Using Web Based Training to Improve Classroom Performance

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I. Introduction

Web-based training has quickly increased in use as a training medium. Schools, government organizations, and private businesses have recently begun to utilize this powerful teaching aid for their own training purposes. With the increased use of web-based training, one is led to ask two important questions. “If web-based training is becoming so prevalent, what will happen to traditional classroom based instruction?” and “Is there any significant difference in the performance of students who receive web based training and those who receive traditional classroom instruction?” The latter question was the focus of this study. This study assessed the performance of students who received web-based training in a mechanical engineering technology course, versus students in the same course who did not receive the web-based training. The title of the course studied was MET 142, Manufacturing Processes 1. This course was designed to introduce students to manufacturing processes such as casting, forming and welding. A hands-on approach was used to introduce these concepts. Since not all students enrolled were Mechanical Engineering Technology majors, their diverse backgrounds had to be taken into account.

II. Literature review

Web-based instruction has been defined as:

“…a hypermedia based instruction program which utilizes the attributes and resources of the World Wide Web to create a meaningful environment where learning is fostered and supported.”¹

The most important aspect of web-based instruction, also called web-based training is that information is disseminated through the use of the Internet and the World Wide Web (WWW). Web based training is actually a specialized form of online education which is defined as, “…any form of learning/teaching that takes place over a computer network”. This type of activity can take place on any type of network, from an intranet to the World Wide Web.²

According to educator Andy Carvin, “traditional teaching fails because students have no use or interest in much of the material as it is presented”.³ This statement leads to several questions. What type of educational materials should be placed on the web? What is the most effective method of presentation of that material? How can an instructor assess whether or not actual learning has taken place? Teaching should, after all, be student centered.

The advantage of using the web as a teaching tool is that information can be presented in a clear and concise manner to many people of various backgrounds and abilities. Since differences in learning style do exist, the web is ideal as a teaching instrument because it can allow for the insertion of video, animation and other types of training media. It can also allow students to
learn at their own pace. The latter is an advantage to the student because he or she can repeat a lesson as many times as needed until the concepts are grasped. As stated by a student in a study conducted at MIT, “I think the real strength of the Web lecture, is that you can do it when you have the time, go at your own pace”.

In 1990, a study was conducted at Charles Sturt University, in Australia, to assess the impact of distance learning in a biology course. According to the students surveyed, there were numerous positive responses to the presentation of various study guides on the web. About 91% of the students surveyed stated the presentation of study guides was clear and easy to follow. Ninety-three percent stated that the subject organization was clearly explained. Ninety-five percent agreed that the interactive tasks used helped to develop study skills.

With regard to the method of presentation, 97% of the students said that the use of video was worthwhile. The use of video, as well as text-with-images, has worked well in other distance learning studies, such as one performed at MIT. In this experiment, the performance of students receiving a web lecture was compared to the performance of those who received the regular classroom lecture. It was found that almost 30% of the students surveyed preferred video as a method of presentation, while 50% preferred the text-with-images method.

The assessment of student performance yielded positive results. “The average performance of the students receiving web instruction was higher than for those receiving traditional classroom instruction”. A significance level of 0.063 was found, thereby, dispelling the belief that the two groups would have an equal performance. Significance means that any results obtained are not likely to be due to chance. “A significant result leads to the rejection of the null hypothesis”. In this paper’s study the null hypothesis was that there was no difference, in the way of performance, between students who received web-based training and those who did not.

III. Assumptions

For this study, it was assumed that students receiving web instruction had adequate access to the World Wide Web, and that they actually went to the web site to review the material. Also, since the students were observed in two groups, it was assumed that both groups were academically equal.

IV. Limitations

Going into this study, it was known that time would be a constraining factor. The research was to be conducted over a period of between one and two semesters. Another constraint was that access to the web could not be completely restricted to just the test group. There may have been a sharing of information among students. Another constraining factor was the possible difficulty of accessing the web site from an off-campus location. Students may have gotten a busy signal, or they may have had routing problems. The problem of encountering a busy signal occurs during the hours of peak usage of a network. The Internet Service Provider generally takes care of routing as well as other internal network issues. It must be stated that such problems are often minor and temporary. Additionally, it was known that there were enrollment differences in the course for fall and spring sections. Generally, enrollment was lower in fall for MET 142.
factor had the potential to impact the sampling size for the study. In addition to enrollment 
figures, student attention spans may have dropped during the spring semester with the approach 
of summer break. This could have impacted the results as well.

The greatest limitation to this study was the lack of time. In order to have a more detailed 
assessment of the effectiveness of the web site, a period of at least one academic semester would 
be required. Since that time period was beyond the scope of this study, the results were limited. 
Also, when the survey was administered, the dates of availability of the survey were too limited. 
This fact contributed to the lack of online response.

V. Procedures

The procedures used in this study were as follows:

1. Students were divided into two groups. There were two sections of MET 142, which met at 
   7:30 a.m. and 8:30 a.m. The 7:30 section was the group that received the Web treatment. 
The 8:30 section did not. It was decided to divide students by section because this method was 
the quickest and simplest one available at the time of selection. Dividing students by section 
allowed for better comparison because it was easier to keep track of what students were in 
each group. Also, division of the two groups allowed the study to remain “blind”. This is 
because information pertaining to the study was not mentioned to the 8:30 section.

2. Topics were identified that would be best to place on the Internet. This portion of the process 
took place during January and February 1999. It was decided to include course notes, 
practice quizzes, and links. Lecture notes and outlines already existed as MS Word 
documents and as such were easy to transfer into html documents through a Save command. 
Notes and outlines were intended for students to review prior to lectures and to use as 
supplements for lecture absences. The WebCT software that was used to construct the web 
site allowed the creation of quizzes that could be scored electronically and immediately. 
Incorporating quizzes took advantage of the WebCT tool and was intended to give students 
an opportunity to evaluate their knowledge on their own. Web site quizzes were considered 
practice only and were not included in final course grades. Links to other relevant web sites 
were included because such capabilities were considered strengths of the web presentation.

3. Order in which to place the topics was determined. Topics were arranged according to the 
order in which lecture material was presented in class. Since normal class time would not 
permit, a review section of concepts from MET 141, a prerequisite materials course for MET 
142, was added first in order to refresh the students’ knowledge.

4. Presentation media for course material was determined. It was decided to use text-with-
images, and conservative amounts of animation (within links) for the web site. The rationale 
behind this decision was that users of the site might have been averse to superfluous amounts 
of video clips and animation. Video clips can be helpful, but they can take long periods of 
time to download and also take up vast amounts of hard drive space on a computer. 
Animation can also enhance a site but it can become disruptive to the user after its initial
impact has worn off. Graphics were also considered as an option, but there were no appropriate ones available at the time that the site was being developed.

5. Information was placed on the Internet, with the use of WebCT (Web Course Tools). This critical step in the process took place from mid-February to mid-March. In addition to placing material on the site, certain precautions were taken. The ability for users to create their own user ID’s for Web CT was disabled. This action was an attempt to prevent students in the control (non-web) group from having access to the material.

6. A survey was conducted to assess such issues as the effectiveness of the methods used, and the types of problems (if any) encountered by students. (see Appendix A) A survey was distributed to online students to assess such issues as prior web experience, ease of site navigation, and expected outcomes. The majority of the students did not complete the survey online, so it was administered on paper, during class time. Results were tabulated and analyzed. Survey questions were evaluated with the use of a five point Likert scale. Use of the survey within this study served to attest to the results of the grade comparisons.

Although grades may have improved, they (the numbers) did not indicate the degree to which the material was effective (or not effective) in that improvement. Students were also asked to give their impressions of the site and whether or not it was helpful to them and were asked to make recommendations for future improvements to the site.

7. A quiz was administered to both sections. The 7:30 section was not given prior notice of the quiz. However, the 8:30 section was not only given prior notice, but was also alerted to the format of the quiz.

8. The overall academic performance of the students was evaluated for evidence of any improvements or declines. A t-test was used to compare quiz grades of the two sections.

VI. Results

Calculations are presented in Appendix B.

<table>
<thead>
<tr>
<th>Results Table</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test Group 7:30 Section</strong></td>
</tr>
<tr>
<td>Number of students, n</td>
</tr>
<tr>
<td>Degrees of freedom, v</td>
</tr>
<tr>
<td>Sample mean, $\bar{x}$</td>
</tr>
<tr>
<td>Standard deviation, s</td>
</tr>
<tr>
<td>Pooled standard deviation, $S_p$</td>
</tr>
<tr>
<td>t-value</td>
</tr>
</tbody>
</table>

Reject null hypothesis if $t > 0.679$
VII. Findings and discussion

Upon tabulation of the quiz results, the 7:30 section was found to have a mean score of 9.3 out of a possible 10 points. The mean for the 8:30 section was 9.1. Using the two means and the raw quiz data, the pooled standard deviation was calculated to be 1.12. The t-value was then calculated in order determine the significance level of the difference between the two means. The result was a t-value of 0.732. At an alpha level of 0.25, a value of at least 0.679 would be required to establish significance. At an alpha level of 0.25, the 7:30 section was statistically different from the 8:30 section.

Figure 1. Summary of survey responses from MET 142, Spring 1999

The survey results (see Figure 1) provided qualitative feedback about the effectiveness of the web site. Out of the 45 students in the 7:30 section, only eleven responded to the survey. Low response stemmed from the fact that many students were absent from class on the day that the survey was administered. Some students also stated that they had not used the web site, with one person citing insufficient Internet access. Another stated they would access the site in the future. In terms of whether or not the site would improve performance, 54.5% of the respondents strongly agreed that the site would accomplish this objective. The same amount of respondents agreed that the presentation method of the material was appropriate. Finally, 63.6% of the respondents agreed that the material was presented in a logical order.
VIII. Conclusions and recommendations

Since there was a significant difference between the performances of the two classes at the 0.25 level, the null hypothesis was rejected and it was found that there was a relationship between web usage and academic performance. Additionally, favorable results of the survey indicated that use of the web site was beneficial to performance. It is therefore recommended that further study is warranted in order to gain a more accurate assessment of the effectiveness of the Web as a supplemental teaching tool. Suggestions for improvement from the students included using more links, providing more content, and posting grades onto the web site.

During the 2000-2001 school year student suggestions will be implemented. More practice opportunities will be added in the form of review questions and practice quizzes. Follow-up studies will be conducted for fall 2000 and spring 2001 semesters using more appropriate \( \alpha \) levels such as 0.10 or 0.05. Comparisons between student groups will also be further enhanced.

Bibliography


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Appendix A

Survey given to MET 142 students Spring 1999 (Numerical results follow at end of survey)

I DID NOT ACCESS THE WEB SITE (Check Here)

1. I have previously used the web for core/supplemental information in a course.
   - o 1. Strongly agree
   - o 2. Somewhat agree
   - o 3. Undecided
   - o 4. Somewhat disagree
   - o 5. Strongly disagree

2. This site will help to improve my understanding of the subject matter in this course.
   - o 1. Strongly agree
   - o 2. Somewhat agree
   - o 3. Undecided
   - o 4. Somewhat disagree
   - o 5. Strongly disagree

3. This site is easy to navigate.
   - o 1. Strongly agree
   - o 2. Somewhat agree
   - o 3. Undecided
   - o 4. Somewhat disagree
   - o 5. Strongly disagree

4. This site is aesthetically pleasing. (Easy to read, etc.)
   - o 1. Strongly agree
   - o 2. Somewhat agree
   - o 3. Undecided
   - o 4. Somewhat disagree
   - o 5. Strongly disagree

5. The use of text, graphics, and links is appropriate for this site.
   - o 1. Strongly agree
   - o 2. Somewhat agree
   - o 3. Undecided
   - o 4. Somewhat disagree
   - o 5. Strongly disagree
6. The information on this web site is presented in a logical order.
   - 1. Strongly agree
   - 2. Somewhat agree
   - 3. Undecided
   - 4. Somewhat disagree
   - 5. Strongly disagree

7. What improvements do you feel should be made to this site?

Numerical Survey Results

<table>
<thead>
<tr>
<th>Questions</th>
<th>1 strongly agree</th>
<th>2 somewhat agree</th>
<th>3 undecided</th>
<th>4 somewhat disagree</th>
<th>5 strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior web course experience?</td>
<td>2.27</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Anticipated improvement?</td>
<td>1.63</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Easy Navigation?</td>
<td>1.81</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Aesthetically pleasing?</td>
<td>1.63</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Appropriate use of multimedia?</td>
<td>1.45</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Logical order?</td>
<td>1.63</td>
<td>4</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Improvements needed?</td>
<td>Grades posted to site</td>
<td>More content</td>
<td>Homework online</td>
<td>More links</td>
<td></td>
</tr>
</tbody>
</table>

Survey Results in Percentages

<table>
<thead>
<tr>
<th>Questions</th>
<th>1 strongly agree</th>
<th>2 somewhat agree</th>
<th>3 undecided</th>
<th>4 somewhat disagree</th>
<th>5 strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior web course experience?</td>
<td>27.2%</td>
<td>45.4%</td>
<td>9.0%</td>
<td>9.0%</td>
<td>9.0%</td>
</tr>
<tr>
<td>Anticipated improvement?</td>
<td>54.5%</td>
<td>27.2%</td>
<td>18.1%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Easy Navigation?</td>
<td>36.3%</td>
<td>54.5%</td>
<td>0.0%</td>
<td>9.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Aesthetically pleasing?</td>
<td>45.4%</td>
<td>45.4%</td>
<td>9.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Appropriate use of multimedia?</td>
<td>54.5%</td>
<td>45.4%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Logical order?</td>
<td>36.3%</td>
<td>63.6%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
Appendix B

Calculations

\( \bar{x}_1 = 9.3 \quad s_1 = 0.81 \quad n_1 = 29 \quad \nu_1 = 28 \)

\( \bar{x}_2 = 9.1 \quad s_2 = 1.30 \quad n_2 = 40 \quad \nu_2 = 39 \)

Where:
- \( \bar{x} \) = sample mean.
- \( S_p \) = pooled standard deviations of the two samples
- \( s \) = standard deviation
- \( n \) = number in the sample
- \( \nu \) = degrees of freedom

A subscript of "1" on any variable represents data for the 7:30 (Web) section and a subscript "2" represents data for the 8:30 (non Web) section.

\[
S_p = \sqrt{\frac{s_1^2 + s_2^2}{\nu_1 + \nu_2}} = \sqrt{\frac{28(0.656) + 39(1.69)}{28 + 39}}
\]

\[
S_p = \sqrt{\frac{18.368 + 65.91}{67}} = \sqrt{\frac{84.278}{67}}
\]

\[
S_p = \sqrt{1.257} \quad S_p = 1.12
\]

Then, the t-value was found.

\[
t = \frac{\bar{x}_1 - \bar{x}_2}{S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = \frac{9.3 - 9.1}{1.12 \sqrt{\frac{1}{29} + \frac{1}{40}}} = \frac{0.2}{1.12 \sqrt{0.0594}}
\]

\[
t = 0.2 \quad t = 0.732
\]