Journal of Executive Education

Volume 9 | Issue 1 Article 4

October 2013

The Effects of Computer Mediated Communication on Computer-Based Training

Mark A. Revels
Western Kentucky University, mrevels2@earthlink.net

Journal of Executive Education, 9(1) (2010). pp. 45–63

The Effects of Computer Mediated Communication on Computer-Based Training

Mark A. Revels, Ph.D.
Department of Computer Information Systems,
Western Kentucky University

Abstract

Student performance using computer-based training (CBT) may be related to the degree of interaction that occurs between students and the instructor, or between students and each other. This is significant in that the individualized nature of CBT (and perhaps Web-based training) is contrary to the social interaction needs of students. Using relevant pedagogical and social communication theories as a basis, this study employed empirical research methods on undergraduate participants to achieve the following objectives: to explore the use of computer mediated communication (CMC) as a surrogate for face-to-face interaction with CBT students, and to provide research-based recommendations for human resource development (HRD) managers charged with deployment of these and related technologies. The research results showed that undergraduate CBT participants who were sent personalized email once per week performed significantly better than participants who were sent no email.

Introduction

In the early nineties, the United States Air Force employed Stephenson and Armstrong Laboratory (U.S.) (1991) to research computer-based training (CBT) environments. Specifically, they did several studies that evaluated the performance of trainees using CBT while varying

the amount of interaction that occurred between the trainees and the instructor, and between the trainees and each other. They determined that trainees performed better with increased social interaction (Stephenson and Armstrong Laboratory (U.S.), 1991).

Stephenson's and Armstrong Laboratory's (U.S.) (1991) results were consistent with traditional instruction (TI) research, which showed that consistent, short instructor-student interactions positively influence student achievement (Brophy, 1986; McCombs, Back, & West, 1984; Rosenshine, 1983). Regarding TI, Brophy and Good (1986) wrote:

"Teachers who produced the most achievement…enjoyed working with students but interacted with them primarily within a teacher-student relationship." (p. 341). Additionally, in terms of distance learning, Harrell (1999) wrote that many students miss the face-to-face interaction offered by a traditional learning environment, and feel isolated as a result. Even so, some authors report that student-teacher interaction does not positively impact the learning environment. For example, according to Lee & Mamone (1995): "Since many adults have had a less than positive experience as children in school, the traditional classroom with an instructor conjures up negative experiences and makes learning less effective" (p. 8). This begs the question as to whether adults who had positive experiences as children would better appreciate student-teacher interaction later in life.

The potential impact of Stephenson's (1991) findings, the fact that they are supported by TI theory, and the lack of expert consensus only contributes to the confusion experienced by human resource development (HRD) managers charged with deploying CBT technology. For example, one of the purported benefits of CBT is the cost savings associated with reduced trainer requirements resulting from the self-paced nature of the training (Janson, 1992; Lawson, 1999; Lee & Mamone, 1995). However, while having students use CBT independently instead of using traditional instructional methods may save time and money at the outset, the lack of expert consensus interjects a question as to the effectiveness of that training since it lacks a social interaction component. To further compound the problem, in terms of CBT, at least one study came to the exact opposite conclusion as Stephenson. According to Desai, Richards, and Eddy (2000), CBT users who were isolated from instructors performed better than students using TI with instructor interaction.

This disagreement raises the question as to whether HRD managers should utilize technological surrogates in order to improve social

interaction and concomitant learning while using CBT techniques. In other words, will computer mediated communication (CMC) (i.e., electronic mail) positively influence the learning of CBT participants? Or, from a research perspective:

What CMC variables impact student learning?
What research-based guidelines can be provided to HRD managers?

Methodology

This section presents the research methodology, including the study hypotheses, assumptions, and limitations; as well as (a) how the study was designed, (b) the ethical considerations that were given, (c) considerations concerning the study participants, (d) the instruments and measures that were used, and, (e) data collection and analysis techniques.

Hypotheses

The fundamental research hypothesis of this study was that CMC, specifically email, could be used as a surrogate for face-to-face instructor interaction with students using CBT, thereby increasing their social interaction and learning. Therefore, the following hypotheses were developed:

1. Personally addressing CBT participants by name when interacting with an instructor via email will create a statistically significant difference in the participant's learning.
2. Increasing the frequency in which CBT participants interact with an instructor via email will create a statistically significant difference in their learning.

Assumptions

The following research assumptions were made in pursuit of this study:

1. The sample frame consisted of undergraduate students taking a CBT course in a given semester. Typically, this number ranges from 450 to 550, depending on the semester. However, not all of the students were available for evaluation as some instructors did

not wish to participate in the study. The actual study pool was 360 participants spread over eight sections of one course.
2. Because participants were randomly assigned, potential bias was mitigated.
3. All participant interaction with instructors, other participants, instructional materials, and the general training environment was similar for each participant.
4. Participants did not significantly interact with each other with regard to sharing treatment information or experience.
5. The randomized pretest-posttest control-group design of the experiment reduced participant sensitization.
6. A statistically significant difference in pretest-posttest results indicated a significant change in learning.
7. Participants completed the pretests with the same level of effort as the posttests.
8. The pretests adequately represented the material covered in the posttests.
9. It should be noted that extant research is not clear as to the appropriateness of undergraduate students as surrogates in the training context. However, Hughes and Gibson (1991) wrote that undergraduates were not adequate surrogates for industry managers in the decision-making context. Conversely, Ro and Tangpong (2008) reported that undergraduates can successfully be used for decision-making contexts, but not for transactional or competitive supply chain contexts. As a result, it is assumed that the research results using undergraduates *in this study* directly correlate to trainees in other contexts.

Limitations

The following limitations were made in pursuit of this study:

1. Due to the time limit on each section of the course, the pretest and posttest instruments were developed such that students were able to complete them within the allotted class period (approximately one hour).
2. Participants were limited to undergraduate students taking a CBT-based course.

3. Limited participant attrition occurred as a result of the environment.
4. The researcher was the instructor for some courses, but was not directly cognizant of which participants were in which study groups.
5. Pretest scores were measured correctly and had little or no impact on posttest scores.

Design of the Study

In addition to providing HRD managers, educators, and trainers with strategies to improve learning effectiveness, the study also intended to answer research questions concerning what CMC variables impact participant learning. Therefore, it was necessary to use a methodology that enabled the researcher to explore one or more variables with one or more variable factors while also providing for pretest-posttest analysis in order to measure learning gain. Thus, the study used a single-blind, randomized pretest-posttest control-group design as outlined by Bonate (2000) and Trochim (2001). This method effectively controlled for the following threats to internal validity as reported by Mitchell and Jolley (2001): statistical regression, differential selection, history, testing, maturation, select-maturation interaction, experimental mortality, and instrumentation.

The research consisted of four steps as follows: (a) participants were randomly assigned to treatment and non-treatment groups, (b) pretests were administered to all groups before the start of treatment, (c) the treatment (CMC) was administered to the treatment groups, and (d) the posttest was administered to all groups to determine any change in learning.

Ethical Considerations

At the outset of each course, students were informed by their instructors that they could voluntarily participate in the program. If they chose to do so, they were instructed to complete an authorization form, which was reviewed and approved as part of the overall approval of the research program by the university Human Subjects Review Board.

Participants

The ideal study population is all current and potential participants of CBT programs. However, the sample frame chosen did not cause any serious threats to the external validity as a relatively large sample of undergraduate participants is representative of that population.

The sample groups were selected by assigning a random number to each student volunteer listed in the participating courses, matching their student ID number and a number generated by a random number generator. In this manner, unmatched participants were randomly and permanently assigned to control and treatment groups. Furthermore, participant email addresses were matched with the participant ID numbers in order to ensure that the proper email was sent to the proper participant. In order to investigate the effect of developing a personal relationship between the instructor and the participant, one participant treatment group received emails wherein the recipient was addressed personally by first name. The other participant treatment group was addressed non-personally by a generic greeting. In order to investigate the effects of frequency of communication between instructor and participants, within these two participant groups was two additional sub-groups: one who received email with a frequency of one email per week, and another who received email with a frequency of three emails per week. A final set of participants was randomly assigned to a non-treatment group as a control.

Instrumentation and Measures

Pretest

All participants were encouraged to take the pretest. Everett and Ahern (1994) reported that rewarding students for participating in 'extra-classroom' activities increases the participation rate. As a result, participants who took the pretest examination were awarded 1% extra credit if they took the exam, but were not penalized if they did not take the exam. Those that did not take the pretest did not participate in the study.

The pretest was designed and administered in the same fashion as the posttest, but with a different question order.

Bonate (2000) reported that pretest sensitization can be an issue in sociological studies and that one method of dealing with this issue is to 'disguise' the pretest such that the participant cannot detect its

characteristics. This was accomplished by calling the pretests orientation exams, and explaining that they were used for helping the participants become more used to the type of examinations that will be used to calculate their grades.

Treatment

To test the effects of message repetition, treatment consisted of sending emails to all treatment groups either once per week, or three times per week. Furthermore, to test the effects of social presence, there was a total number of five types of email groups: (a) a vocative (personal) salutation, once per week; (b) a vocative (personal) salutation, three times per week; (c) a generic, non-vocative salutation, once per week; (d) a generic, non-vocative salutation, three times per week; and (e) the control group, which received no treatment (email).

Since the purpose of the treatment was to determine learning impacts that resulted from personalization and repetitive frequency of email, the actual content of the email message was the same for all participants. While the messages changed from week to week, they were always a brief encouragement.

Posttest

The participant training and pretest/posttest assessments were administered using SimNet XPert, a CBT product of the McGraw-Hill Companies (2005). Over the course of the treatment period, using standard CBT delivery techniques, the participants trained themselves on four sections of Microsoft Office skills using the SimNet software: (a) Windows XP, (b) Excel, (c) Powerpoint, and (d) Word. For each of these subject areas, there was a performance-based posttest exam wherein participants demonstrated a broad set of skills for that subject area. The examinations were automatically scored by the software and reported to the student's online grade book.

Data Collection and Analysis

Because the goal of the research was investigate the improvement of learning gain while using email as a surrogate for instructor interaction, the independent variables included the type and volume of email sent to students in the treatment group. The dependent variables included

the learning gain of the treatment group and the learning gain of the control group.

Email was automatically managed by a broadcast email program, sent on scheduled days, and at the same time of day. In order to ensure that treatment groups are treated similarly, the number of valid (not returned) email transmissions sent to each group was recorded using electronic data collection. Moreover, all non-treatment email correspondence from course instructors was collected and factored into the overall email transmissions by counting and categorizing them according to the research groups (personal, non-personal, once per week, and three times per week).

Two email treatments were conducted: once per week, and three times per week. Additionally, two types of email were sent: personalized and non-personalized. Personalized email contained the same message, but was addressed to the student using their first name as a salutation. Non-personalized messages used a generic salutation such as 'Dear Student.'

Learning gain for each group was measured using pretest and posttest instruments. These were administered electronically in similar fashion as other CBT assessments in the course: Percentage-correct scores were electronically transmitted from the student's workstation to a centralized server.

From the collected data, several analyses were conducted. First, there are numerous statistical methods traditionally used for comparing groups using pretest and posttest data: ANOVA on the gain scores, ANOVA on the residual scores, ANOVA on percent-change scores, blocking by initial scores, and ANCOVA (Bonate, 2000). Most sources recommend the use of ANCOVA as it is relatively robust when assumptions of normality and homogeneity are violated. In addition, when using ANCOVA in a randomized experiment, the pretest can be used as a covariate in order to reduce variability in the posttest that is unrelated to the treatment. By reducing posttest variability in this way, treatment effects should be more significant (Trochim, 2001). Furthermore, Dimitrov and Rumrill (2003) noted: "ANCOVA should be the preferred method of analysis of pretest-posttest data" (p.164).

In this experiment multi-way ANCOVA could not be used because the research design could not be fully-crossed. It is impossible to implement a control for the factor Frequency without causing a no-treatment condition. This is called incomplete factorial design (Trochim, 2001). To accommodate this situation, one-way ANOVA for the five resulting groups including pretest, unadjusted posttest, and gain scores was used. In addition, a one-

way ANCOVA was performed on the adjusted group posttest scores by controlling for the participant's pretest score.

For this research, two error estimations were made: the margin of error, and the alpha level. The margin of error is the risk the researcher is taking that the sample does not exactly represent the population. The alpha level (α) is the risk the researcher is taking that the difference between the sample and the population determined by statistics does not actually exist (Type I error). According to Maxwell & Delaney (1990), for educational research the alpha level is traditionally set at .10 for pilot studies; at .01 for research were errors may cause significant financial or human injury; and at .05 for general research. Furthermore, categorical margin of error rates are usually set at 5%, whereas continuous data is set at 3%. This study used .05, and 5%, respectively.

Medium effect size was adopted ($f = .25$, $R = .24$, $R^2 = .06$), which combined with an alpha level of .05 and a statistical power of .97, yields a required sample size of 40 participants per cell, or 240 total participants, which was accommodated by the sample frame.

Findings and Analysis of Data

This section presents the results of the studies conducted during this research. Specifically, descriptive statistics were used to characterize the group performance on pretests and posttests. Analysis of variance (ANOVA) and analysis of covariance (ANCOVA) were used to demonstrate the significance of treatment results in terms of participant learning.

Research Sample and Descriptive Statistics

As one of the goals of the research was to investigate the improvement of learning gain while using email as a surrogate for instructor interaction, the independent variables included the type and frequency of email sent to students in the treatment group. The dependent variables included the learning gain of the treatment groups and the learning gain of the control group.

Participants who did not complete all tests (pretests and posttests) were eliminated from the sample.

The participants were randomly assigned to each group, which resulted in a control group with $N = 136$ and total treatment groups with $N = 224$. The treatment group assignments were as follows: (a) a group receiving vocative (personal) salutations, once per week, with $N = 56$; (b)

a group receiving vocative (personal) salutations, three times per week, with N = 57; (c) a group receiving non-vocative salutations, once per week, with N = 55 ; and, (d) a group receiving non-vocative salutations, three times per week, with N = 56.

The distribution of gender across the study groups was as follows: (a) vocative (personal) salutations, once per week was 41% male, and 59% female; (b) vocative (personal) salutations, three times per week was 43% male, and 57% female; (c) non-vocative salutations, once per week was 40% male and 60% female, (d) non-vocative salutations, three times per week was 48% male and 52% female (Table 1).

Table 1. *Frequency Counts and Gender Distribution for Experimental Groups (N= 360)*

Group	N	%	Male %	Female %
Control	136	37.8	42	58
Vocative, Once per Week	56	15.6	41	59
Vocative, Three per Week	57	15.8	43	57
Non-Vocative, Once per Week	55	15.3	40	60
Non-Vocative, Three per Week	56	15.6	48	52

Note: Percentage may not equal 100 due to rounding.

Analysis Assumptions

For analysis of variance (ANOVA), four assumptions were made:

1. The level or scale of measurement must be of the interval or ratio type. The measurements used in this study satisfy this requirement because they are ratio measurements with a non-arbitrary zero value.
2. Observations must be random and independent. The observations used in this study satisfy this requirement because participants were randomly assigned and observations made before and after treatment.
3. Even though there is a small effect on the Type I error rate when normality is violated in ANOVA, each group was tested using

the one sample Kolmogorov – Smirnov Test. The results showed that all groups were normally distributed (see Table 2).

4. The final ANOVA assumption is that there is homogeneity of variance, or that the distribution variances are equal. This was tested with Levene's test of homogeneity of variance. The test was not significant, thus the assumption of homogeneity was not violated ($F(2,357) = .624$, $p > .05$).

For analysis of covariance (ANCOVA), four assumptions were made:

1. The covariate should be chosen based on existing theory and research. This requirement is met as pretest scores are routinely used as ANCOVA covariates in pretest-posttest studies (Bonate, 2000).
2. Covariates may be continuous or discrete. In the case of this study, the covariate is continuous.
3. The independent variable must not have effects on the covariate. This is assured since the covariate was measured before treatment.

Table 2. *One Sample Kolmogorov—Smirnov Test*

Group	N	KS	Asymtotic Sig. (2-tailed)	Normal
Control	136	1.172	0.128	Yes
Vocative, Once per Week	56	0.782	0.574	Yes
Vocative, Three per Week	57	0.720	0.678	Yes
None-Vocative, Once per Week	55	0.436	0.436	Yes
Non-Vocative, Three per Week	56	0.782	0.782	Yes

4. There must be a linear relationship between the covariate and the dependent variable, in this case between the pretest and posttest scores. For this study, the pretest is linearly related to the dependent variable, posttest (*Rsq* = .55) (Figure 1).

5. The final ANCOVA assumption is homogeneity of regression, meaning there is a similar relationship between the dependent variable and the covariate across multiple levels of the independent variable. This is assured using Levene's test, which was not significant, and thus the assumption of homogeneity was valid ($F(4,355) = .317, p > .05$).

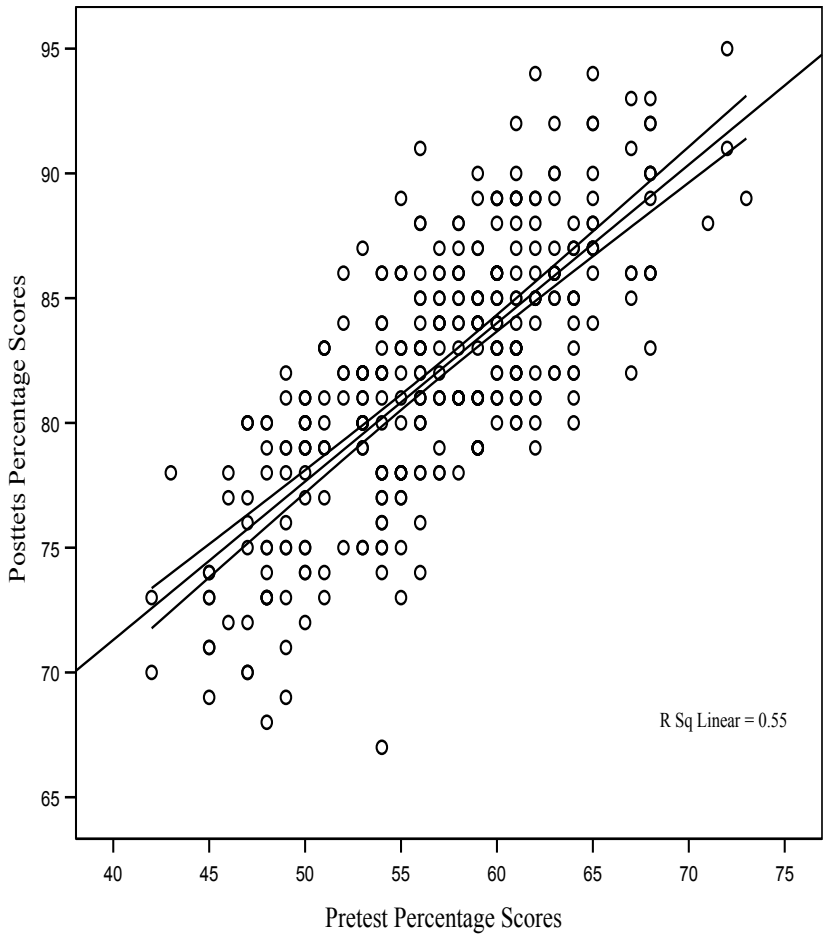

Figure 1. Scatterplot illustrating relationship between covariate and dependent variable

Analysis of Participant Learning

This study made the following hypotheses:

1. Personally addressing CBT participants by name when interacting with an instructor via email will create a statistically significant difference in the participant's learning.
2. Increasing the frequency in which CBT participants interact with an instructor via email will create a statistically significant difference in their learning.

As part of the learning analysis, the results of the one way ANOVA test for pretest, unadjusted posttest and gain scores for the five groups are displayed in Table 3. No significant differences were found between the five groups (p = .30) for their pretest scores. Unadjusted posttest scores were significantly different between the groups (p = .001). Scheffé post hoc tests showed that participants in the 'once, vocative' group had significantly higher scores than did 'control' participants (p = .001), 'three, non-vocative' participants (p = .02) and the 'three, vocative' participants (p = .04). None of the other Scheffé post hoc tests for the participants' unadjusted posttest scores were significant at the $p < .05$ level.

Gain scores (posttest score minus pretest score) were compared across the five groups of participants and found to be significantly different at the p = .001 level. All five groups of participants gained at least 23 percentage points between the pretest and posttest. Scheffé post hoc tests revealed that participants in the 'once, vocative' group had significantly higher scores than did 'control' participants (p = .001) and the 'three, non-vocative' participants (p = .001). In addition, the 'control' participants had less gain than the 'three, vocative' participants (p = .002) and the 'once, non-vocative' participants (p = .002). None of the other post hoc tests for the participants' gain scores were significant at the $p <$ .05 level. Table 4 summarizes these results.

Table 5 displays the results of the one way ANCOVA model for the posttest score based on the participants' group adjusted for their pretest score. The pretest score was selected as a covariate because the Pearson product-moment correlation between the pretest score and posttest score was significant (r = .74, p = .001).

Table 3. *One Way ANOVA Tests Based on Experimental Group with Scheffé Post Hoc Tests (N = 360)*

Score	Group	*N*	*M*	*SD*	*F*	*p*
Pretest Percentage a	1. Control	136	57.54	6.30	1.23	0.30
	2. Once, Non-Vocative	55	56.95	5.24		
	3. Once, Vocative	56	56.75	5.18		
	4. Three, Non-Vocative	56	57.07	6.73		
	5. Three, Vocative	57	55.49	5.25		
	Total	360	56.93	5.91		
Posttest Percentage b	1. Control	136	81.21	5.29	5.23	0.001
	2. Once, Non-Vocative	55	82.69	4.02		
	3. Once, Vocative	56	84.57	4.58		
	4. Three, Non-Vocative	56	81.36	5.46		0.30
	5. Three, Vocative	57	81.63	4.67		
	Total	360	82.05	5.06		

[a] Post Hoc Tests: No pairs of means significantly different at the $p < .05$ level.

[b] Post Hoc Tests: 3 > 1 ($p = .001$); 3 > 4 ($p = .02$); 3 > 5 ($p = .04$); no other pairs of means were significantly different at the $p < .05$ level.

Table 4. *Gain Score Comparison*

Score	Group	*n*	*M*	*SD*	*F*	*p*
Gain c	1. Control	136	23.68	3.62	14.44	0.001
	2. Once, Non-Vocative	55	25.75	4.19		
	3. Once, Vocative	56	27.82	3.28		
	4. Three, Non-Vocative	56	24.29	3.67		
	5. Three, Vocative	57	26.14	4.11		
	Total	360	25.12	4.02		

[c] Post Hoc Tests: 3 > 1 (p = .001); 3 > 4 (p = .001); 5 > 1 (p = .002); 2 > 1 (p = .002); no other pairs of means significantly different at the p < .05 level.

Table 5. *Analysis of Covariance Model for Posttest Score Based on Experimental Group and Controlling for Pretest Score (N = 360)*

Source	*SS*	*df*	*MS*	*F*	*p*
Full Model	5,714.14	5	1142.83	116.62	0.001
Pretest Covariate	5,203.43	1	5203.43	531.00	0.001
Group	664.76	4	166.19	16.96	0.001
Error	3,468.96	354	9.80		
Total	9,183.10	359			

Significant differences in the adjusted group means were found after controlling for the pretest score (p = .001).

Table 6 displays the means and standard error results for the ANCOVA model. Based on Bonferroni post hoc tests, participants in the 'once, vocative' group had significantly higher adjusted posttest scores than for any of the other four groups. In addition, the 'control' participants had lower adjusted posttest scores than the 'three, vocative' participants (p = .005) and the 'once, non-vocative' participants (p = .002).

Table 6. *Adjusted Posttest Means Based on Experimental Group (N = 360)*

Group[a]	M	SE
1. Control	80.82	0.27
2. Once, Non-Vocative	82.68	0.42
3. Once, Vocative	84.69	0.42
4. Three, Non-Vocative	81.26	0.42
5. Three, Vocative	82.56	0.42

[a] Bonferroni Post Hoc Tests: 3 > 1 (p = .001); 3 > 4 (p = .001); 3 > 5 (p = .004); 3 > 2 (p = .008); 2 > 1 (p = .002); 5 > 1 (p = .005); no other pairs of means significantly different at the p < .05 level.

None of the other post hoc tests for the participants' adjusted posttest scores were significant at the p < .05 level.

Conclusions

In terms of using CMC and the effect on CBT participant learning, the results showed that there was no significant difference between participant group pretest scores. This result was expected since participants were randomly selected. However, once treated, the participants' posttest scores were significantly different from pretest scores, even after controlling for the pretest as a confounding variable. Of the four treatment groups, the participants that received email once per week with a personal (vocative) salutation performed significantly better than other groups (p = .001). Furthermore, the two groups who received email three times per week also showed a statistically significant improvement (p = .02 for 'three, non-vocative', and p = .04 for 'three, vocative').

Why these results occurred may be attributable to a well-known phenomenon. The Hawthorne effect is an aspect of industrial psychology wherein participants of a study will perform differently if they know they are being studied (Mayo, 1933). Some researchers state that this was the result of the participants feeling more important since they were chosen to be studied. In this case, students may perform better because they feel the instructor is taking a personal interest in them by

sending personalized email messages on a routine basis. If this is so, then one might expect even more learning as more email messages are sent. However, Berlyne's (1970) two factor theory may explain why this did not happen: too much email simply becomes noise as the tedium factor increases. While the result of this study illustrated a positive effect of learner outcome with increased personalized emails, further study would be needed to determine if this was a result of the Hawthorne effect.

Recommendations

In practical terms, these results indicated that practitioners can use inexpensive email as a proxy for instructor interaction, which should result in increased CBT participant learning gain. Since one of the benefits of CBT is cost savings (Janson, 1992; Lawson, 1999; Lee & Mamone, 1995), email is an ideal solution, especially when combined with a local broadcast email server. This type of software allows for automated email distribution with low cost, setup, and maintenance. As an alternative to installing server software locally, users may also choose to use a broadcast email service, which manages the server software and hardware external to the organization, usually for a fee. There are several resources available on the Internet, many of which can be found by searching the phrase, 'choosing broadcast email.'

Future Research

In terms of future research, there are several areas that may have additional impact on CBT learning. Foremost, varying the content of the email message should be explored. In this study, the message was simple and held constant across all groups. However, the message could be personalized even more by: (a) increasing the level of empathy toward the participant, (b) using the participant's name in more than one place, (c) providing suggestions of how the participant could better learn difficult material; and (d), using any discourse that suggests to the participant that the instructor has a personal interest in them.

Message content research could be further explored by looking for correlation of certain types of messages and demographic characteristics of the participants. For example, will older males appreciate intimate instructor communication as much as younger females? If there is demographic correlation, then email messages should be tuned to the specific participant demographic in order to maximize learning. Lastly,

additional research would need to be conducted to understand the perceived outcomes in relation to the unintended gains resulting from the Hawthorne effect.

Summary

In 1998 the American Society for Training and Development (ASTD) estimated that typical private-sector businesses (with 50 or more employees) spent approximately $500 per employee on training (Bassi & Van Buren, 1998). In 2004 this estimate increased to $812 per employee, which represented approximately 7.50% of all organizational profit. Of this total, 5.00% was allocated to CBT, while 11.98% was allocated web-based training (WBT) (Sugrue & Kim, 2004). Thus, the total CBT training cost per employee was over $40, while WBT was over $97. Combined, this represents 1.27% of all organizational profit. As a result, HRD managers have a fiduciary responsibility to contain cost while meeting the training needs of the organization, especially considering the size of financial investment. Part of this responsibility means using appropriate technology whenever possible. This research demonstrated that existing training modalities can be enhanced by implementing relatively inexpensive, simple tools.

References

Bassi, L. J., & Van Buren, M. E. (1998). The 1998 ASTD State of the industry report. *Training and Development, 52*(1), 21-43.

Berlyne, D. E. (1970). Novelty, complexity, and hedonic value. *Pecerptions & Psychophysics, 8*, (pp. 279-286).

Bonate, P. L. (2000). *Analysis of pretest-posttest design*. Boca Raton, FL: CRC.

Brophy, J. E. (1986). Teacher behavior and student achievement. *American Psychologist*, 4 (10), 1069-1077.

Brophy, J. E., & Good, T. L. (1986). Teacher behavior and student achievement. In M. Wittrock (Ed.), *Third handbook of research on teaching* (pp. 328-375). New York: Macmillan.

Desai, M. S., Richards, T., & Eddy, J. (2000). A field experiment: Instructor-based training vs. computer-based training. *Journal of Instructional Psychology*, *27*(3), 239-243.

Dimitrov, D. M., & Rumrill, P. D. Jr., (2003). Pretest-posttest designs and measurement of change. *Work*, *20*(2), 159-165.

Everett, D. R., & Ahern, T.C. (1994). Computer-mediated communication as a teaching tool: A case study. *Journal of Research on Computing in Education*, *26*(3), 336-357.

Harrell, W., Jr. (1999). Language learning at a distance via computer. *International Journal of Instructional Media*, *26*(3), 267-282.

Hughes, C.T., & Gibson, M.L. (1991). Students as Surrogates for managers in a decision-making environment: an experimental study. *Journal of Management Information Systems*, *8*(2), 153-166.

Janson, J. L. (1992, January). Simulation program helps Coast Guard sink training costs. *PC Week Special Reports*, 91-93.

Lawson, R. (1999). Computer-based training: Is it the next wave? *Professional Safety*, *44*(1), 30-34.

Lee, W. W., & Mamone, R. A. (1995). *The computer based training handbook*. Englewwod Cliffs, NJ: Educational Technology.

Maxwell, S. E., & Delaney, H. D. (1990). *Designing experiments and analyzing data: A model comparison perspective*. Pacific Grove, CA: Brooks/Cole.

Mayo, E. (1933). *The human problems of an industrial civilization*. New York: MacMillan.

McCombs, B. L., Back, S. M., & West, A. S. (1984). *Self-paced instruction: Factors critical to implementation in Air Force technical training – A preliminary inquiry* (AFHRL-TP-84-23, AD-A145 098). Lowry Air Force Base, CO: Air Force Human resources Laboratory, Training Systems Division.

McGraw-Hill Companies. (2005). SimNet™ XPert (Release 4) [Computer software]. New York: McGraw-Hill.

Mitchell, M. & Jolley, J. (2001). Research Design Explained (4th Ed) New York: Harcourt.

Poore, E. E. (2004). A comparison of knowledge retention of computer-based training under varied environments. *ProQuest Information and Learning Company*. (UMI No. 3117403).

Ro, Y.K., and Tangpong, C. (2008). Student-manager surrogacy in supply chain Decision making. *Journal of Business and Management, 14*(1), 77-91.

Rosenshine, B. (1983). Teaching functions in instructional programs. *The Elementary School Journal*, *83*, 335-351.

Stephenson, S. D., & Armstrong Laboratory (U.S.). (1991). *Maximizing achievement in computer-based training: The role of the instructor and other variables* (D 301.45/27-4:1991-0004). Brooks Air Force Base, Tex.: Armstrong Laboratory Air Force Systems Command.

Sugrue, B., & Kim, K. (2004). *ASTD 2004 state of the industry report*. Alexandria, VA: ASTD.

Trochim, W. M. (2001). *The research methods knowledge base*. Cincinnati, OH: Atomic Dog.