



# Training Report

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Print & Electronic Training Materials  
Human Resources Division

## Executive Summary

This research assessed TxDOT preferences for **printed** or **electronic materials** (e-materials) in training and explored whether the type of materials impacted learning outcomes. HRD conducted an analysis of end-of-course survey (Level 1) responses and an experiment that used end-of-course examinations (Level 2) delivered 30 days after Campus Consolidation training events; all occurring between late October 2019 and January 2020. *This research found that most employees in a sample of Austin-based employees preferred **e-materials** over **printed** materials.* The type of materials used in the class likely significantly influenced responses, but there was still an overall preference for **e-materials**. The second aim of this study was to determine if the format of training materials impacted learning outcomes, regardless of employee preference. *Based on the sample data, this study found that participants who received only **e-materials** had statistically significantly higher performance test results ( $.8432 \pm 0.058$ ) after 30 days compared to those who received **printed** training materials ( $.7986 \pm .087$ ) in class,  $t(74)=2.381$ ,  $p=.020$ .* Although there was no clear explanation for the difference, we have enough information about preference and performance to prioritize **e-materials** ahead of **printed** materials in our cognitive skills training courses.

## Introduction

Among TxDOT's Mission, Vision, and Values, we strive to both Foster Stewardship (Strategy 4) of government resources and to Value our Employees (Strategy 7). In the case of printing training materials, these strategies sometimes conflict. The argument for printing materials is that some employees prefer or even learn better with printed materials. The argument against printing materials is that increasing paper and printing costs in the era of e-books is hard to justify. In the field of research, even with over 17 years of data, there is still no definitive position on which mode is best for TxDOT. This research intended to assess TxDOT preferences and to explore whether the type of training materials impacted learning outcomes. This Training Report is a summary of research conducted by Workforce Development Section of the Human Resources Division (HRD) as part of its support to the Support Services Division (SSD) in the Campus Consolidation Project.

## Background

Replacing printed materials with e-materials is an appealing proposition for TxDOT. However, a recent meta-analysis of over 54 studies with more than 171,000 people spanning from 2000 through 2017 did not definitively show that print was better than e-materials, or vice versa (Delgado, Vargas, Ackerman, & Salmerón, 2018). While our Strategy 4 goal to Foster Stewardship of resources implores us to favor electronic materials, even 17 years of recent research cannot tell us how this might impact Strategy 7 training goals. Regardless, TxDOT's current Instructional System Design process recognizes its Strategy 4 duties. As a result, all print materials in training are both intentional and recycled. Participant guides are developed to be reference documents that survive well past the end of a training event, which may also be skewing participant reliance on printed materials at training events. Additionally, unused materials are put back into circulation for the next class, which may have an affective impact on the perception of printed materials. The material costs, as well as the shipping, storing, transporting, and even lifting of large boxes all represent significant costs and risks to TxDOT. All that said, TxDOT wants to shift to e-materials, but not at the expense of learning, or without understanding employee preferences.

Related to the evaluation of training and training outcomes for this research, the Kirkpatrick Method uses a four-level training evaluation model applied in most training organizations (Kirkpatrick, 1959). Level 1 surveys assess participant reactions to learning and contain self-reports of participant opinions. Level 2 surveys assess learner comprehension and are typically end-of-course examinations. In the case of this research, the Level 2 surveys were end-of-course examinations delivered 30 days after the end of training.

## **Problem Statement, Purpose of the Study, & Significance**

It is not known if using electronic training materials at a training event is the same as using printed materials. The purpose of this study was twofold: to determine employee preferences for training materials and to determine if the type of materials impacted learning outcomes. The significance of this study is that it gives decision makers at TxDOT a better understanding of workforce preferences and their performance after training, which will inform budget and planning considerations for at least the Support Services and Human Resources Divisions. This study will also add to the body of knowledge regarding print and electronic materials in adult training.

## **Research Questions**

- RQ1: To what extent do employees prefer printed and electronic training materials at TxDOT?
- RQ2: Does the type of course material used in TxDOT training impact learning outcomes?

## **Research Methodology & Design**

This research used two methods – a Level 1 survey and a quasi-experimental quantitative design (an experiment done in a real-world setting) that used Level 2 surveys.

- To answer RQ1, we ran 2 Class Climate reports in late February 2020 for one campus consolidation course (DEV375); running separate reports for e-materials and print sessions, which output to .csv files for analysis.
- To answer RQ2, we conducted an experiment between October 22, 2019 and January 30, 2020. We targeted 48 classes, of which 20 were randomly selected to receive only electronic materials. Employees in the experimental classes received an e-mail the day before class with instructions for attached e-materials and were told bring a device (TxDOT laptop, surface, or smartphone) to access the materials in class. The e-materials were PDF versions of the printed participant guides, with features enabled that allowed for annotation and highlighting. Instructors also gathered additional in-class information on worksheets to aid in later data analysis. At the end of training, all participants received the same Level 1 end-of-course surveys that were collected in class and uploaded to Class Climate, some of which were used to answer RQ1. Approximately 30 days after each session, employees received a Survey Monkey survey with a Level 2 survey and additional questions about factors that may have impacted learning (Appendix A; Martins, Zerbini, & Medina, 2019). This process continued through the end of January. All data from Survey Monkey was output to .xls files for analysis.

## **Population and Sample Selection**

A convenience sample was selected from among a target population of the 2,000–3,000 employees who work primarily in the Austin region of Texas and will be relocating to a consolidated campus in 2022. To answer the first research question, a convenience sample from the target population were asked to answer an additional question about their media preferences as part of the Level 1 survey administered at the end of every training event.

To answer the second research question, a quasi-experimental design (an experiment done in a real-world setting) was implemented that assigned e-materials to 20 randomly selected campus consolidation training sessions (variable) and left 28 sessions with print materials (control). All participants involved in the second research question received a Survey Monkey survey 30 days after the completion of training with a Level 2 survey and additional questions about factors that may have impacted their learning (Appendix A; Martins, Zerbini, & Medina, 2019).

## **Instrumentation**

This research used two instruments. The first instrument was a Level 1 survey based on the Kirkpatrick Method that is used for all Instructor Led Training events at TxDOT using our existing Class Climate evaluation system. The second instrument was a Level 2 survey developed by TxDOT training staff as an end-of-course exam for each of the Campus Consolidation training courses using a Survey Monkey account. This Level 2 survey also included items regarding individual opinions about practical application, satisfaction with the overall course, satisfaction with the training materials provided, and possible barriers to learning (Appendix A; Martins, Zerbini, & Medina, 2019). The Level 2 exams were designed and developed by training professionals, but were not tested for reliability or validity.

## **Descriptive Data**

A convenience sample was selected from among a target population of the 2,000–3,000 employees who work primarily in the Austin region of Texas and are expected to relocate to a consolidated campus in 2022. The sample population for RQ1 was a convenience sample of 227 employees' data gathered between October 22 and December 19, 2019. For RQ2, the 76 samples used represent consenting volunteers who came from among the 1,039 employee enrollments for Campus Consolidation training. Volunteers completed surveys sometime between October 22, 2019 and January 31, 2020. We solicited no demographic information, but did solicit responses to additional concepts that may have moderated performance and would have been used to further clean data (Appendix A; Martins, Zerbini, & Medina, 2019).

## Data Analysis Procedures

To answer RQ1, we summarized the output of 2 Class Climate reports and reported them in Figure X below. Additionally, we used the Data Analysis toolpak of Microsoft Excel 2016 to run a t-test comparing the two means of the groups.

To answer RQ2, we also used the Data Analysis toolpak of Microsoft Excel 2016. We had originally intended to conduct analyses of variance (ANOVA) among all 6 groups – print and electronic materials for all 3 courses – to determine if there were statistically significant performance differences between the groups. However, lingering questions about the true independence of observations during the data analysis gave us pause, as participants in one course could have also been participants in the other two courses; a limitation posed by the quasi-experimental condition. We did run the ANOVA of the entire cleaned data set and found a significant result, but ultimately decided to remove doubt regarding the assumption of independent samples by analyzing only one of the courses – DEV375, the first course in the series – using a t-Test for Two Samples with Equal Variances, ( $\alpha = .05$ ). That said, the work done in support of checking assumptions for the original ANOVA and the eventual t-Test did show us that the other assumptions had been met for the subset of DEV375 and that it had independent observations, included no outliers, was normally distributed, and had homogeneity of variance. We also replaced the scores from 4 stop-outs are these stop-outs (temporary withdrawals) or just drop-outs? If they are stop-outs, the intended readers are not likely to know what a stop-out is, so better to explain it. in the DEV375 data with an average score that, when removed, did not change the results of this research.

## Results

The first purpose of this study was to determine TxDOT employee preferences for print or electronic training materials. From Figure 1 below, we found that most employees in a sample preferred electronic materials over printed materials. Based on our 1-to-5 scale, we consider a score of 1-3 to be general disagreement and a score of 3-5 to be general agreement. In this sample, we found that the materials in the class likely significantly influenced survey preferences, but we still observed a general agreement in preferring e-materials.

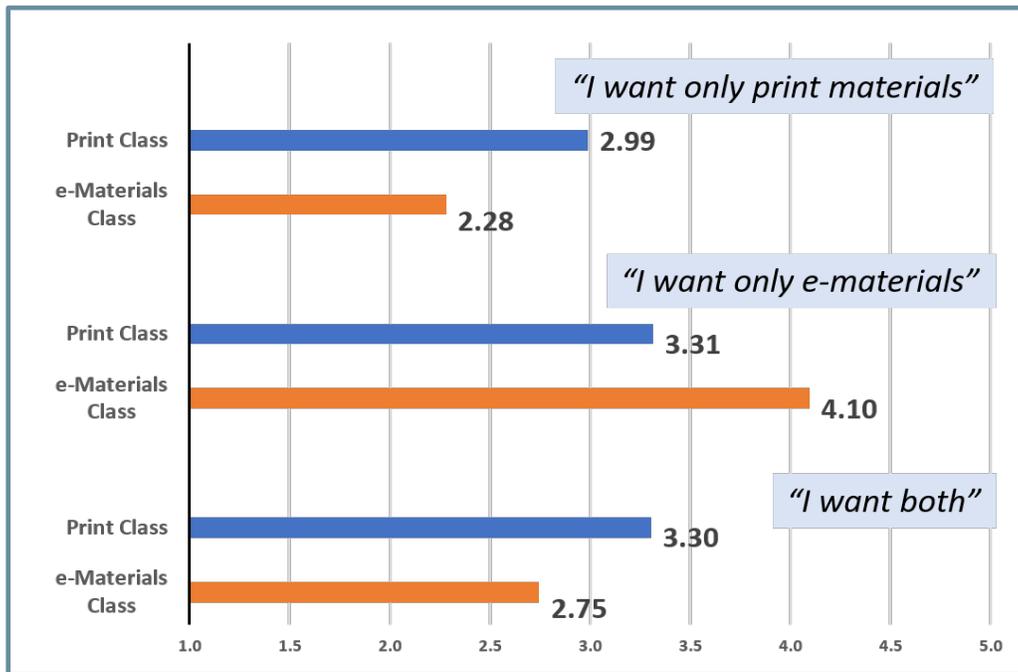


Figure 1. Participants in classes that received only printed materials (Print Class, n=138) have responses shown as blue bars, while participants in classes that received only e-materials (e-Materials Class, n=89) are shown as orange bars. A shortened version of the question asked on the Level 1 survey is to the right of the bars.

The second purpose of this study was to determine if the format of training materials impacted learning outcomes, regardless of personal preference. Based on the sample data, we observed the average percent correct score for participants who had used only electronic materials in class was 84.3% (n=27) while those who used printed materials scored 79.9% (n=49). This study found that participants who received only e-materials had statistically significantly higher performance test results (.8432 ± 0.058) after 30 days compared to those who received printed training materials (.7986 ± .087) in class,  $t(74)=2.381, p=.020$  (Appendix B). The t-Test demonstrated statistical significance at a 95% confidence level ( $\alpha = .05$ ), which led us to conclude that we were correct in rejecting the null hypothesis null hypothesis not stated in Research Methodology and Design. We also calculated the observed effect size as moderate, Cohen’s  $d=0.57$ , for use in future research (Cohen, 2013; Sullivan & Feinn, 2012).

### Discussion, Conclusions, & Lessons Learned

This research concluded that a sample of mostly Austin-based TxDOT employees prefer electronic training materials. This research also concluded that a sample of mostly Austin-based TxDOT

employees performed significantly better on an end-of-course test after being issued only electronic materials compared to a group that used printed materials.

We did look for moderating factors that may have impacted learning (Appendix A) and found no explanatory variables from what we observed, which still leaves us with the fact that we don't know why the group that had e-materials performed better than the print group – an area for further research.

Another positive result is that we understand customer preferences enough to begin converting some training courses into “e-materials only” courses with a reasonable assumption that training outcomes will not be impacted.

Similarly, this training implementation had crossover between print and e-materials that we can assume that “mixed media” formats are acceptable to TxDOT employees and that it's acceptable to change our training model to prioritize e-materials ahead of print, which will represent future cost savings.

### *Lessons Learned during Implementation*

This research project was conducted in the context of organizational change management training which took priority over research, but this research project was a successful “stress test” of organizational capabilities. On its face, this project showcased new mandatory training that was implemented in support of a major organizational change – a campus consolidation and a move to a new site – targeted at sometimes unwilling participants. Additionally, classes were routinely facilitated by “change champions” or “adjunct instructors” and not full-time training professionals better equipped to manage classrooms under any conditions. Even the research project itself was a useful stress test of the organization. Some data sheets were not completed, many data sheets were completed incorrectly, some instructors did not follow implementation or research guidance, some end-of-course evaluations were not completed, drop-ins and drop-outs were common, changes in course administration in the learning management system were frequent, and even classroom changes were common. These factors, and our caution regarding statistical assumptions, led to this research project using a much smaller subset of total data collected. Regardless, training was implemented with few issues and separate survey data concerning attitudes towards the campus consolidation are increasingly meeting organizational targets.

- The “housekeeping” instructions at the beginning of all training events should more explicitly cover expectations of electronic device usage in the classroom, to include expectations of attention and focus, as well as physical battery charging and power cord management.

- Some training courses or audiences may do better with a “no device” policy, depending on objectives and overall course design. In those cases, the discussion is then whether to have print materials or no materials at all, which is a significant instructional design consideration.
- Instructors should always be prepared to re-send the materials e-mail at the beginning of each class.
- Instructors should have a clear understanding of whether the course has e-materials, print materials, or both. Instructors should also be comfortable with the electronic annotation and highlighting functions of e-materials.
- Instructors should still have print materials available as a back-up for late arrivals, for those with faulty technology, and with the understanding that some participants will still ask for print materials regardless of developed formats.
- For on premises training courses using e-materials, instructors should have these materials readily available for fast distribution via attachments to a previously prepared e-mail, and on files saved to a USB drive as a backup. That way, any participants arriving without the materials on their devices would be able to access them during class.
- We observed that some participants brought their own printed materials, even in classes where they expected printed materials to be issued. This represents a mostly hidden cost of training in unit overhead budgets that may approach zero, but may never reach zero.

For further questions about this report or the research, please contact the Workforce Development Section of the Human Resources Division at: [training@txdot.gov](mailto:training@txdot.gov).

## References

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Academic press.

Delgado, P., Vargas, C., Ackerman, R., & Salmerón, L. (2018). Don't throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension. *Educational Research Review*.

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Martins, L. B., Zerbini, T., & Medina, F. J. (2019). Impact of Online Training on Behavioral Transfer and Job Performance in a Large Organization. *Journal of Work and Organizational Psychology*, 35(1), 27-37.

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## Appendix A

*Likert Items added to the Level 2 survey:*

### **PRACTICAL APPLICATION (Included by TxDOT)**

- I am successfully applying the skills, best practices, and knowledge that I have learned in the Flexible Work Execution Course in my workplace.

### **SATISFACTION (Included by TxDOT)**

- I feel confident about applying the [SKILL] I learned for my position.

### **MATERIALS (Included based on Martins, Zerbini, & Medina, 2019)**

- The right kinds of materials were provided to me as part of the training.
- The right amounts of materials were provided to me as part of the training.

### **PRACTICAL APPLICATION (Included based on Martins, Zerbini, & Medina, 2019)**

- During and since the training, I thought about the new content and its implications for me personally.
- During and since the training, I identified daily situations at TxDOT where I could try to implement some of the practices presented during the training.
- During and since the training, I looked for connections between the course material and what I already knew.
- During and since the training, I tried to develop an overall idea of how different parts of all the other materials I've seen relate to each other.

### **BARRIERS (Included based on Martins, Zerbini, & Medina, 2019)**

- I had technical problems with the materials provided to me for the training.
- I got my first or second choice of the date and time I wanted to attend this training.
- The training was too short.
- The content was appropriate for the audience.
- The amount of activities during the course was adequate.
- I had enough time to absorb the material to meet the course objectives.
- I felt healthy during the training
- Overall, the training was about what I expected.
- I was ready to be focused on training during the training course.
- I had no difficulty switching between the materials and following the instructor.

### **MATERIALS (Included by TxDOT)**

- I used printed course materials to answer some of the earlier survey questions.
- I used electronic course materials to answer some of the earlier survey questions.

## Appendix B

### Excel Output

("E" denotes the e-materials classes and "P" denotes the print materials classes.)

#### DEV375

t-Test: Two-Sample Assuming Equal Variances

	<i>E Scores</i>	<i>P Scores</i>
Mean	0.843191555	0.79860917
Variance	0.00338888	0.007574686
Observations	27	49
Pooled Variance	0.006103997	
Hypothesized Mean Difference	0	
df	74	
t Stat	2.380834831	
P(T<=t) one-tail	0.009924015	
t Critical one-tail	1.665706893	
P(T<=t) two-tail	0.01984803	
t Critical two-tail	1.992543495	

#### DESCRIPTIVE STATISTICS DEV375

<i>E Scores</i>		<i>P Scores</i>	
Mean	0.843192	Mean	0.798609
Standard Error	0.011203	Standard Error	0.012433
Median	0.847222	Median	0.791667
Mode	0.819444	Mode	0.791667
Standard Deviation	0.058214	Standard Deviation	0.087033
Sample Variance	0.003389	Sample Variance	0.007575
Kurtosis	-0.65618	Kurtosis	-0.30243
Skewness	-0.00083	Skewness	-0.02055
Range	0.208333	Range	0.375
Minimum	0.736111	Minimum	0.597222
Maximum	0.944444	Maximum	0.972222
Sum	22.76617	Sum	39.13185
Count	27	Count	49
Largest(1)	0.944444	Largest(1)	0.972222
Smallest(1)	0.736111	Smallest(1)	0.597222
Confidence Level(95.0%)	0.023029	Confidence Level(95.0%)	0.024999