Assessment and Subsequent Improvement of a National Web Site for Teaching Communication to Engineering Students

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Abstract – Web sites are becoming more important as teaching and learning tools in engineering. This paper discusses our assessment and subsequent improvement of one such educational web site, which Google ranks as the number one site (out of more than 8 million) for its topic area: *engineering writing*. In our assessment, we compared what pages faculty members considered to be the most valuable with what pages students visited most frequently. From this comparison, we made several changes to highlight the strongest pages and to improve the most visited pages. These changes served to increase the traffic to the site such that the average number of pages downloaded at the site per month has risen from 95,000 to more than 120,000. Included in this paper are web design strategies that could be applied to any teaching–learning web site, such as a course web page.

Keywords: **Web Page Design, Technical Writing, Engineering Communication**

INTRODUCTION

As students have become more accustomed to acquiring information from the World Wide Web, web sites have become more important as teaching and learning tools in engineering education. When attempting to use this new teaching medium, engineering educators should consider several issues, especially for sites that serve large numbers of students. These issues include what types of information are best communicated through the web, how students try to locate that information, and how to design web pages such that students find that information. This paper focuses on the last of these issues through an analysis of a web site for teaching one aspect of engineering—namely, the way that engineers should communicate their technical work.

According to Google [1], more than 8 million web sites include information about engineering writing, and the number 1 site is the *Writing Guidelines for Engineering and Science Students* (http://writing.eng.vt.edu/). Created in 1997, the *Guidelines* site now has more than 300 pages of advice, models, exercises, and templates to help engineering and science students communicate their work in documents and presentations [2]. Over the past eight years, not only has the site continually expanded in number of pages, but so has the traffic to it. Because of the increases in traffic, the site has had to change servers four times. From an estimated 2000 hits per month during the 1998 academic year, the site received more than 200,000 hits per month during the 2004 academic year (hits per month do not necessarily correspond to pages downloaded per month—downloading one page with graphics might cause two or more hits to occur at the site).

Why has this site become so popular? One reason has been that the site offers information that cannot be found in most textbooks. The following are examples of such information: models of various documents, such as memos and reports, which are presented in 8.5 by 11-inch formats; hypertext exercises on grammar, punctuation, and usage exercises; and computer file templates for presentation slides, posters, and thesis chapters. Another reason

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for the site's popularity is that the present web address for the site (http://writing.eng.vt.edu) is simple. This simplicity contrasts to earlier addresses that were cumbersome. When the site went from a long and non-memorable address to a much simpler address, the amount of traffic increased considerably—from 12,000 hits a month to more than 55,000 hits a month in less than two year's time (April 1999–February 2001). Yet a third reason for the site's current popularity is that the site has followed the advice of Jeff Bezos, the CEO of Amazon.com: "Work fast and fix small mistakes later. The only fatal error on the Web is being too slow" [3].

As mentioned, this paper focuses not on the setting up of a web site, but on how a site can be designed such that the students can readily find the most valuable information. In particular, the paper focuses on such a design for a large web site, because the larger the site is, the more challenging that navigation for the user becomes. As a case study, this paper considers a popular web site in engineering education: the *Writing Guidelines for Engineering and Science Students*.

Presented first in this paper are results of a faculty survey for the most valuable resources on the *Guidelines* web site. Next, the paper presents statistics that show a ranking of the resources that students have been accessing at the site. After that, the paper discusses changes to the design of the site to highlight those pages that the faculty considered to be the most valuable. Following that, the paper documents the effects of those changes. Concluding the paper are design practices for educational web pages, such as course web pages.

MOST VALUED RESOURCES ON THE *GUIDELINES* WEB SITE

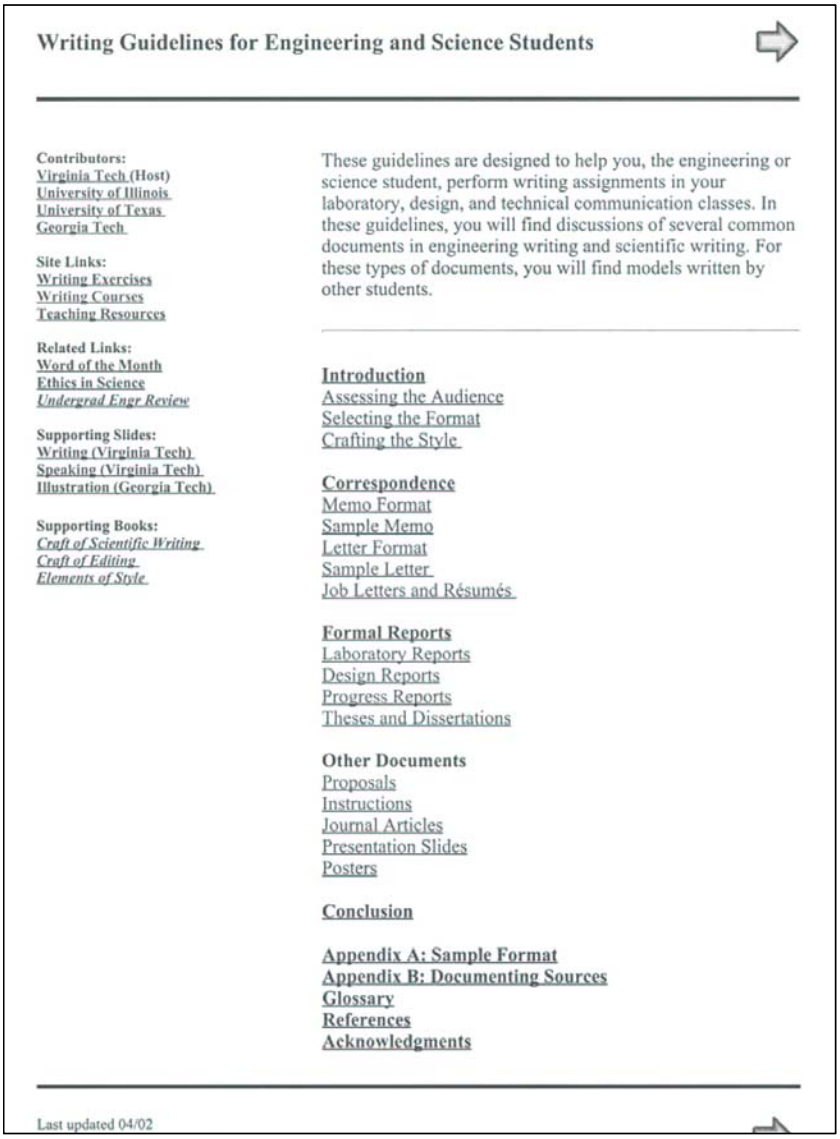
The *Writing Guidelines for Engineering and Science Students* has more than 300 web pages to help engineering students improve their technical communication. As shown in its April 2004 entry page (see Figure 1), these pages range from self-paced exercises on grammar to models, advice, and templates about specific documents such as laboratory reports, posters, presentation slides, proposals, and memos. The value of these individual pages has been assessed in two different ways: the pages that instructors consider to be the most valuable, and the pages that students visit the most often. Faculty input was gathered through interviews and surveys, and the numbers of student visits were gathered from the server's usage statistics.

Table 1 presents a listing of the pages that faculty members considered to be the most valuable. This assessment arose from surveys and interviews of several faculty members who use the site in their classes. One page that most faculty members found to be valuable was the "Writing Exercises" page, which contains sets of exercises to teach students how to avoid the most common grammar, punctuation, and usage mistakes that engineers make. Another page that faculty members determined to be valuable was the "Presentation Slides" page, which presents a unique design for presentation slides (such as PowerPoint slides). Unlike other web pages on slide design, the "Presentation Slides" page on the *Writing Guidelines* site advocates a way to design slides that is dramatically different from what Microsoft PowerPoint has listed as its default [4–5]. Another such page that fell into the "unique instruction" category was the "Posters" page. A third category of pages that faculty members considered valuable were pages designed to help faculty teach engineering writing and presentations. One such page in this category, "Teaching Slides," provides information to instructors on how to obtain free slides to teach engineering writing. In the past four years, more than 300 instructors have written requesting these slides.

STATISTICAL RANKING OF SITE'S MOST ACCESSED PAGES

As with many web sites, the record keeping of traffic for the *Writing Guidelines for Engineering and Science Students* has changed much in the last few years. From 1997 to 1999, one monthly count of total hits was approximated, but nothing was documented. After 1999, statistics were kept for the total number of hits to the entire web site for two months each year, except for 2003 when the site moved to a much larger server and counts were suspended. A summary of these statistics since 1999 appears in Table 2. As shown in the table, the site usage grew significantly from Spring 1999 to Spring 2004. This growth is partially due to a general increase in internet usage, which has seen a global increase of 125 percent between 2000 and 2004 [6]. However, over the same period, the usage of the *Writing Guidelines* site has increased 550 percent, greatly outpacing global internet growth. As

mentioned, we attribute much of that growth to the valuable information, the relatively simple web address, and the fact that this web page was one of the first in its area.



Writing Guidelines for Engineering and Science Students

Contributors:
Virginia Tech (Host)
University of Illinois
University of Texas
Georgia Tech

Site Links:
Writing Exercises
Writing Courses
Teaching Resources

Related Links:
Word of the Month
Ethics in Science
Undergrad Engr Review

Supporting Slides:
Writing (Virginia Tech)
Speaking (Virginia Tech)
Illustration (Georgia Tech)

Supporting Books:
Craft of Scientific Writing
Craft of Editing
Elements of Style

These guidelines are designed to help you, the engineering or science student, perform writing assignments in your laboratory, design, and technical communication classes. In these guidelines, you will find discussions of several common documents in engineering writing and scientific writing. For these types of documents, you will find models written by other students.

Introduction
Assessing the Audience
Selecting the Format
Crafting the Style

Correspondence
Memo Format
Sample Memo
Letter Format
Sample Letter
Job Letters and Résumés

Formal Reports
Laboratory Reports
Design Reports
Progress Reports
Theses and Dissertations

Other Documents
Proposals
Instructions
Journal Articles
Presentation Slides
Posters

Conclusion

Appendix A: Sample Format
Appendix B: Documenting Sources
Glossary
References
Acknowledgments

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Figure 1. Entry page for the *Writing Guidelines for Engineering and Science Students* (April 2004). Upon opening this web page, how much of that page that is visible depends on the browser and its settings.

Table 1. Pages that instructors considered to be the most valuable.

Page Name	Description (Valuable Feature)
Writing Exercises	Grammar, punctuation, and usage exercises (allows for self-paced learning)
Presentation Slides	Models and templates for a design of presentation slides that is especially suited for engineering and science presentations (not available elsewhere)
Posters	Advice, models, and templates of engineering posters (examples are from engineering)
Teaching Slides	Free slides to teach engineering writing and speaking (not available elsewhere)

Beginning in February 2004, the statistics for the site became much more sophisticated. That change occurred because of the capabilities of the new server on which the site had been placed. Since February 2004, not only could we keep track of the number of hits, but more important the number of unique visitors, the number of visits, and the number of pages downloaded. Table 3 presents these statistics for three months from the Spring 2004 academic term. In addition to these total site statistics, we could assess how many visits that each individual page received. The top fifteen pages for the month of April are shown in Table 4.

Table 2. The number of hits per month for an academic semester from 1999–2004.

Academic Semester	Number of Hits per Month
Spring 1999	12,000
Fall 1999	15,000
Spring 2000	16,000
Fall 2000	49,000
Spring 2001	54,000
Fall 2001	108,500
Spring 2002	114,800
Spring 2004	192,000

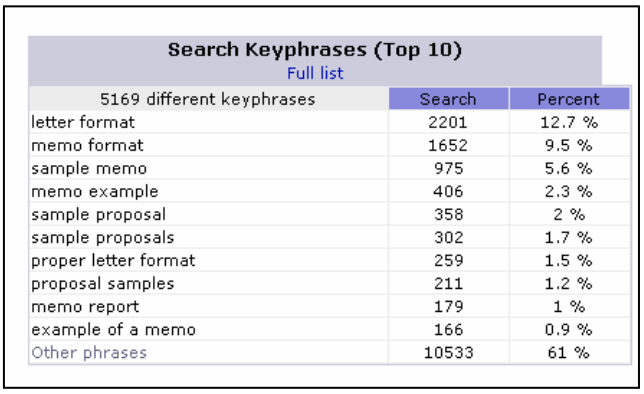
Table 3. Statistics on total web site usage for the Spring 2004 semester.

Month	Unique Visitors	Number of Visits	Pages Downloaded	Hits
February	18731	24451	83246	176094
March	20656	27285	120140	220953
April	20212	26570	81408	180298

Table 4. Most accessed pages at *Writing Guidelines* site for April 2004.

Rank	Page Name: Description	Number of Downloads
1	Main Entry Page: http://writing.eng.vt.edu/	9026
2	Letter Format	4038
3	Memo Format	3911
4	**Writing Exercises**: Page with links to specific exercises	3583
5	Incorrect Choice: Page where users are sent after making incorrect choices on an exercise	2836
6	Correspondence: Page with links to formats and models of letters, memos, and resumes	2615
7	Sample Memo	2444
8	Introduction: Background information on communicating in engineering and science	2300
9	Proposal Samples	1898
10	Format Guidelines: General guidelines for formatting a document	1864
11	Design Reports: Discussion of design reports	1539
12	Formal Reports: Discussion of formal reports	1462
13	Laboratory Reports: Discussion of laboratory reports	1456
14	**Presentation Slides**	1361
15	Proposals: Discussion of proposals	1319
…	…	…
18	**Posters**	1153
…	…	…
69	**Teaching Slides**	223

Much can be learned from Table 4 in terms of which pages that students were visiting during April 2004 (these rankings are similar to the ones for February 2004 and March 2004). In our analysis, we assumed that these numbers reflected essentially which pages the students had visited. In other words, we assumed that most of the traffic to the site's pages—except for those pages specifically targeting faulty members—consisted of students. Given this assumption, we realized that the pages which faculty considered most important were not necessarily the pages that students were visiting. For instance, the most visited page on the site, next to the entry page, was "Letter Format," which presented a format for letters. Statistics revealed that many users accessing this page were doing so through search engines, such as Google. Figure 2 shows the key phrases bringing search engines to the site for April 2004 and reveals that 2201 downloads for the web site occurred through users typing in the key phrase "letter format." Typing this search phrase into Google, the most popular search engine, brings up the *Writing* Guidelines page "Letter Format" as the #12 listing out of more than 13 million sites.



Search Keyphrases (Top 10)
Full list

5169 different keyphrases	Search	Percent
letter format	2201	12.7 %
memo format	1652	9.5 %
sample memo	975	5.6 %
memo example	406	2.3 %
sample proposal	358	2 %
sample proposals	302	1.7 %
proper letter format	259	1.5 %
proposal samples	211	1.2 %
memo report	179	1 %
example of a memo	166	0.9 %
Other phrases	10533	61 %

Figure 2. Key phrases that led users to the *Writing Guidelines* site through search engines in April 2004. The popularity of the site's web page "Letter Format" in Table 4 was a reflection of students desiring to acquire the information on that page and then finding that information through search engines such as Google.

A surprise in the analysis of the statistics was that two of the pages that faculty members considered to be valuable were not popular. Those pages were the "Presentation Slides" page and the "Posters" page. In retrospect, the lack of traffic to those pages was not so surprising. As was shown in Figure 1, the links on the site's entry page to the "Presentation Slides" page and the "Posters" page were in the bottom half of the page and out of view in many browsers when the page came up. Granted, other pages in the bottom half of this entry page were relatively popular, but many of those pages such as "Sample Proposals" and "Sample Memo" were reached by students through the search engines.

DESIGN CHANGES MADE TO INCREASE TRAFFIC TO MOST VALUABLE PAGES

In assessing why pages that faculty considered to be valuable were not visited often, we realized that the placement of those links on the site's entry page did not correspond to their value. In other words, links leading to pages of less value were positioned with much more emphasis. For example, the top positioned links in the left column of the entry page (refer back to Figure 1) led users off the site and to various pages of the sponsoring universities. Such a strategy goes against advice in the literature [7]. For that reason, soon after many users reached the site, they were ushered off to other sites. Another realization was that the button at the top of the entry page took users to the page entitled "Introduction," which contained background information found in most textbooks on technical communication. Given how widely available this introductory material is, we realized that this button was a missed opportunity to emphasize the site's most valuable information.

To address these weaknesses in the web site's design, we reformatted the entry page so that the most important pages, according to the faculty, received emphasis. These changes can be visualized in Figure 3 and are summarized in Table 5. One page that we emphasized was the "Posters" page, which we simply moved up to the top half of the entry page. Another page that we highlighted was the "Writing Exercises" page. This page we

emphasized by moving its link on the entry page to the top of the left column. We also emphasized this page by adding a backward arrow on the entry page that led users to the "Writing Exercises" page. A third page that we emphasized were the two pages for "Teaching Slides"—one page contains slides for teaching writing, and the other page contains slides for teaching presentations. These pages we emphasized by bringing their links to the entry page (a first-level link) as opposed to a second-level link. In addition, we positioned the link beneath a category of "Instructor Resources" (as opposed to "Student Resources") to target the intended audience. We also allowed instructors to download the teaching slides directly, rather than having to send an email to the site editor.

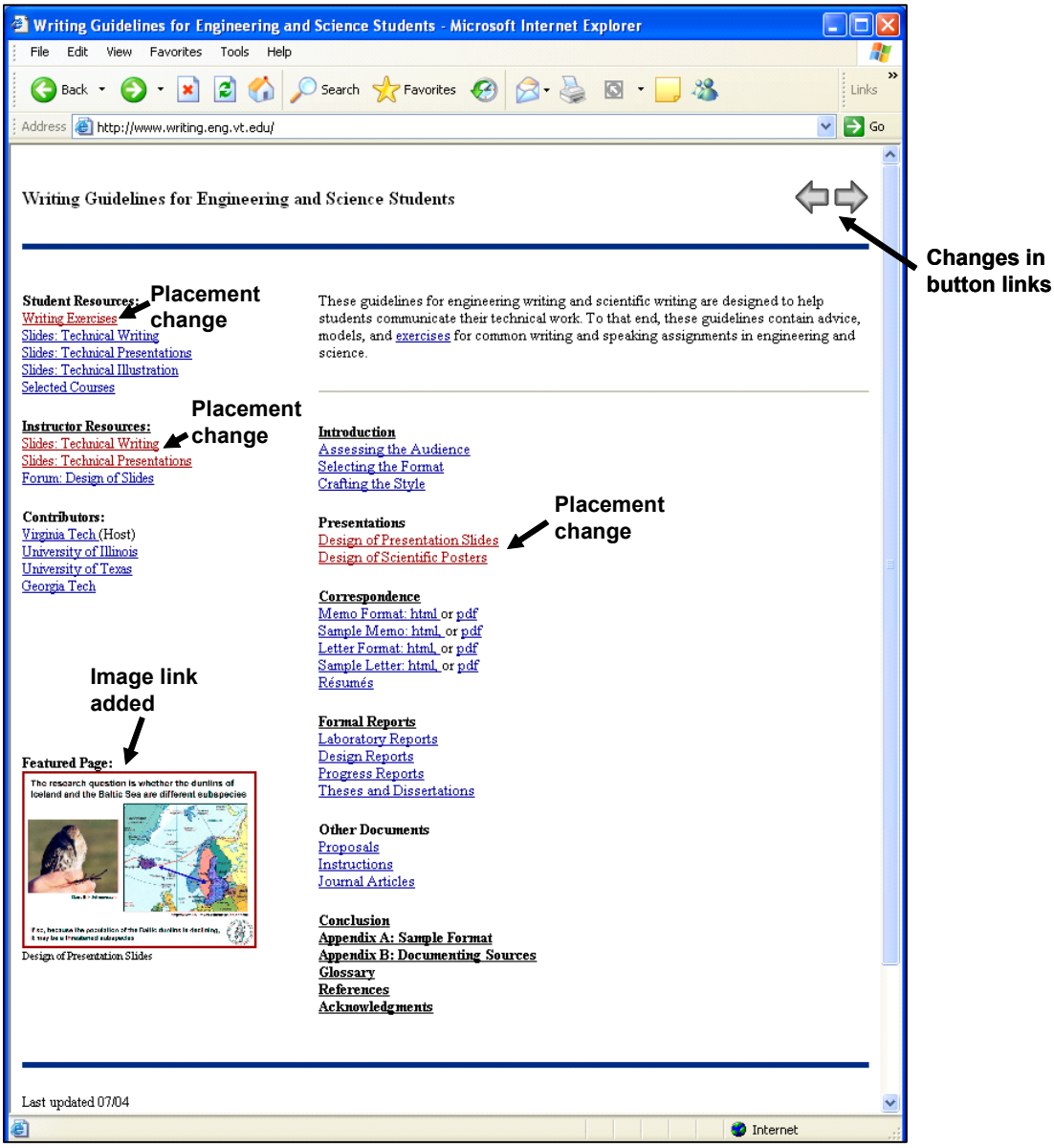


Figure 3. Entry page to the *Writing Guidelines* site in September 2004. A number of changes occurred over the Summer of 2004 to increase traffic to the site's pages that faculty members considered to be most valuable.

Of all the pages we highlighted, the greatest emphasis was given to the "Presentation Slides" page. Because this page contains a design for slides not found on any other web site, we emphasized it three ways: (1) we moved up its position so that it was in the top half of the entry page, (2) we included an image link on the entry page

so that users would be drawn to this page, and (3) we had the forward button at the top of the page lead users to that page rather than to the background page "Introduction."

As an aside, after analyzing the usage statistics shown back in Table 4, we decided to increase the value of those pages that the students were seeking. The idea here was that if this information was what students were seeking, then a significant portion of our energies should go into making that information as valuable as possible. In other words, because a site editor has only so much energy to devote to his or her web site, the amount of energy that the editor expends on any one page on the site should depend in part on what value the users assign to that page. Given that, we performed a number of changes that are summarized in Table 6.

Table 5. Design changes made to *Writing Guidelines* entry page in the Summer of 2004 to increase traffic to pages that faculty consider important.

Page	Design Change to Entry Page
Posters	Moved link to upper portion of entry page (right column)
Writing Exercises	Moved link to topmost position in left column Added backward button at top that takes users to this page
Teaching Slides	Moved link from second-level page to entry page Allowed direct downloading of presentation files
Presentation Slides	Moved link to upper portion of entry page (right column) Added visual link (slide with bird in Figure 3) Had forward button on this page takes users to this page

Table 6. Design changes made to *Writing Guidelines* site in the Summer of 2004 to increase value of pages that students visited the most often.

Change	Pages Affected
Added pdf versions for pages that showed key formats	Letters, memos, resumes
On second-level entry pages, reworked placement of links to make it easier for users to find third-level information	Correspondence, Formal Reports, Proposals, Lab Reports, Design Reports
Added more examples	Resumes, Design Reports, Proposals, Memos
Added a template	Resumes

EFFECT OF DESIGN CHANGES

This section discusses the effects of the changes made to the web site in terms of how much traffic increased after those changes came into effect. Table 7 presents the traffic both during the main academic months of the Spring term before the changes were made and during the main academic months of the Fall term after the changes to the site were in effect. A limitation of this study is that we compared statistics gathered during the Spring of 2004 with statistics gathered in the Fall of 2004. The difference in academic term could have affected the statistics in a number of ways. For instance, more faculty members in the Spring might have recommended a particular page such as the "Writing Exercises" than faculty members had done in the Fall. A more controlled comparison would be to compare Spring to Spring, a comparison that will not be possible until Spring 2005.

Overall, Table 7 shows an increase in traffic of unique visitors (14%), number of visits (23%), pages downloaded (24%), and hits (41%). Although these increases are significant, we cannot claim that all these increases are due to the changes made to the site. Other factors, such as continued growth of the internet, could have contributed. However, as Table 8 shows, the pages that we tried to emphasize on the entry page experienced, with one exception, a significant increase in traffic relative to the other pages.

The following paragraphs discuss the effects on several individual pages that were changed according to the descriptions in Table 2: "Posters," "Teaching Slides," "Writing Exercises," and "Presentation Slides." The

relative increases of these pages can be seen in Table 8, which compares the months of April 2004, which was before the changes were made, with October 2004, which was after the changes occurred.

During the Summer of 2004, the change to the link to the "Posters" page on the site's entry page was as follows: the link was moved from the bottom half the page to the top half of the page. This movement brought the link clearly into view, whenever someone opened the page—no matter what their browser settings were. From the Spring to the Fall, the "posters" page experiences an 84 percent increase in downloads. Interestingly, for this web page, if we had used March statistics rather than April statistics, the increase would have appeared to be much higher, because in April a popular web site (http://www.biology.eku.edu/) began linking to the "Posters" page and brought in (and continues to bring in) several hundred visits each month. Given that increase of 84 percent was significantly higher than the overall increase in the site's traffic (24 percent), the movement of the link on the entry page undoubtedly increased the traffic.

Table 7. Statistics on total web site usage for key academic months in 2004.

Month	Unique Visitors	Number of Visits	Pages Downloaded	Hits
Before Changes				
February	18731	24451	83246	176094
March	20656	27285	120140	220953
April	20212	26570	81408	180298
Total	59599	78306	284794	577345
After Changes				
September	22900	32682	125408	295822
October	22667	32538	118431	268729
November	22124	31390	110027	251196
	67691	96610	353866	815747

Table 8. Comparison of most downloaded pages April 2004 and October 2004.

April Rank	Page Name	Number of Downloads	October Rank	Page Name	Number of Downloads
1	Main Entry Page	9026	1	Main Entry Page	17693
2	Letter Format	4038	2	**Writing Exercises**	3701
3	Memo Format	3911	3	Incorrect Choice	3486
4	**Writing Exercises**	3583	4	**Presentation Slides**	2948
5	Incorrect Choice	2836	5	Laboratory Reports	2605
6	Correspondence	2615	6	Lab Report Samples	2372
7	Sample Memo	2444	7	Formal Report Samples	2217
8	Introduction	2300	8	**Posters**	2120
9	Proposal Samples	1898	9	Correspondence	2052
10	General Format Guidelines	1864	10	Memo Format	2040
11	Design Reports	1539	11	Sample Memo	1996
12	Formal Reports	1462	12	Introduction	1788
13	Laboratory Reports	1456	13	Proposals	1635
14	**Presentation Slides**	1361	14	Formal Reports	1445
15	Proposals	1319	15	General Format Guidelines	1442
…	…	…	…	…	…
18	**Posters**	1153	19	Letter Format	1162
…	…	…	…	…	…
69	**Teaching Slides**	223	29	**Teaching Slides**	849

For the "Teaching Slides" page, one change made over the summer was bringing the page's link from a second-level position on the "Instructor Resources" page to a first-level position on the main entry page to the site. A second change was to allow visitors the opportunity to download the teaching slides directly as opposed to emailing a request for the slides from the site's editor. While this second change did not affect the visibility of the links, it did increase the value of the page for those faculty members, because downloading was a much simpler and faster process. Over the period considered, the increase in traffic to the "Teaching Slides" page was 280 percent, which was more than ten times higher than the overall increase in downloads at the site. Much of this dramatic increase is undoubtedly from changing the link from a second-level position at the site to a first-level position at the site. Not as clear is how much, if any, of the increase was due to the increased value added to the page.

The third page to be considered is the "Writing Exercises" page. The entry to "Writing Exercises" page was changed in two ways. First, the main link in the left column of the entry page was moved to the top of the column, and second, a back button was added to the entry page that brought users to this page. For the percent change in the number of downloads, this page essentially had no increase, which did not match the overall increase in traffic to the entire site (24 percent). This result could have arisen from a number of possibilities. First, the number of users desiring this type of information could have dropped significantly between the Spring and the Fall. That could have arisen because more instructors in the Spring recommend that students visit this page. Second, the changes to the entry page's links to this page might not have been not large enough to affect overall traffic. Granted, the link was moved up, but its original position was already near the top of its column. A third reason that the increase was not as high was that of the four pages that were modified, this page already had the highest number of downloads for both periods. Because the exercises page was already in significant demand before any changes were made, it is not surprising to note that a less dramatic change in the number of downloads of this page occurred. Fourth, as suggested by the literature [7], back buttons often are not used.

The fourth page to be considered is the "Presentation Slides" page. The entry page's changes to the links to the "Presentations Slides" page were as follows: (1) we moved up its position so that it was in the top half of the entry page, (2) we included an image link on the entry page so that users would be drawn to this page, and (3) we had the forward button at the top of the page lead users to that page rather than to the background page "Introduction." The overall increase to this page was more than 117 percent. Like the "Posters" page, the "Presentation Slides" page had a similar move in its main link on the entry page, from the bottom half of the page to the top half. In addition, the entry page included a change in the link of the forward button in the top right-hand corner from the "Introduction" page to the "Presentation Slides" page. Interestingly, the "Introduction" page suffered a 14 percent decrease in number of downloads between the Spring and the Fall, a finding that suggests that the forward button in the upper right-hand of an entry web-page is an emphasized link. The third change to the linking on the "Presentation Slides" was the inclusion of the visual link at the bottom left corner of the entry page. Although the positioning of this link is such that some users will not immediately see it in their window when the entry page downloads, the picture should have drawn their attention. A controlled experiment is needed to assess the influence of such a link. The literature suggests that its effect would not be high [7].

CONCLUSIONS

This paper has presented an assessment and subsequent improvement of the most popular web site (according to Google) dedicated to engineering writing and speaking: *Writing Guidelines for Engineering and Science Students* (http://writing.eng.vt.edu/). This paper has determined that the positioning of links on the entry page of a web site is important for determining the traffic of students through that web site. Of primary importance is the linking of key pages on the entry page rather than on a secondary page. Also important is the positioning of key links in the top portion of a page, where the students can see it when the page downloads. Note that what portion of the web page that the faculty member sees upon downloading might not correspond to what many students see upon downloading. What is seen depends heavily on the browser settings. A third means for emphasis is the use of a forward button at the top of an entry page. Many factors can influence the traffic to an educational web site in engineering: the academic term (Spring or Fall), the key words that students type into search engines, the different types of links. More analysis is needed on the *Writing Guidelines* site to isolate the contributions of each of these factors.

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