

A Case Study Assessing the Effects of Training on Conducting Website Searches Using Control and Treatment Groups of College Students

Saeed Yazdani and Talat Yazdani*

Abstract: The Internet and Web-based technologies have become a popular platform in all walks of life, including the academic world. An increasing number of college students use this media for conducting searches. The students' ability to successfully interact with the computer and conduct web searches is, however, dependent upon their prior knowledge of web searching, critical thinking skills, motivation, and competency with computers and related applications. The study is designed to discover if differences in students' information technology skills and critical thinking skills affect their ability to conduct effective searches on the Internet. The purpose of study is to test the impact of information technology applications training focused on conducting Web searches of varying difficulty. The findings are obtained by analyzing data provided from a survey conducted at Lane College in Jackson, Tennessee, consisting of junior and senior students ranging between the ages of 20 to 24. The results illustrate accuracy and time scores for students conducting web searches. They were given three levels of difficulty. Throughout the analysis, the treatment group consistently had higher scores than the control group.

Keywords: Efficiency

JEL classification: I21

1. Introduction

In advanced countries, such as the United States, academic research plays a vital role in the improvement of almost every aspect of life. Barry (1996) says internet and electronic library are altering the nature of research in academia. One specific change is the intensification in the need for information skills in an increasingly complex information rich world. Therefore, among other emerging competent researchers need to learn new skills require to conduct successful searches on the internet.

In the past, information was available through newspapers, textbooks, and news reports. Therefore, in that era of slower print-media based information search, the users required time to locate and evaluate the needed

* The authors are, respectively, Associate Professor of Business Administration at Southwestern College, Winfield, Kansas, USA and Professor of Economics at Lahore College for Women University, Lahore, Pakistan.

illustrated accuracy and time scores for students conducting web searches. They were given three levels of difficulty. Throughout the analysis, the treatment group consistently had higher scores than the control group.

The rest of paper is organized as follows: Section 2 is a brief overview of the literature. The methodology to arrive at relevant results is explained in section 3, exploring the search paradigm shift from traditional methods to electronic methods. Section 4 analyzes the impact of the empirically tested training in information technology applications, focusing on conducting web searches of varying difficulty. Section 5 concludes the study and provides brief policy recommendations.

2. Literature Review

A little over a decade ago, prior to the wide spread use of the Internet, college students were using different methods of conducting searches for their research. At the time, information-gathering processes were relatively simple. Geographically, information domains were restricted to the local area libraries. The internet, with a global domain, swiftly changed the entire search paradigm. The users were able to access and retrieve information without putting a step in a library.

Extensive literature is available on the broad topic of computers and on specific topics of the internet. Yet, disagreement exists among experts even in the meaning and interpretation attached to basic terms. According to *et al.*, Allen (2003) computer literacy is a slippery notion. The term functions much like the terms democracy, freedom, and common sense. Just about everyone knows precisely what he or she means, but no one seems to be able to agree on that meaning.

The study focuses on college students' educational research and emphasize that a student's depth of information utilization is dependent upon his or her level of information literacy. Kroenke (2002) stated that information literacy is the recognition of a need for information; the importance of organizing information so that it can be readily retrieved; the ability to evaluate information obtained and to apply critical thinking skills.

Holdsworth Limited) online CTT (Critical Thinking Test). There were fifty-two questions on this twenty-five minutes online test. The CTT was administered at the beginning of the research project, before the pre-test to both control and treatment groups. This published test has tested retest reliability of 0.77.

The second instrument used in this study was WSA (Web Search Assessment.) The researcher, an experienced IT professional with support of the LaneCollege's Computer Science, Mathematics, Physics faculty and IT department, constructed the Web Search Assessment test and training.

In this study, the difficulty of search has been divided into three levels; low, medium, and high. The low-level search difficulty means entering a word(s), phrase or sentence in the single search field.

Normally, a low difficulty information search will result in too many or too few returned links. Therefore, a searcher might be required to go to next level of search difficulty, referred to as medium-level difficulty in this study. In such cases, expanding or narrowing the information search could be achieved by using certain techniques. The high-level search difficulty, in this study, refers to an information search that requires advance knowledge about the search engine or search directory to match certain conditions.

Each student's assigned search outcome was scored for two assessment elements; time and accuracy. Each student identified the start and the end of the search episode and registered it. A score was assigned based on the classification of time expected for each level. In terms of the accuracy score the researcher assessed the quality of the students finding and assigned a value. Higher values correlated with the increased numbers of conditions that were allocated to more difficult search. Two search assignments were administered on control and treatment groups based on low, medium and high level of difficulty.

To accomplish the study, a case comparison design was utilized. Each group was administered the critical thinking test in order to confirm equivalency or near equivalency of the two groups regarding their critical

thinking skills. Based on the objective of study, the following null hypothesis is formed:

Null Hypothesis 1 ($H_o : \bar{X}_T = \bar{X}_C$)

There is no significant difference on the pretest for the accuracy between the control and treatment groups for low level of search difficulty.

Null Hypothesis 2 ($H_o : \bar{X}_T = \bar{X}_C$)

There is no significant difference on the posttest accuracy scores between the treatment and control groups for low level of search difficulty.

Null Hypothesis 3 ($H_o : \bar{X}_T = \bar{X}_C$)

There is no significant difference on the pretest of accuracy between the control and treatment groups for medium level of search difficulty.

Null Hypothesis 4 ($H_o : \bar{X}_T = \bar{X}_C$)

There is no significant difference on the posttest accuracy score between the treatment and control group for medium level of search difficulty.

Null Hypothesis 5 ($H_o : \bar{X}_T \neq \bar{X}_C$)

There is no significant difference on the pretest accuracy scores between the control and treatment groups for high level of difficulty.

Null Hypothesis 6 ($H_o : \bar{X}_T = \bar{X}_C$)

There is no significant difference on the posttest accuracy score between the treatment and control group for high level of search difficulty.

Null Hypothesis 7 ($H_o : \bar{X}_T = \bar{X}_C$)

There is no significant difference on the search time scores between the control and treatment groups for low level of web search difficulty.

Null Hypothesis 8 ($H_o : \bar{X}_T = \bar{X}_C$)

There is no significant difference on the posttest search time scores between the treatment and control group for low level of search difficulty.

Null Hypothesis 9 ($H_o : \bar{X}_T = \bar{X}_C$)

There is no significant difference on scores of search time between the control and treatment groups for medium level of web search difficulty.

Null Hypothesis 10 ($H_o : \bar{X}_T = \bar{X}_C$)

There is no significant difference on the posttest search time scores between the treatment and control group for medium level of search difficulty.

Null Hypothesis 11 ($H_o : \bar{X}_T = \bar{X}_C$)

There is no significant difference on the scores of search time between the control and treatment groups for high level of web search difficulty.

Null Hypothesis 12 ($H_o : \bar{X}_T = \bar{X}_C$)

There is no significant difference on the posttest search time scores between the treatment and control group for high level of search difficulty.

3.1 Context of Study

The study was conducted at Lane College in Jackson Tennessee, founded in 1882. LaneCollege is a small, private, co-educational, church-related institution. LaneCollege is considered one of the top institutions among Historically Black Colleges and Universities (HBCUs). Along with Computer Science, Math, and Physics faculty, the IT (Information Technology) department at Lane College was closely consulted in designing the Web search assessment and training for the treatment group. The dependent variables for the study were the accuracy found for each level of difficulty and time of conducting the searches. The number of links would reflect the relevancy and accuracy of a search. The independent variables were the control and treatment groups, and the pre and post testing condition.

3.2 Population and Sample of the Study

Almost 99 percent of the Lane College population is African-American. A sample of forty students, majoring in Computer Science, Mathematics, Engineering, English, and Physics were non-randomly selected for the study. Taking the convenience sample selection approach, forty students for both treatment and control groups were non-randomly selected from students majoring in Computer Science, Engineering, Mathematics, and Physics. The treatment and control groups consisted twenty students each. Given the small size of classes, a random sample selection was not possible. In order to control for variability of students capabilities related to computer

and web search related skills, only science majors were included in the sample.

The students in the sample were between the ages of 20 to 24 years. The treatment group consisted of 8 male and 12 female students, and the control group consisted of 9 male and 11 female students. The assigned control and treatment groups were randomly assigned thus discouraging any biased selection by the researcher.

3.3 Training for the Treatment Group

The eight hours training was conducted for three days comprising two, three hours and one, two hours session. The treatment group received demonstrations on three levels of web search difficulty; categorized as low, medium, and high.

4. Statistical Analysis

The researcher assessed similarity between the treatment and control group using the critical thinking test. The omnibus analysis was the two factor analysis variance with grouping variable treatment and control as one independent variable and pre testing-post testing was the second independent variable. The dependent variables were accuracy and time. Descriptive statistics, means and standard deviations was accompanied each ANOVA.

A key consideration when assessing the comparability of the two groups, besides gender and grade distribution, was the critical thinking skills. As shown in Table 1, the computed *t* value for unpaired groups was found to be non-significant, thus concluding that the critical thinking skills were the same between the two groups and accepting the null hypothesis.

Table 1: t-test for Critical Thinking Test for Both Groups

Source	Mean Score	SD	t-Value	P
Control Group (n=20)	18.2	5.32	<i>t</i> =.616	54*

Treatment Group (n=20)	19.1	4.39		
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* Critical t-value for 38 degree of freedom (Two tailed test) for $p = .05$ $T = 2.035$

Tables 2 and 3 illustrate the cell means and the results of the two factor ANOVA. Regarding the low level of difficulty for accuracy, there was an increase in mean scores for both groups as shown in Table 2. Table 3 illustrates F-value for the treatment-control group condition as highly significant. For the pre-post condition, the F -value is significant ($F = .06$), again illustrating substantial differences between the pre-test and post-test scores.

Table 2: Mean Scores for Accuracy of Low Difficulty Search

Source	<i>Pre-Test</i>	<i>Post-Test</i>	Rows
Treatment Group	7.8	9.0	8.4
Control Group	6.0	6.8	6.4
Columns	6.9	7.9	7.4

Table 3: Analysis of Variance Summary for Low Difficulty Search

Source	<i>SS</i>	<i>DF</i>	<i>MS</i>	<i>F</i>	<i>P</i>
Between Groups	100.8	3.0			
Rows	80.0	1.0	80.0	13.62	0.000
Columns	20.0	1.0	20.0	3.41	0.068
Row X Column	0.8	1.0	0.8	0.14	0.709
Within Group	446.4	76.0	5.87		
Total	547.2	79.0			

Further review of the findings, shown in Table 4 and 5, for the medium level of difficulty finds that the mean score for the treatment group increases from 8.3 to 9 and a slightly decrease in the mean scores for the control group. The F -value, shown in Table 5, exhibits significant differences comparing the treatment and control group. The pre-post F -value was not significant. However, the mean scores for the treatment group was found to be higher and a significant difference from the control group.

Table 4: Mean Scores for Accuracy of Medium Difficulty Search

Source	<i>Pre-Test</i>	<i>Post-Test</i>	<i>Rows</i>
Treatment Group	8.25	9.0	8.625
Control Group	7.8	7.7	7.750
Columns	8.025	8.35	8.1875

Table 5: Analysis of Variance Summary for Medium Difficulty Search

Source	<i>SS</i>	<i>DF</i>	<i>MS</i>	<i>F</i>	<i>P</i>
Between Groups	20.03	3.0			
Rows	15.31	1.0	15.31	3.86	0.053
Columns	2.11	1.0	2.11	0.53	0.468
Row X Column	3.61	1.0	3.61	0.91	0.343
Within Group	301.15	76.0	3.96		
Total	322.18	79.0			

Table 6 illustrates the mean values for the treatment-control groups measuring accuracy with high level of difficulty. The treatment groups pre-test mean score changed from 6.2 to 8.6 while the control group had a change from 5.9 to 7.5 followed with an ANOVA shown in Table 9, which found no significant difference between treatment and control groups.

An examination of Table 7, ANOVA summary, shows highly significant differences between pre and post test scores ($p = .000$).

Table 6: Mean Scores for Accuracy of High Difficulty Search

Source	<i>Pre-Test</i>	<i>Post-Test</i>	<i>Rows</i>
Treatment Group	6.22	8.6	7.412
Control Group	5.90	7.5	6.7
Columns	6.06	8.05	7.056

Table 7: Analysis of Variance Summary for High Difficulty Search

Source	<i>SS</i>	<i>DF</i>	<i>MS</i>	<i>F</i>	<i>P</i>
Between Groups	92.15	3.0			

Rows	10.15	1.0	10.15	1.51	0.222
Columns	79.00	1.0	79.00	11.75	0.000
Row X Column	3.00	1.0	3.00	0.45	0.504
Within Group	510.83	76.0	6.72		
Total	602.99	79.0			

Tables 8 through 13 contains the mean scores and the results of the two factor ANOVA, using time as the dependent variable. Table 8 shows the mean scores for the low difficulty level similar in value and Table 9 shows the *F*- values for both rows (treatment) and columns (pre-post testing) as non significant. However, a nearly significant *F*-value was found for interaction between the treatment and pre-post conditions.

The mean scores of the two groups in terms of medium level of difficulty is illustrated in Table 10 showing the treatment group having higher mean scores than the control group on both the pre and post tests. The ANOVA, shown in Table 11, found a significant *F*-statistic ($p = .02$) when the treatment group was compared to the control group, using the medium level of difficulty as the dependent variable.

Comparisons between the two groups for the higher difficulty level are shown in Table 12 and 13. The mean scores (Table 12) illustrate an increase in pre-postconditions with the treatment group consistently having higher scores but not significantly different than the control group.

Table 8: Mean Scores for Time of Low Difficulty Search

Source	<i>Pre-Test</i>	<i>Post-Test</i>	<i>Rows</i>
Treatment Group	4.00	3.82	3.912
Control Group	3.12	4.25	3.687
Columns	3.56	4.03	3.8

Table 9: Analysis of Time Summary for Low Difficulty Search

Source	<i>SS</i>	<i>DF</i>	<i>MS</i>	<i>F</i>	<i>P</i>
Between Groups	13.97	3.0			

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Rows	1.01	1.0	1.01	0.45	0.504
Columns	4.51	1.0	4.51	2.01	0.160
Row X Column	8.45	1.0	8.45	3.77	0.055
Within Group	170.32	76.0	2.24		
Total	184.43	79.0			

Table 10: Mean Scores for Time of Medium Difficulty Search

Source	<i>Pre-Test</i>	<i>Post-Test</i>	<i>Rows</i>
Treatment Group	3.50	4.25	3.975
Control Group	2.75	3.00	2.875
Columns	3.12	3.62	3.375

Table 11: Analysis of Time Summary for Medium Difficulty Search

Source	<i>SS</i>	<i>DF</i>	<i>MS</i>	<i>F</i>	<i>P</i>
Between Groups	26.25	3.0			
Rows	20.00	1.0	20.00	5.53	0.021
Columns	5.00	1.0	5.00	1.38	0.243
Row X Column	1.25	1.0	1.25	0.35	0.555
Within Group	275.00	76.0	3.61		
Total	301.25	79.0			

The analysis of variance found no significance difference between and within groups mean values.

Table 12: Mean Scores for Time of High Difficulty Search

Source	<i>Pre-Test</i>	<i>Post-Test</i>	<i>Rows</i>
Treatment Group	3.87	4.37	4.125
Control Group	3.25	3.75	3.5
Columns	3.56	4.06	3.812

Table 13: Analysis of Time Summary for High Difficulty Search

Source	<i>SS</i>	<i>DF</i>	<i>MS</i>	<i>F</i>	<i>P</i>
Between Groups	12.81	3.0			

Rows	7.81	1.0	7.81	2.51	0.11
Columns	5.00	1.0	5.00	1.60	0.209
Row X Column	0.00	1.0	0.00	0.00	1.000
Within Group	236.87	76.0	3.11		
Total	249.68	79.0			

A generalized null hypothesis is that all paired comparisons are not significant. Generally, through the mean comparisons, the treatment scores were found to be higher. The four significant t -values found the treatment group as having achieved the higher gains which resulted from the training administered. Interestingly, the pre-post mean scores on all these levels for accuracy were found to be significant for the treatment group.

5. Conclusions and Policy Recommendations

The case comparison study was conducted at a small liberal art four years college in Jackson, Tennessee. The sample consisted of a control and treatment groups selected on the basis of convenience. The sample was representative in terms of class designation and gender.

A published online critical thinking assessment was used to determine the comparability of the treatment and control group. There was no significance difference of mean scores on the critical thinking assessment between the two groups. Pre and post web search assessments were used to gather the data for the comparisons between and within the groups.

The treatment group was provided with eight hours of training distributed over three days. The training focused on web search techniques using accuracy and time as the dependent variables. The study employed analysis of variance and t -tests. A consistent pattern of treatment effect was found. The training mean scores were, for the most part, higher than the control group. In summary, the ability to influence performance using web search technology was effectively demonstrated by the training provided to college students. Policy recommendations are as follows:

- The web search technology could become an influential part of an introduction to computer course in colleges.

- The framework of this study could be applied to an expanded design in larger samples and different programs in different universities and colleges.
- The replication of this study using different levels on difficulty would provide validation to the objectives of an expanded web-search program.
- The development of curriculum and/or resource material should embody the process of high-order web-search technology.
- An examination of other IT and computer courses be conducted to determine the extent of current practices in web-search technology.

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