A COMPARISON OF TRADITIONAL AND WORLD WIDE WEB METHODOLOGIES, COMPUTER ANXIETY, AND HIGHER ORDER THINKING SKILLS IN THE IN-SERVICE TRAINING OF MISSISSIPPI 4-H EXTENSION AGENTS

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Abstract

This research compared traditional and World Wide Web based Extension agent in-service training in Mississippi with respect to higher-order thinking skills and computer anxiety. While the experimental sample (n = 26) was small, the study examined agents' ability to perform on two subject-matter post-tests at differing levels of Bloom's taxonomy of the cognitive domain and examined the role that computer anxiety played in the agents' performance. A hierarchical multiple linear regression was used in order to arrive at R^2 values to use in performing F tests at the .10 level of significance. At the knowledge level of Bloom's taxonomy, the researchers found no statistically significant difference in the post-test based on the training methodology (traditional or Web based), the agents' level of computer anxiety, or the interaction of these two variables. However, at the application level of Bloom's taxonomy, the interaction between type of training methodology (traditional or Web based) and computer anxiety was statistically significant at the .10 level of significance. This treatment and computer anxiety interaction indicated that agents in the traditional group scored statistically significantly higher than agents in the Web-based group on the application level post-test.

Introduction

Keeping Extension agents up-to-date with the latest information necessary to effectively promote change in their respective communities is no small task. Training agents in the traditional manner requires agents to travel to the training destination. These training sessions require the agents to spend time away from their duties and involve the use of travel budgets. However, information technology has provided a way to train both agents and clientele "where they are." Training via the World Wide Web (Web) could replace some of the current training sessions and alleviate some of the above-mentioned concerns. As with any major change, Extension administration, as well as anyone considering adopting Web-based employee training, would like to be assured that using the Web to facilitate training is not only feasible and attainable, but also that it is an effective mode of training.

Few studies have examined the use of the Web to train Extension agents, and most have used a descriptive, ex-post facto approach to inquire about agents' perspectives on the training (Lippert, Plank, Camberato, & Chastain, 1998). This descriptive research lacks the empirical foundation for making decisions about the efficacy of training Extension agents via the Web.

Theoretical Framework

Higher-Order Thinking Skills

The use of the Web as a training delivery method cannot mean abandonment of sound educational practice. While using information technology may aid the learning process, there is still a need for instilling higher-order thinking skills in learners. Newcomb (1995) stated that given the pace

of change, it was useless to focus on teaching facts. Educators must instead provoke learners to think at a higher level of cognition. Bloom's taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) of the cognitive domain is useful when considering the challenge associated with a training task. Bloom et al. (1956) identified the cognitive levels of learning in a hierarchical arrangement as knowledge, comprehension, application, analysis, synthesis and evaluation. Mastery at each cognitive level is dependent on the learner being able to successfully complete tasks associated with the lower levels (Gilbert, 1992). Higher-order questions require the learner to apply learned information in a new situation or to otherwise analyze, synthesize, and evaluate information. Lower-order questions, indicative of the first two levels of Bloom's taxonomy, require learners to recall and understand information.

Research by Lewis (1997) showed that student grades and interest levels increased significantly when interactive, visual, and auditory computer-based tutorials are used during the teaching process. The use of relevant visual material over the Web increased interest and enhanced recall and understanding, partly because more senses and stimulation were involved. Moreover, the use of Web information technology is supported by both the Constructivist and Cognitive Information Processing (CIP) theories of learning mainly because they allow learners to create their own knowledge structures (Ramirez, 1998). However, the act of using a computer and the Web will not magically improve critical thinking skills. Carr (1998) found through a qualitative analysis of an on-line university course that some students lack the cognitive readiness to independently apply critical thinking skills.

Computer Anxiety

McInerney, McInerney, and Sinclair (1994) proposed that computer anxiety is an affective response of apprehension coupled with feelings of intimidation, hostility and nervousness. Martin (1998) examined the computer anxiety levels of Virginia Cooperative Extension personnel and found that 20% of Virginia Extension personnel were anxious or highly anxious about using the computer. The study indicated that the more a person used the computer, the less anxious they were. This finding is consistent with many other studies that have examined computer anxiety (Glass & Knight, 1988; Sexton, Newman, & Raven, 1998).

Extension In-Service Training

In most states, Extension agents are required to attend courses each year in order to stay up-to-date with information such as new trends in technology, advancements in subject matter related issues, and Extension evaluation tactics. A study done at The Pennsylvania State University, however, helped to shed light on the reasons why Extension agents fail to attend in-service training events (Mincemoyer & Kelsey, 1999). Fifty-three percent of the Extension agents cited time away from the office as the primary reason that they did not attend in-service training while 45% said that a conflict with local programming forced them to stay in the county. Moreover, the Extension agents in this Pennsylvania study reported that the in-service training programs they did attend had problems. These problems included that the in-service lacked sufficient content depth (36%), the agents already knew the information being presented (33%) and the instructors (often subject-matter specialists) were poor instructors (23%) (Mincemoyer & Kelsey, 1999).

Web Related Issues

Dobbs and Gordon (1999) predicted that virtual universities (on-line only) would become a threat to traditional institutions of higher learning in years to come with regard to student recruitment and retention. While this may or may not be the case, the Web has caused many educators to rethink their beliefs about education, especially concerning teaching and learning (Owsten, 1997). Miller and Shih (1998) reported that university faculty perceive off-campus distance education courses to be less rigorous than traditional on-campus courses. For this reason, course design and evaluation of distance learning attempts must be analyzed intensely.

Many studies have examined the use of the Web as an instructional medium in formal education (for example, Goldberg, 1997; Roberts, 1999). Goldberg (1997) found no difference in academic performance between students taught with a traditional method, students taught using Web-only and students with access to both delivery methods. Furthermore, those in the Web instruction only group expressed a high degree of satisfaction with the delivery technique (Goldberg, 1997). Additionally, Roberts (1999) found no statistical difference between the two methods of instruction (Web only and traditional with Web support) on student achievement in a Technical Writing course at Mississippi State University.

However, few studies have documented and published the use of the Web for non-formal educational purposes. Khan (1989) identified several important dimensions of non-formal education. These include a learner-centered approach to activities and a variable and flexible curriculum. When non-formal education of any type is designed without thought to these dimensions, there is an increased chance of failure, regardless of the delivery methodology.

Hippology

The training topic selected for this study was "Training a 4-H Equine Hippology Team". Hippology is the study of the horse. The Hippology program and contest is designed to promote a higher level of horse-related critical thinking in the 4-H member. Ration formulation is one area of the contest that brings much anxiety for the leader and contestants, in part, because of the mathematics involved. The ration-formulation process involves a series of progressive calculations and sound decisions to arrive at an ideal ration for a given horse.

The Hippology topic was selected to test in-service training of Extension agents via the Web because it represents an animal science topic that would typically be taught using the experiential learning model and is a topic that would challenge the Web delivery methodology.

Purpose and Null Hypotheses

The purpose of this research was to compare the effectiveness of traditional and Web based Extension agent in-service training in Mississippi with respect to higher-order thinking skills and computer anxiety. The following six null hypotheses were tested in this study:

H_0-1: There will be no difference in group means between agents trained using the traditional method and agents trained using the Web training method on the station identification portion of the post-test (Bloom's knowledge level).

H_0-2: There will be no difference on the station identification portion of the post-test (knowledge level of Bloom's taxonomy) based on computer anxiety.

H_0-3: There will be no interaction observed between training methodology and computer anxiety on the station identification portion of the post-test (Bloom's knowledge level).

H_0-4: There will be no difference in group means between agents trained using the traditional method and agents trained using the Web training method on the ration formulation portion of the post-test (Bloom's application level).

H_0-5: There will be no difference on the ration formulation portion of the post-test (Bloom's application level) based on computer anxiety.

H_0-6: There will be no interaction observed between training methodology and computer anxiety on the ration formulation portion of the post-test (Bloom's application level).

Methodology

Research Design

The study was conducted using a post-test-only control group design (Campbell & Stanley, 1963). This true experimental design allowed random assignment of individuals assuring that treatment groups were equivalent (Borg & Gall, 1989). This design controlled all potential sources of

internal validity concerns. A potential concern for external validity, however, was reactive arrangements. The post-test-only control group design helped slightly reduce the reactive arrangement threat by avoiding an experimenter-introduced pretest session (Campbell & Stanley, 1963). Additionally, as Web-based in-service training was an innovative idea to the agents, the ecological external validity threat of novelty was also a concern.

Participants

The population for this study was Extension agents employed with the Mississippi State University Extension Service (MSU-ES). The sample for this study was 23 4-H Extension youth agents employed by the MSU-ES. Additionally, one graduate student with 20 years of Extension experience, one 4-H volunteer, and one 4-H program assistant were included in the sample. These three individuals had many characteristics in common with the agents in the study and, therefore, the researcher made no attempt to separate their data. Therefore, the entire sample was 26 adults (13 per treatment group) that have youth-development responsibilities in their respective counties. These 4-H agents elected to voluntarily enroll in in-service training to receive guidance in training a youth Hippology team.

The first of three workshops was held on campus and six agents attended. The other workshops were scheduled in locations based on agent travel needs, accommodations, and bandwidth connection. The research process was the same for all three in-service workshops. Nine agents attended the second workshop and 11 agents attended the third workshop.

The 26 agents ranged in age from 23 to 53 years (M = 35.81, SD = 11.00). Males made up 46% of the sample. Sixty-two percent of the agents possessed a bachelor's degree and all had a computer in their office with access to the Internet and the Web. In addition, all 26 agents had previously accessed the Web for work or school-related purposes. Seventy-three percent of the agents had accessed the Web for entertainment purposes and 54% of the agents had made an on-line purchase over the Web. In addition, 65% of the agents had computers available in their homes. Illustrated in Table 1 are the demographics across groups.

Table 1
Demographics and Computer Use of 4-H Agents (n = 26)

	Traditional		Web-Based	
Variable	*M*	*SD*	*M*	*SD*
Age	37.69	12.38	33.92	9.53
Years of Education	16.62	1.89	16.46	0.88
Number of Computer Courses Taken	4.69	3.66	3.62	1.50
Days/Yr. of Computer Use	246.92	90.13	256.15	90.07
Times/Wk. Use Internet to Communicate	13.62	13.90	36.08	80.07

Variables of Interest

The dependent variables were the agents' scores on two knowledge post-tests. These two post-tests represented two distinct cognitive levels of Bloom's taxonomy. Independent variables included the teaching method and the agents' level of computer anxiety.

Instrumentation

Three instruments were used in this study. These included a computer anxiety and demographics questionnaire and two subject-matter post-test instruments. Chou (1997) developed the 12-question computer anxiety instrument used in this study and reported a Cronbach's alpha coefficient of .83. The instrument, which has been used in a variety of educational settings, uses a four-point Likert scale that allows for no neutral answers (1 = strongly disagree, 4 = strongly agree). A second section was used to collect demographic data including age, education, gender, computer usage, and computer preferences.

The other two instruments were post-tests designed to measure the knowledge of the agents relative to the Hippology training, particularly the subject-matter specific material addressed during the in-service training. Four faculty members from different universities were given the details of the training event and asked to decide which level of Bloom's taxonomy the two post-tests targeted. All agreed that the first post-test, station identification, required learners to complete a task at the knowledge level of Bloom's taxonomy. Likewise, all faculty members were in agreement that the second post-test, ration formulation, targeted the application level of Bloom's taxonomy. A pilot test with Extension agents and specialists from neighboring states and graduate students was conducted on the post-test instruments and the Web site to ascertain face and content validity.

The first post-test represented Bloom's knowledge phase of the training and consisted of a series of eight identification stations. The agents rotated to each of these stations and identified a horse-related item that was shown and discussed in the training. The second post-test, a ration formulation problem where the participant had to make six progressive calculations and formulate a ration for a given horse, represented Bloom's application phase of the training.

Description of Treatment

On all three training occasions, the research process was the same. Agents met in the morning, were randomly assigned to treatment groups, moved to separate locations to complete the training, and then came back together to complete the post-tests.

Agents in the traditional group (control) received a typical agent in-service training session. The instructor used a variety of teaching techniques including lecture, demonstrations, hands-on activities, group activities, and discussion. This group could see and hold examples of horse-related equipment, get one-on-one help with mathematical questions and were able to seek immediate feedback from the instructor and other participants. The traditional session was videotaped and later reviewed to make certain that participants in both groups were exposed to the same subject matter related to the posttests.

The Web-based group was taken to a computer lab with Internet capabilities. The agents had individual access to a computer and were allowed to work alone at their own pace. The agents were asked to use the Web site as their sole source of information regarding the Hippology training. The Web site included features that enabled agents to submit learning checks and receive information regarding their learning progress. If agents submitted a wrong answer to one of the learning checks, they were informed of their incorrect response and asked to try again. This group had more limited means of feedback and was not able to physically touch the horse-related equipment they would later see in the station identification post-test.

Web Site

The Web site used to train Extension agents in the Web-based group was interactive to the extent that an agent could submit answers to learning checks found at the bottom of each Web page and get

feedback as to the correctness of their response. A 4-H equine specialist checked the Web site for face and content validity.

Data Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), Version 10.0. The sample size of Extension agents participating in the training event was less than desired to achieve an ideal statistical power. According to Borg and Gall (1989), in experimental research it is desirable to have a minimum of 15 cases in each comparison group. However, after the results from all three training sessions were combined, there were only 13 agents per group. According to Cohen and Cohen (1983), the choice of alpha depends on considerations of statistical power or the probability of rejecting the null hypothesis. With a sample size of 26 (13 per treatment group), a medium effect size and an alpha level of .05 for the *F* test, the resulting power was .25 (Cohen, 1977). The researcher was concerned about the possibility of a small sample size prior to the study and, in order to increase the statistical power, the researcher established a less stringent alpha level of .10 *a priori*.

According to Cohen (1977), the researcher should set the beta level (Type II) at four times their alpha (Type I) level. Accordingly, in this study, the beta level was .40. Since power is derived by subtracting the beta level from one (1 - .40), an acceptable power for this study was .60. However, with only 13 agents in each treatment group, the final statistical power was .38 with a medium effect size and an *F* test (Cohen, 1977). The researcher acknowledges this to be a less-than-ideal statistical power. While it is important to acknowledge this power when interpreting the research, the choice of a statistical technique and its ability to detect statistical differences in the data needs to be considered as well. According to Ary, Jacobs and Razavieh (1996), the use of interval-level data provides more information than other types of data. Therefore, statistical tests that use interval-level data are more powerful than tests of ordinal or nominal level data. Since the computer anxiety instrument provided the researcher with interval level data, it was appropriate to select a statistical technique with the power to analyze this data. Multiple linear regression, instead of an analysis of variance technique, afforded the researcher with this option and was, therefore, used to analyze the data.

Multiple linear regression analysis was used to test the six hypotheses. The data were checked to see if the assumptions of the multiple linear regression were met. These checks, including normality, homoscedasticity and multicollinearity, revealed no cause for concern. For both dependent variables, the following series of linear regression analyses were performed:

1. The first regression analysis included the main effects of treatment (T) and computer anxiety (A) as well the interaction variable (T x A). This analysis revealed the overall combined variation of all experimental factors on the dependent variable ($R^2_{Y \bullet T, A, TxA}$).

2. The second regression analyzed the main effects of treatment (T) and computer anxiety (A). This analysis allowed the researcher to isolate the variation of the T x A interaction. (Step 1 - Step 2) = T x A effect ($R^2_{Y \bullet T, A}$).

3. The third regression analyzed the main effect of treatment. By subtracting the interaction effect (Step 2) and the treatment effect found here from the overall effect (Step 1), the computer anxiety variation was derived. (Step 1 - (Step 2 + Step 3)) = A ($R^2_{Y \bullet A}$).

4. The fourth regression analyzed the main effect of computer anxiety. By subtracting the interaction effect (Step 2) and the computer anxiety effect found here from the overall effect (Step 1), the treatment variation was derived. (Step 1 - (Step 2 + Step 4)) = T ($R^2_{Y \bullet T}$).

Once these R^2 values were computed, the researcher used them to compute *F*

values and test the null hypotheses using the calculations prescribed by Cohen and Cohen (1983) at an alpha level of .10. These critical values were found by using the IDF.F function of SPSS.

Results

The hypotheses were grouped according to the dependent variable. The first three hypotheses related to the station identification (knowledge) post-test. Hypotheses four through six related to the ration formulation (application) post-test. Mean differences across groups were analyzed first (see Table 2). With 48 being the maximum on the computer anxiety instrument and indicating a high level of computer anxiety, both groups reported a computer anxiety level in the middle of the scale. This indicates that, in general, the agents were not overly anxious or overly confident in their computer-related skills.

Table 2
Mean Differences in Variables Across Groups (n = 26)

	Station post-test (Knowledge) (12 pts max.)		Rations post-test (Application) (17 points max.)		Computer Anxiety (48 points max.)	
Treatment	*M*	*SD*	*M*	*SD*	*M*	*SD*
Traditional	9.04	2.81	9.85	5.04	21.69	8.10
Computer	7.42	2.63	8.60	3.92	21.00	6.21

Next, a set of four hierarchical linear regression analyses were performed for both dependent variables to find the R^2 values necessary for completing the *F* tests for the hypotheses. According to the classification schematic proposed by Ary, Jacobs and Razavieh (1996), three of the intercorrelations between the variables of interest were negligible (.00 to .19). The remaining three intercorrelations were classified as having a low relationship (.20 to .49). The intercorrelations are presented in Table 3 and resulting R^2 values can be found in Table 4.

Table 3
Regression Intercorrelations (n = 26)

	Intercorrelations			
Variables	X_1	X_2	Y_1	Y_2
Treatment (X_1)	1.000	-.050	-.295	-.143
Computer Anxiety (X_2)		1.000	-.172	-.214
Station ID Post-test (Y_1)			1.000	.318
Rations Post-test (Y_2)				1.000

Table 4
R^2 Values for Research Variables (n = 26)

Variables	Station ID	Ration Formulation
Treatment (Group) (T)	.087	.020
Computer Anxiety (A)	.030	.043
Interaction (T X A)	.106	.175
Total	.223	.238

Once these R^2 values were computed, the researcher used them to compute F values. These F values were then compared to critical values to check for statistical significance at the .10 level of significance. For the treatment (k_T, n-k-1) and interaction ($k_{T\ X\ A}$, n-k-1) variables, the critical value of interest was $F_{2,\ 23} = 2.55$. For the computer anxiety (k_A, n-k-1) variable, the critical value of interest was $F_{1,24} = 2.93$. If F_{OBS} was greater than or equal to the critical values, the decision was to reject the null hypothesis. Otherwise, the researcher retained (failed to reject) the null hypothesis.

Hypotheses One to Three (Knowledge Level)

When analyzing means, the agents in the traditional group had a higher mean than agents in the Web-based group on both post-test measures with very little difference in overall computer anxiety. However, at the .10 level of significance, the F test revealed no statistically significant difference between the traditional and Web-based treatment groups on the station identification post-test ($F_{2,23} = 1.288$). Therefore there was no difference between the agent training groups on the post-test representing the lowest level of Bloom's taxonomy and null hypothesis one was retained.

Additionally, at the .10 level of significance, the F test revealed that a participant's level of computer anxiety did not statistically significantly alter their performance on the station identification post-test ($F_{1,\ 24} = 0.926$). On the lowest level of Bloom's taxonomy, agent computer anxiety did not influence the agent's ability to complete the knowledge-level post-test, and null hypothesis two was retained.

Finally, the interaction between treatment group and computer anxiety did not yield a statistically significant difference on the station identification post-test ($F_{2,\ 23} = 1.569$) and null hypothesis three was retained. This indicates that at the lowest level of Bloom's taxonomy, the training methodology used and level of agent computer anxiety did not interact to cause a difference in the post-test results. A summary of these results for the station identification post-test can be found in Table 5.

Table 5
Results From F-Tests for the Station Post-test (Knowledge Level of Bloom's Taxonomy) (n = 26)

	F value	Critical Value	Significance
Treatment (T)	1.288	2.55	$p > .10$
Anxiety (A)	0.926	2.93	$p > .10$
T x A	1.569	2.55	$P > .10$

Hypotheses Four to Six (Application Level)

At the .10 level of significance, the *F* test revealed no statistically significant difference between the traditional and Web-based treatment groups on the ration formulation post-test ($F_{2,23} = 0.302$). Therefore null hypothesis four was retained thereby indicating that at a higher level of cognition, the type of training methodology used did not make a difference. Furthermore, at the .10 level of significance, the *F* test revealed that the main effect of agent computer anxiety did not statistically significantly alter their performance on the ration formulation post-test ($F_{1, 24} = 1.354$). Therefore null hypothesis five was retained as well.

The interaction effect between treatment group and computer anxiety yielded a statistically significant difference on the ration formulation post-test ($F_{2, 23} = 2.644$). The interaction indicated that when combined with the 4-H agents' computer anxiety, the training methodology had an effect on the rations post-test outcome. When a 4-H agent was experiencing a higher level of computer anxiety than their peers and were asked to learn new information at higher levels of cognition over the Web, they scored lower on the post-test. Therefore, null hypothesis six was rejected. A summary of the results for the ration formulation post-test can be found in Table 6.

Table 6
Results From F-Tests for the Rations Post-test (Application Level of Bloom's Taxonomy (n = 26)

	F value	Critical Value	Significance
Treatment (T)	0.302	2.55	$p > .10$
Anxiety (A)	1.354	2.93	$p > .10$
T x A	2.644	2.55	$p < .10$

Discussion and Conclusions

The research revealed that at the lowest level of cognition (knowledge), the type of training methodology, computer anxiety level, and the resulting interaction were not statistically significant. In other words, the 4-H agents were equally successful in completing the knowledge-level station identification post-test, regardless of training methodology or computer anxiety. One possible explanation for this may be that

many of the agents in both groups were familiar with the subject matter presented at this level of cognition. This was the case for some agents in Mincemoyer and Kelsey's (1999) Pennsylvania study where 33% of the agents were bored with in-service training events because they already knew the information being presented.

Perhaps the most interesting finding from this study is that when subject matter at higher levels of cognition was presented to the agent using a teaching methodology they may already have anxiety about, there was an increased rate of learning failure. This appears to be the case even when a learner-centered approach, as recommended by Khan (1989) was used. In addition, while Lippert, Radhakrishna, and Plank (1999) reported percentage gains on 25 items taught over the Web in an Extension in-service training, they did not attempt to categorize the cognitive level of each of the 25 items on their pre and post-test. It is possible that the items that the agents did not gain knowledge on via the Web training were items written at higher levels of cognition.

It seems logical that when agents were experiencing computer-related apprehension and intimidation (as described by McInerney, McInerney and Sinclair, 1994) and then were asked to use the computer to learn subject matter at higher levels of cognition, they may have been set up for failure. However, this exposure may be just what they need in order to gain experience and familiarity with computers that many researchers claim will reduce their computer-related anxiety (Glass & Knight, 1988; Raven, Newman & Day, 1997).

Many of the agents from both groups claimed that the ration formulation post-test was the hardest thing they had ever been confronted with at an in-service training event. It is possible that agents from both groups may have become comfortable attending in-service training events that were taught at the lower levels of cognition and, therefore, the agents were not prepared to engage in critical thinking. Whittington (1995) reported that while many educators profess to be teaching at higher levels of cognition, they rarely actually reach those critical levels of cognition. This may be the case with MSU-ES in-service instructors; they may be routinely offering training workshops that do not move the agents beyond the lowest levels of cognition.

Recommendations

In this study, with increasing difficulty of the cognitive task, the types of training methodology and computer anxiety interacted to provide a less-than-ideal learning outcome. Therefore, more research is needed to investigate the interplay between cognitive level, anxiety and the Web. The researchers recommend that this type of Web-based training be continued in research and practice with these suggested themes for future research:

- The effectiveness of a Web teaching methodology in a variety of educational settings. Is it more appropriate for formal educational settings?
- The role of Web site design. How can research data best distinguish between the effects of delivery medium and Web instructional design?
- The types of subject matter that work best when taught via the Web. For example, at the application level in this study, the Web-based group was learning to use mathematical formulas. Was this appropriate content to be teaching over the Web?
- The correlation between cognitive challenge of learning material and the effects of computer anxiety. Does increased cognitive challenge amplify the effects of computer anxiety?
- The importance of enhanced feedback mechanisms. For example, would results have differed if 4-H agents were allowed to email the instructor?

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