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EXTENDING THE TRAINING EFFICIENCY AND EFFECTIVENESS METHODOLOGY (TEEM) WITH TRAINING TRANSFER DATA

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13. ABSTRACT *(Maximum 200 words)*

Although the most popular framework for depicting training evaluation has been Kirkpatrick's (1959; 1960) four-stage process of reactions, learning, behavior, and results, this framework offers no specific mechanism for making changes to training courses. However, the systems approach to training (Goldstein, 1993) depicts evaluation as a key component that provides feedback to the needs assessment, design, development and delivery stages of training to continuously update and improve the entire training process. Despite these conceptual models, little research has been conducted to develop methodologies for using training evaluation information to make training course changes. One exception is the work of Ford & Wroten (1984) who developed a Matching Technique that compares, or matches, training needs to the emphasis placed on tasks in a training program. The Matching Technique has previously been used in the Training Efficiency and Effectiveness Methodology (TEEM) (Teachout, Sego, & Ford, 1995) and combines efficiency and effectiveness data for course re-design. The purpose of this paper is to extend the TEEM through the integration of information about the efficiency, effectiveness and transfer of training for training system re-design. The TEEM was applied to a mechanic's training course. Efficiency results produced by the Matching Technique was integrated with follow-up task performance effectiveness and opportunity to perform data (Ford, Quinones, Sego & Sorra, 1992) collected from training graduates and their supervisors 8 months after the completion of training. The integration of these data into the TEEM for training system re-design was illustrated.

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CONTENTS

LIST OF FIGURES

EXTENDING THE TRAINING EFFICIENCY AND EFFECTIVENESS METHODOLOGY (TEEM) WITH TRAINING TRANSFER DATA

SUMMARY

The Training Efficiency and Effectiveness Methodolgy (TEEM) was extended using training transfer data. Course efficiency, field effectiveness and transfer data were integrated in an application to an Aerospace Ground Equipment technical training course to demonstrate how these data could be utilized for training system re-design.

I. INTRODUCTION

A significant amount of resources are devoted to training in the private sector (Tannenbaum & Yukl, 1992) as well as in the military (Ruck, Thompson, & Stacy, 1987). Therefore, training that is irrelevant, inefficient, or ineffective can be costly. Due to organizational downsizing, the associated reduction of resources devoted to training, and the increased complexity of technology, equipment and jobs (Howell & Cooke, 1988), improving the quality of training has never been more critical. The purpose of this paper is to describe an effort directed at assessing and utilizing training efficiency, training effectiveness and training transfer information for training system improvement.

Background

The most popular framework for evaluating training programs was developed by Kirkpatrick (1959; 1960). This four-level framework includes: student reactions to training; learning of facts, principles or techniques; changes in on-the-job behavior; and tangible business results. Although this framework has advanced the practice of training evaluation over the years, it does not offer a systematic approach for the use of evaluation information to improve training.

The systems approach to training specifies the use of evaluation information for training system improvement. In fact, evaluation is depicted as a key component that provides feedback information to the needs assessment, design, development and delivery stages of the process to continuously update and improve training quality (Goldstein, 1993). Thus, evaluation information should be instrumental in helping human resource managers and training personnel make informed, accurate and meaningful changes to training. Unfortunately, training evaluation information is typically collected to determine trainee reactions to the course, with less attention paid to whether learning objectives were met, and almost no attention given to subsequent transfer of training and performance on the job (Alliger & Janak, 1989; Baldwin & Ford, 1988). As a result, evaluation information is rarely available or utilized to improve training, and subsequently, little research has been conducted in this area.

One exception is Ford and Wroten (1984), who developed a Matching Technique that compared training needs with current training emphasis in order to link training evaluation to training needs assessment and facilitate course re-design. Ford and Sego (1990) recommended that this technique be used to determine training efficiency, that is, the extent to which tasks may be over- or under-trained. They extended the Matching Technique by developing a conceptual framework to integrate efficiency and effectiveness information for course re-design. Since then, efforts have demonstrated the use of the matching technique to determine training efficiency and make course revisions (Teachout, Olea, Phalen, & Barham, 1993) as well as integrating efficiency and course effectiveness information for course re-design (Teachout, Sego, & Ford, 1995).

While these efforts have advanced the use of evaluation data for course revision, they did not incorporate information from the job context. The importance of training transfer to the job has been well documented (e.g., Baldwin & Ford, 1988). An important factor in facilitating the transfer of skills is the trainee's opportunity to perform the trained tasks on-the-job. Ford, Quinones, Sego and Sorra (1992) demonstrated that individuals obtained relatively different opportunities to perform (OTP) trained tasks. Since the lack of opportunity to perform tasks is related to performance decrements (Fendrich, Healy, Meiskey, Crutcher, Little, & Borne, 1988), on-the-job task performance of trainees should be higher for tasks that receive relatively more OTP. Ford et al. (1992) suggest the need for integrating training program content with on-the-job opportunities to increase the understanding of training transfer and training effectiveness. The present paper extends previous work by Teachout, Sego and Ford (1995) by incorporating training transfer and job effectiveness data into Ford and Wroten's (1984) matching technique, and demonstrating how the combination of efficiency, effectiveness and transfer data can be used for training system re-design.

II. METHOD AND PROCEDURE

Training Course and Job Context

This study integrated training efficiency, training transfer and training effectiveness information from a United States Air Force Aerospace Ground Equipment (AGE) Airman Basic-in-Residence (ABR) technical training course and subsequent on-the-job information. The AGE ABR course consists of 18 weeks of instruction regarding powered and non-powered equipment used to support aircraft in the Air Force.

Participants

Participants were 182 Aerospace Ground Equipment (AGE) trainees in the Airman Basic-in-Residence (ABR) course at Chanute AFB, IL. In addition, the training manager, course developers and instructors participated in specifying course content. Finally, 182 supervisors of the training graduates provided on-the-job performance ratings for the trained tasks.

Training Efficiency

Ford and Wroten's (1984) Matching Technique was used to determine training efficiency. Training efficiency examines whether the appropriate amount of time is devoted to each task taught in training, or whether tasks are potentially over- or under-trained. This requires training needs information that indicates the relative time required to learn a task and the actual time devoted to training each task. Occupational Survey Reports (OSRs) produced by the Air Force's occupational measurement process contain a rich source of information that is used to identify and prioritize tasks to be included in initial technical training courses. From the OSR, the task learning difficulty rating was used as the measure of the time to learn a task. Since this index is based on the notion of task learning time, it provides a reasonable estimate of the relative time that should be devoted to training each task. The construct validity of the task learning difficulty ratings have been well established against entry-level training variables (Mumford, Weeks, Harding, & Fleishman, 1987) and job performance measures (Dickinson & Teachout, 1993).

A four-step procedure was developed to collect information on the actual time (in hours) devoted to each task taught in training. First, course personnel determined that 99 OSR tasks were taught in the course. Second, course instructors linked these 99 tasks to specifc training objectives in the course Plan of Instruction (POI). In several cases, a single task was covered in more than one training objective. Third, instructors divided the time allocated for each training objective among all of the tasks covered in the objective. For example, if an objective contains 6 hours of instruction and 3 tasks are covered in that objective, the instructors estimated how much of the 6 hours was spent on instruction for each task. Fourth, the total amount of training time devoted to each task was summed. Since tasks could be covered by more than one training objective, the training time for each task was summed across the appropriate training objectives to specifiy the amount of course time spent training that task.

Before the task learning difficulty rating and the hours spent in training were matched for each task, both variables were transformed into standard scores with a mean of "0" and a standard deviation of "1". Ford and Wroten's (1984) Matching Technique was then used to match these two data elements.

Training Effectiveness

Training effectiveness addresses whether trainees learned or can perform the tasks taught in training. This requires information about the knowledge or performance levels of trainees at the end of the training program and later on the job. The greater the learning and performance, compared to a specified standard, the greater the effectiveness of the training program. In this study, supervisor ratings of task performance were provided after trainees had worked for 8 months on-the-job. Thirty-three of the 99 tasks were sampled to represent different content areas (i.e., AGE equipment) across different levels of task learning difficulty (Ford et. al., 1992). A 7-point Likert-type scale ranging from 1-poor, or well below acceptable level of performance, to 7-excellent, or well above acceptable level of performance, was used. The mid-point of the scale, 4-average, or meets acceptable level of performance, was considered the standard to illustrate whether performance for a given task fell above or below that standard. The mean performance rating across all incumbents (i.e., training graduates) was calculated for each of the 33 tasks to represent training effectiveness. If the mean rating was 4.00 or greater, training was considered effective since graduates were performing above standard . If the mean rating was less than 4.00 training was considered ineffective since graduates were performing below standard.

Training Transfer

The OTP trained tasks measure (Ford et al., 1992) was used as the measure of training transfer. Each trainee recorded the number of times they had performed each of the 33 tasks in the 8 month period since they had arrived on-the-job. The mean number of times performed (NTP) across all incumbents was calculated for each of the 33 tasks to represent training transfer.

III. RESULTS

Training Efficiency

Figure 1 summarizes the results of the matching technique for the 33 tasks. The task learning difficulty rating (i.e., relative time to learn) is represented on the x-axis and the actual ourse time spent training each task is represented on the y-axis. Three potential outcomes are depicted. Training matches, depicted as the area between the diagonal lines, result when the difference between the two variables is small (i.e., the standard score difference is 1 standard deviation or less). Fifteen of the 33 tasks (45%) were considered training matches, indicating that the relative amount of time spent in training seems appropriate. Potentially over-trained tasks, depicted in the upper left of the graph, result when relatively more time is spent training a task, compared to the corresponding task learning difficulty variable (i.e., the actual training time standard score exceeds the task learning difficulty standard score by more than 1 standard deviation). Twelve of the 33 tasks (36%) were considered potentially over-trained tasks, indicating that training time might be reduced for these tasks. Potentially under-trained tasks, depicted in the bottom right of the graph, result when the task learning difficulty variable is relatively greater than the corresponding actual training time variable (i.e., the task learning difficulty standard score exceeds the actual task time standard score by more than 1 standard deviation). Six of the 33 tasks (18%) were considered potentially under-trained tasks indicating, that more training time might be allocated to these tasks.

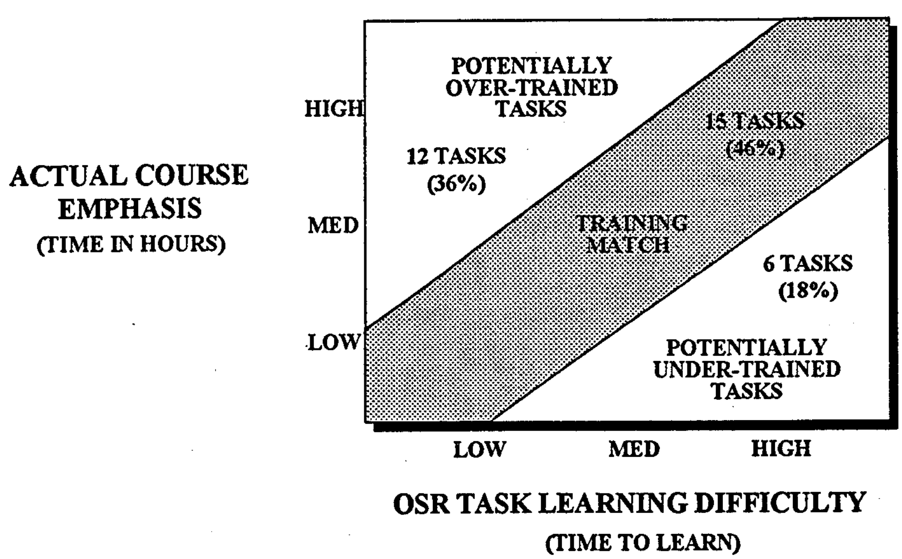

Figure 1. Matching Technique to Assess Training Efficiency.

Training Efficiency, Effectiveness and Transfer Integration

Figure 2 summarizes the training efficiency, effectivenss and transfer integration in a 3 X 2 matrix. The three rows represent training efficiency in the form of the three potential outcomes of the Matching Technique. The two columns represent training effectiveness by depicting task performance as above or below standard. Training transfer is repesented by the mean NTP associated with the tasks in each box of the matrix.

Twenty-nine of the 33 tasks were performed above standard. The average performance level is highest for the over-trained tasks and lowest for the undertrained tasks. This is consistent with expectations, since more training time relative to the recommended time (i.e., over-trained tasks) results in higher performance levels, while less training time relative to the recommended time results in lower performance levels.

The average NTP is highest for over-trained tasks and lowest for under-trained tasks. This is also consistent with expectations. Tasks that receive more time in training are typically performed more frequently on-the-job, since the percentage of incumbents performing a task on-the-job is a factor used in prioritizing tasks for inclusion in Air Force technical training programs. In this study, tasks that receive more training time relative to the recommended time from the Matching Technique are also performed more frequently for this sample as indicated by the NTP results.

The mean NTPs are also much lower for the tasks performed below standard compared to the tasks performed above standard. Regardless of the efficiency outcome, this indicates that NTP may be a significant factor in improving on-the-job task performance.

Figure 2. Training Efficiency, Effectiveness and Transfer Integration

RESULTS OF MATCHING TECHNIQUE	PERFORMANCE LEVEL: LOW (BELOW-STANDARD)	PERFORMANCE LEVEL: HIGH (ABOVE-STANDARD)
POTENTIALLY OVER-TRAINED TASKS	NO TASKS	12 TASKS (36%) $\bar{X}$ PERF = 4.6 $\bar{X}$ NTP = 18.08
TRAINING MATCH	1 TASK (3%) $\bar{X}$ PERF = 2.81 $\bar{X}$ NTP = .80	14 TASKS (43%) $\bar{X}$ PERF = 4.40 $\bar{X}$ NTP = 5.93
POTENTIALLY UNDER-TRAINED TASKS	3 TASKS (9%) $\bar{X}$ PERF = 3.86 $\bar{X}$ NTP = .59	3 TASKS (9%) $\bar{X}$ PERF = 4.24 $\bar{X}$ NTP = 3.74

IV. DISCUSSION AND SUMMARY

This paper extended previous work by demonstrating the potential use of training efficiency, training effectiveness and training transfer information for training system re-design. Ford & Wroten (1984) developed and demonstrated the use of the Matching Technique for training program re-design. Teachout, Olea, Barham, & Phalen (1993) applied this technique to determine training efficiency and facilitate course revisions, while Teachout, Sego & Ford (1995) integrated training efficiency and course effectiveness data for course re-design. The present study includes the use of job effectiveness and training transfer data that permits a broader application beyond the scope of the course to training system re-design.

Examined separately, the results of training efficiency, training effectiveness and training transfer data provide useful information for understanding and changing different aspects of a training system. Results of the Matching Technique suggest that the course efficiency can be improved by reducing training time for over-trained tasks and increasing training time for under-trained tasks. Training effectiveness data suggest that for tasks performed below the performance standard, course revisions may be necessary, or perhaps required, while tasks performed above standard are less likely to require course changes. Training transfer data indicates that more task experience might be required early on-the job to facilitate job performance where the opportunity to perform the trained tasks is low. However, these data are more useful when considered in combination. For example, the results illustrate how a training program can be re-designed to be more efficient by reducing training time for over-trained tasks that were performed above standard, while increasing training time for under-trained tasks that were performed below standard. Furthermore, the training transfer information is useful in determining whether the training program itself should be modified, or the transfer environment changed. For example, if a task is under-trained, the amount of practice on the job is sufficient, but it is performed below standard, the training program might be modified by increasing the training time for that task. Alternatively, if an over-trained task is performed below standard on-the-job, yet the amount of practice for that task is low, modifying the training program is probably not a reasonable action. A better solution might be to ensure training graduates receive more practice for that task on the job, or consider eliminating it from training, and allocate that time to other tasks in the program. Of course, other options should always be considered, such as developing improved instructional approaches.

In the Air Force, training personnel frequently make training course revisions due to reductions in course length, additional requirements dictated by policy changes, or customer feedback that suggests that an area of training is deficient. This methodology utilizes relevant information, integrates that information in a way that is easy to use and understand, and puts it in a format that can facilitate decision-making by training course personnel.

In summary, this paper illustrates an extension of TEEM by integrating training efficiency, effectiveness and transfer information and displaying the information in a format that facilitates training course revisions. Conceptual models of training (e.g., Goldstein, 1993) suggest that evaluation plays a vital role in helping training personnel re-assess training needs and re-allocate scarce training resources. This methodology helps us take a step in that direction. While each piece of information is useful in evaluating different aspects of a training system, considered in combination, training efficiency, effectiveness and transfer provide powerful diagnostic information for re-designing a training system.

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