the knowledge structure that the learner should have constructed. Table 10 contains an abbreviated sample of these guidelines.

Table 10
Example Measurements for Assessment Method Formats for Knowledge Levels from Gijbels et al. (2005) and Sugrue (1995)

	Format		
Knowledge Level	Multiple Choice	Open-Ended	Hands-On
Factual Knowledge	Select examples	Generate examples	Select live examples
Principles	Select similar problems	Generate predictions	Explain solution
Procedures	Select best procedure to effect a desired change	Generate a procedure	Perform/explain how to perform a procedure

PCI instructor issues. Consideration of constructivist instructional issues such as scaffolding, problem generation, and learning assessment leads to consideration of the role and responsibilities of the instructor, especially with respect to the Army instructor, in PCI. As indicated previously, in a PCI environment, the instructor's role is not so much that of a "broadcaster of knowledge," but that of a facilitator. Blumenfeld et al. (1991) note that the PCI instructor must be expert in the subject domain, must be motivated to engage learners at a personal level, and must be willing to share with the learner responsibility for the direction that learning may take. These characteristics are manifested in the PCI instructor's performance. Ertmer et al. (2009), after a survey of the literature touching PCI instructors' performance and experiences, and after observing five middle school PCI instructors over the course of a year, concluded that the effective PCI instructor is able to

- Develop good problems and questions
- Anticipate learners' questions and learning needs
- Deal with the complexity inherent in real-world problems
- Make appropriate resources available
- Manage small groups
- Let learners be responsible for their own learning
- Integrate learners with different capabilities into PCI

However, Dahlgren et al. (1998) found that some established, experienced teachers, when transitioning to PCI, tend to retain what was termed a "directive" (as opposed to a "supportive") role. Brush and Saye (2006) further investigated this tendency and found that teachers, even though they are attempting to use PCI methods, may after as many as three iterations of teaching/facilitating a course, continue to exhibit pedagogical behaviors more appropriate to direct instruction than to PCI. Dabbagh et al.'s (2000) observation that "probably the most important yet difficult aspect of problem-based learning is the role of the instructor (p 65)" continues to obtain.

Relative efficiencies. Given the practical concerns associated with acceptance and implementation of PCI approaches to learning, from the point of view of Army institutional training, there needs be some assurance of return on investing effort in developing PCI. That is, if the Army is to commit to PCI, then there must be some indication that PCI can be more effective than current instruction. Gijbels et al. in 2005 and, later, Walker and Leary in 2009 conducted meta-analyses of studies that had directly compared differences in learning outcome between PCI-based instruction and non-PCI instruction (e.g., lecture). Using Sugrue's (1995) three knowledge levels (see Table 10 above) as categories of instruction, both meta-analyses found no difference between PCI and lecture for "factual knowledge" but a PCI advantage for both "principles" and "procedures." Note that this result is a comparison of PCI with lecture; it does not necessarily compare PCI with any sort of optimized direct instruction.

Instructor Issues

Army instructor preparation. TRADOC Regulation 350-70 (In preparation – b) outlines the Army institutional instructor training program. Although there are exceptions, the most usual sequence is for personnel assigned to an instructor billet to (a) complete the Army Basic Instructor Course (ABIC), (b) demonstrate mastery of the knowledge domain to be taught, and (c) demonstrate effectiveness in teaching the knowledge domain. If small group instruction is to be employed, the instructor must also complete the Army Small Group Instructor Training Course (SGITC). The courses' basic content (Table 11a and 11b) is centrally managed by TRADOC. Both ABIC and SGITC present guidelines and techniques under the information processing model of instruction, with SGITC presenting additional guidelines and techniques specific to the small group instructional environment, but neither course presents PCI-related material. Both courses are typically conducted at the proponent schools and are conducted by schoolhouse cadre. All new institutional instructors, military, civilian, or contractor, typically complete the standard instructor preparation sequence. Individual schools may supplement the sequence with additional training, such as synchronous/asynchronous dL instructor training or video teletraining instructor training. A small number, for example, the U.S. Army Command and General Staff College's Faculty and Staff Division (U.S. Army Combined Arms Center, 2009), provide alternative preparation for their instructors.

Table 11.
High Level Characterization of Army Basic Instructor and Small Group Instructor Training Courses' Content

Lesson Title	Content
a. Army Basic Instructor Course (ABIC)	
Course Introduction	Course requirements and criteria
Overview of Army Performance Improvement	API overview, 5 phases of API, information about SAT
Prepare for Instruction	Student prepares selected topic for delivery to peers and course instructor
Evaluate Instruction	Evaluation techniques; using assessment to improve instruction
Deliver (Implement) Instruction	Three student presentations: Conference method, Demo/Practical Exercise method, and combination of the two
b. Small Group Instructor Training Course (SGITC)	
Orientation	Welcome and administrative data.
Roles, Responsibilities,and Definitions	A review of SGI terminology.
Group Development	Group and individual dynamics.
Experiential Learning Cycle	Adult learning theory and the ELC.
Intervention	Intervention types, strategies, and pitfalls.
Leaderless Discussions	Brainstorm, Buzz Session, and Topic Discussion.
Conference	Directed large group meeting.
Role Playing	Human interaction and discussion.
Committee Problem Solving	Group problem solving.
Case Studies	Case study applications.
Student Presentations	Final exams for students.
Summary	Course wrap-up.

Army instructor characterization. Typically, military instructors have no formal training as instructor except for ABIC, SGITC, and any additional training specified by the proponent school. In general, military instructors will have had prior experience in the knowledge domain to be taught. Civilian instructors are typically in Career Program 32 (United States Army, 2001), on a professional career track involving training delivery or training support. They may or may not initially have expertise in the knowledge domain to be taught. Contractor instructors' qualifications and experience are specified by the contract under which they are hired. In most cases, contractor instructors have special expertise in the knowledge domain to be taught.

Military instructors are typically in an instructor position from two to three years before being re-assigned to some follow-on billet. Civilian and contractor instructors will typically remain in an instructor position for an indeterminate length of time. In general, usually as a matter of policy, a given instructor billet is not interchangeable amongst military, civilian, and contractor instructors. For example, for the various officer branches' captains career courses, nearly all small group instructors are military personnel.

Although there is variation among the Army schoolhouses, most have drastically reduced their training development staff. The result of this reduction is that in some cases instructors have been obliged to assume some of the training development functions for some courses.

Discussion and Recommendations

To re-iterate, the overall intent of this paper has been twofold: to survey the status of Army institutional training, especially with respect to dL, and to survey current training research and technology as applicable to the Army's institutional training environment. Although various "gaps" in institutional training are pointed out in the preceding sections, in this final section, there is a high-level "sweep up" of all the significant findings of the paper and a general listing and discussion of issues. The listing has two general categories: policy-related findings and research-related findings. Although the distinction is sometimes blurred, the policy-related items are those issues that appear to have direct solutions that need little or no further analysis or that are outside ARI's purview. The research-related items are those issues that appear to have no directly available solution, and need additional analysis before a solution can be considered.

Policy Issues

These overall issues are of a general nature and applicable across Army institutional training.

Soldier-related issues. Currently "task-condition-standard" is both a training and a Soldier mantra. Although *per se* this is an admirable training goal, it is an effective goal only to the extent that the tasks, conditions, and standards encountered in the field are similar to the task, condition, and standard encountered in the institutional setting. A reliance on a small set of tasks, conditions, and standards in the classroom reflects the mindset of training to meet course exit criteria and is somewhat incomplete. As Barnett and Ceci (2005) aver, "no one cares about learning if it stops at the schoolhouse door" (p. 295). Soldiers' learning orientation must be toward subject matter mastery and not just performance to classroom standard. There needs to be, at a high level, a change from measuring Soldiers' end-of-course performance to measuring the transfer of learning in the field that results from a course of instruction.

Course relevance. If the Army is to maintain a life long learning environment, then the Army should continue to pursue a policy of insuring that course content is relevant and up to date. To be relevant, training must be valid. Course validation needs to not only emphasize content validation as outlined in TRADOC Pamphlet 350-70-10 (U.S. Army Training and Doctrine Command, 2004) but also emphasize external validation (cf. Straus et al., 2006).

From the Army point of view, another aspect of relevance is currency: institutional courses, especially those applicable to the current operational environment, must tighten their update cycle. This will involve both process and product changes. Efforts must be made to make more efficient the process by which changes are fed back into to the course development function and the process by which courses are updated. Courses, especially dL courses and dL course components of blended learning, must be designed with specific consideration of updates and modifications kept in mind. That is, there should be a conscious change of mindset within the course development function to design not to accommodate static course content, but to accommodate a dynamic course content that changes, sometimes very rapidly, over time.

Course availability. The Army should continue to pursue a policy of making the right courses available to Soldiers at the right time. The Army should continue to pursue a policy of aligning course offerings within the ARFORGEN cycle. In line with this, the Army also should visit the current policies of managing residential courses at the course level. With fixed residential course start/end dates, any benefits to be had from developing individually self-paced courses are not being exploited. With this in mind, a trade-off between the training effectiveness gained via self-paced courses versus the increased administrative overhead of managing self-paced courses should be conducted, with the results to govern whether the Army invests significantly in developing institutional self-paced courses.

Transfer related issues. Not only must a Soldier's training be oriented beyond the end of the course, but also the work environment to which the Soldier returns must support the Soldier's new learning. Leaders must recognize that to maximize the return on training investment, the Soldier must be allowed the opportunity and resources to perform the newly learned skills. To the extent that the Soldier's leadership and peers support and value the newly learned skills, opportunity for transfer to the operational environment will be optimized. Once emphasis shifts from end-of-course assessment to assessment on the job, there will be a concomitant need to broaden the focus of assessment to include not only Soldiers but also training systems. This broadening is also discussed as a research issue below.

dL-specific issues. The Army has continuing problems with acceptance of dL, by leaders, by developers and instructors, and by students. Many Army senior leaders have yet to firmly endorse dL. Developers and instructors are conflicted by policies that are perceived to undermine job security or to mandate conversion to dL at a programmatic level rather than at a learning requirements level. Students form a vision of dL modules as non-imaginative "page turners" that are unwieldy to access and many times out of date.

Students' visions of dL reflect the Army's continuing problems with its dL infrastructure. End users continue to report annoying to unacceptable delays between user input and system response while they attempt to complete dL courses. The Army has little control over the delay attributable to the user's own platform (usually a PC), some control over the transport (network) delay, and most control over delay due to the servers' processing time. The fact that course developers have come to consciously avoid incorporating potentially effective, but processing intensive, features in dL modules due to anticipated response time issues speaks to the persistence of this problem.

Our finding of students' having impressions of dL as having uneven quality are supported by Straus, Shanley, Burns, Waite, and Crowley (2009) who in a TRADOC-sponsored study concluded that a good proportion of Army dL up until now has suffered from lack of a systematic quality assessment process. The Straus *et al*. report recommends TRADOC bring to bear an emphasis on assessing technical criteria, such as accessibility and usability; production quality criteria, such as legibility of material; and pedagogical criteria, such as characteristics of instruction and student feedback.

Finally, the Army should actively pursue more dL collaboration with other agencies. While the majority of dL projects' content is likely to be Army-specific, there are economies to be investigated with respect to dL for common content and, more importantly, with respect to dL process commonality and lessons learned.

Research Issues

These significant research issues are re-iterated for specific consideration for inclusion in any program of research addressing effectiveness of Army institutional training. Their scope ranges from basic research to advanced development, and some can be quickly addressed while others may require more time.

The Army learner. The Army has for some time espoused the concept of each Soldier being a self-directed life-long learner. While there are increasingly more opportunities for Soldiers to learn, there are as yet no specified meta-principles for helping Soldiers learn to learn. In particular, there is a need for Soldiers to assume more personal responsibility for learning the knowledge and skills necessary to effectively execute their chosen career trajectory. There is a need for research oriented toward identifying those learnable skills that enable the Soldier to be a life-long learner and toward determining the extent to which those skills should change across a Soldier's full career. Some work in this area is being sponsored by TRADOC's recently constituted Institute for NCO Professional Development (Kim, 2009).

Loosely associated with the problem of learning to be a life-long learner is that of the issue of the "average" level of public school education attained by a Soldier before embarking upon life-long learning. Research is needed to determine if success as a life-long learner is significantly correlated with level of public education attained prior to entering service and, if so, what could be done to modify training to match different year-groups' level of public education.

Training for transfer. If the Army is to move from evaluating instruction by depending on end of course assessments to evaluating instruction by depending on subsequent changes in Soldiers' operational performance, there must first be implemented some process, similar to Holton's (2008) LTSI, that views transfer from a system perspective (Holton, et al., 2000). Similar to components of the LTSI model, there is a need to catalog and to assess the roles of components of the Army training and operational environments on transfer of training to operational performance.

In parallel with this investigation, there needs to be research in the area of assessment of transfer. Instead of treating transfer as an all-or-none effect, researchers need to be able to assess it as a graduated effect (e.g., Bransford et al., 2000) and also to assess it dynamically (e.g., Schwartz and Martin, 2004) in terms of Soldiers' preparation for new learning and for learning in new situations.

Probably most importantly, there is a need to investigate pedagogical methods for improving transfer to the operational environment. In fact, since the aim of Army training and education in most cases is to affect performance in the operational environment, the case can be made that any investigation of pedagogical method within the Army institutional training be oriented toward transfer to the operational environment. The pedagogical issues outlined in the next section, when addressed, should be researched with respect to transfer. When considered in this light, it becomes clear that the effect of a pedagogical intervention must be investigated in terms of not just course process and content, but also the post-course factors that bear on Soldiers' operational performance.

Pedagogical issues. Pedagogical issues revolve around Mayer's (1996) three metaphors of behaviorism, information processing, and constructivism. One of the basic issues is that of optimally matching metaphor to the domain the student is to master. While there is no question that all three models of instruction are effective, there are still only general guidelines as to which one will be most effective for which kinds of instructional goals and also the extent to which each model should be used and at what point during the course of instruction for a knowledge domain.

Aside from research addressing the relative merits of the three, there are also needs for research directed specifically at the information processing metaphor and the constructivism metaphor.

Information processing related issues. Because processing in this metaphor is based in the hypothetical structure of short term memory, the majority of research issues revolve around short term memory.

Short term memory capacity issues. Since short term memory is hypothesized as the bottle-neck for learning, its processing capacity is of critical importance to the information processing metaphor. There are two related main research issues associated with capacity. First, of course, is the number of items that can be maintained in short term memory, and second is the nature of short term memory items and whether short term memory capacity changes as a function of the nature of the items held in memory. Theoretically based admonitions to avoid exceeding short term memory capacity during training cannot be implemented in instruction absent some useful non-specific characterization of what constitutes a short term memory item.

Cognitive load issues. Deriving from the issue of short term memory capacity is the issue of cognitive load – if short term memory has some limiting capacity, then for learning to effectively occur, the presented intrinsic, germane, and extraneous loads must be quantifiable. This quantification includes not only the number of intrinsic, germane, and extraneous items presented, but also the rate at which new items can be presented as older items' information is assimilated (in the case of intrinsic and germane elements) or disregarded (in the case of extraneous elements) and the items themselves dropped from short term memory. Research is needed to characterize the rate at which items of various types may be presented the learner without overload and thus optimizing learning rate.

PCI related issues. As PCI methods are incorporated into institutional training, issues, some specific to Army training, arise that should be addressed.

Problem generation issues. For a course presented using PCI, the basic element from which instruction derives is the learning problem. Given that the instructor's role in PCI is more supportive than directive, problems must be carefully crafted to insure that the learners' trajectory through the solution process will treat all the intended course objectives. In the Army environment, an investigation of problem generation will involve not only training developers, but also the instructors who will be providing the scaffolding to shape and guide the problem through to its solution by the learners.

Scaffolding issues. Scaffolding can be compared to germane load in the information processing metaphor. As initially introduced to the field of education, scaffolding referred to focused, individualized support for a learner, ostensibly aimed at an individual's zone of proximal development. However, when the learning environment expands to the classroom, individualization of scaffolding becomes more and more of a challenge to the instructor: how much scaffolding can be provided on an individual basis; when does providing individualized scaffolding begin to interfere with classroom flow; and what are the pro's and con's of providing scaffolding at the class level instead of at the individual level. Some nominal work in this area has been done. Saye and Brush (2002) make the distinction between *hard scaffolding* that is pre-planned for delivery at distinct points in instruction and *soft scaffolding* that is delivered on an *ad hoc,* as needed basis), but little empirical work has addressed issues of scaffolding efficiency.

There is a need to investigate relationships amongst subject matter complexity, scaffolding, and group size. For less complex subject matter, hard scaffolding and larger group sizes may be effective and efficient. On the other hand, for more complex subject matter, soft scaffolding and smaller group sizes may be required to attain training effectiveness.

Associated with scaffolding is the question of the number of small groups an instructor can divide a given class into as he or she progresses through a course. If indeed it is the case for PCI that more complex subjects require smaller groups and more soft scaffolding, then it may be the case that instructors must invest relatively more and more instructional oversight per group as group size decreases.

Training for PCI instructors. The Army's current process for qualifying instructors does not prepare instructors in the use of PCI methods. In view of the up-coming introduction of PCI methods in Army training and education (U.S. Army Training and Doctrine Command, In Preparation-b), there is a need to survey methods for preparing instructors to use PCI and to match and validate those methods in the Army institutional training environment.

Overall, this survey finds that Army institutional training is in reasonably good condition. Even though there are technological constraints on training delivery and management, institutional training appears to be making progress toward implementing blended learning solutions, where before instruction was primarily lecture-style. There is movement toward incorporating advanced pedagogical techniques into instruction, but the gaps between the Army's training needs and what is operational usable from those techniques require additional investigation.

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Appendix A

dL Institutional Training Interview Questions

Course Development

1. For what courses have you ***developed dL***?

2. What is the ***primary teaching objective*** of the dL courses you have developed to date?
    a. To teach declarative knowledge?
    b. To teach process knowledge (how something works)?
    c. To teach procedures (how someone does something)?
    d. To teach causal principles (cause and effect)?

3. Do you follow any specific ***learning theory, model, or principles*** in developing your training courses? (e.g., GEL, SRS)
    a. If yes, please describe.
    b. If yes, does the course content/objectives (e.g., knowledge vs application; skill transfer vs procedural task that does not change; skills that require job aids vs skills that do not) determine the choice of a learning model or principles?
    c. If no, then how do course content/objectives drive your development strategy?

4. What is the ***most important guiding factor*** in your course development?
    a. Mandates from TRADOC?
    b. Learning theory or model?
    c. Training objectives?
    d. Training resources?
    e. Operational needs?
    f. Other?

5. To what extent have user/Soldier-SMEs been involved in course development?

Course Evaluation

6. To what extent have you incorporated some type of ***formative evaluation strategy*** to assist in the development of your instructional training programs?
    a. If so, describe the strategy that you used.
    b. What do you do to maximize the effectiveness of conducting these evaluations?

7. How do you evaluate whether your courses meet stated training objectives?
    a. What types of information do you typically collect as part of your course evaluations?
        i. Student reactions?
        ii. Self-assessment?
        iii. Acquired knowledge?
        iv. Behavioral measures?
            1. To what extent do you attempt to collect follow-up performance data from students in the work place?
            2. What issues have you encountered in trying to collect this type of information, e.g., transfer of training?

8. To what extent do you ***measure results***? (Results = productivity gain by the unit or organization).
    a. How difficult is it to collect “bottom line” data?
    b. What are the major issues you have faced in trying to collect bottom-line data?
        i. Identifying measures that can be interpreted clearly?
        ii. Long-term tracking of students/unit?
        iii. Resources?

9. What type of evaluation strategies (experimental/quasi-experimental) have you used to determine or compare the effectiveness of a particular learning strategy/technique or training media feature?
    i. For example:
        1. one-group posttest
        2. two-group posttest only with nonequivalent comparison group
        3. two-group pretest-posttest with nonequivalent comparison group multiple posttests
    ii. What problems have you encountered in conducting this type of experimental/quasi-experimental research?

10. If you were asked to develop a ***set of evaluation measures*** for a training course, what type of information would you most like to have?
    a. What problems have you encountered or can you expect others to encounter in collecting this information?

11. How do ***students perceive the value*** of the course?
    a. How favorably do students respond to the training content and delivery?
        i. Relevance of the training to the job?
        ii. The training technologies used, the quality of audio and video, the overall training environment, access to live instructors?

12. What ***issues*** (e.g., developing valid measures, administrating tests, updating tests) have you ***faced in developing evaluation instruments*** of which course developers should be aware?

13. What issues have you encountered with students ***interfacing with the dL content***?
    a. What navigation issues emerged?
    b. How user-friendly was the configuration?

14. What features or aspects of dL do ***students generally like***?

15. What features or aspects of dL do ***students generally dislike***?

Lessons Learned

16. Based on your experience, what ***valuable lessons*** have you ***learned*** about the following:
    a. Development
    b. Implementation
    c. Maintenance/management
    d. Evaluation
    e. Resource issues