Faculty Use and Impressions of Courseware Management Tools: A National Survey

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ABSTRACT

Technology in the classroom is changing the way faculties instruct and students learn. Understanding how faculty members perceive and use technology for learning is important for improving the educational process because instructor perceptions can potentially be a hindrance to the use and implementation of technology. This paper describes the results of a survey that investigated faculty Internet usage for instructional purposes as well as their perceptions of courseware management and Web-publishing tools. The survey targeted a random sample of engineering faculty at ABET-accredited universities. The survey results show that while many faculty members are using both Web-publishing tools and courseware management tools for delivering educational content, they use these tools for only a small subset of pedagogical activities.

I. INTRODUCTION

The use of technology, especially the Internet, in the classroom is growing on most college campuses for the delivery of educational content. The Internet is used to enhance traditional lecture classes and to deliver courses to distance learning students. As Internet usage expands, the software tools faculty use to assist in the creation, delivery, and management of educational content also changes. This paper categorizes these software tools used by faculty into two groups: Web publishing tools (WPTs) and courseware management tools (CMTs). The difference between these two types of tools lies in the intended purpose of the tool: a CMT is defined here as a tool specifically designed for the management and delivery of educational content via the Internet. Examples of CMTs are CourseInfo and WebCT. Software that is designed to develop or disseminate online information but not necessarily with an educational purpose is defined here as a WPT. Some examples of WPTs are FrontPage, Dreamweaver, and Adobe Acrobat. For the purpose of this study, stand-alone ftp and e-mail programs (as opposed to the ftp and e-mail capabilities of CMTs) were considered as WPTs because they can be used to disseminate information to students via the Internet.

There are few or no studies in the engineering education literature that report on CMT use. One survey [1] suggests that a majority of instructors are using the Internet and there are studies [2, 3] that show that the Internet can be an effective educational tool. However, CMTs are underrepresented in the literature except with reference to feature comparison reports [4, 5]. The questions as to which tools are being used and how professors perceive the effectiveness of these tools have not been answered and thus were the motivation for this study.

The purpose of this study was to measure Internet usage and assess instructors' perceptions about using the Internet, WPTs, and CMTs for instructional purposes. Specifically, the goals of this study were to:

- determine if faculty members view Internet tools as being effective in assisting in education;
- determine if faculty members view Internet tools as being an efficient use of their time and resources;
- determine which tools are being used most by engineering faculty members; and
- determine the extent to which CMTs and WPTs are being used for specific tasks and how effective they are perceived to be at accomplishing those tasks.

To accomplish these goals, a survey was sent to a random sample of engineering instructors throughout the United States in order to gauge their perceptions of technology use. This study investigated instructors' perceptions of Internet tools as it is believed that perception may be one of the hurdles to use and adoption of technology. The study did not look at how students use technology nor did the study investigate the impacts on student learning. The time and resources allotted for this study were limited and, as such, it was outside the scope of the study to assess student perceptions or to do an experimental analysis of CMT effectiveness. Because actual effectiveness was not measured in this study, we make no recommendations about the use of any particular tool but merely report which tools are commonly being used and how professors perceive the effectiveness of these tools.

This paper presents the development, testing, and dissemination of the survey. Data collection and analysis are also addressed as well as conclusions that can be drawn from this study. The survey and a more detailed collection of the resulting data are available [9].

II. RESEARCH PROCESS AND METHODOLOGY

A draft survey instrument was developed to accomplish the aforementioned goals. The survey consisted of four fundamental portions, along with demographic information about the faculty who responded to the survey. These four sections addressed the following issues: 1) effectiveness of the software tools (do the tools help enhance student learning as perceived by faculty members?); 2) the efficiency of using the software tools (faculty time required to use the tools); 3) types of tools used; and 4) effectiveness of tools, as perceived by faculty members, at accomplishing certain tasks.

The draft survey was sent to the faculty involved in survey creation, to campus assessment leaders, and to teaching center directors at both Georgia Tech and Virginia Tech for comment and input on the survey. Based on the comments received from these individuals, some survey wording was revised and additional questions were added.

The desired sample for this survey was a random selection of participants from a pool of all engineering faculty at schools accredited by the Accreditation Board for Engineering and Technology (ABET). To obtain this sample, a list of all accredited engineering programs located in the United States, 314 total universities, was obtained from ABET's Web site [6]. Student assistants then visited all of the engineering Web sites for these 314 schools and collected faculty listings for each. The list of faculty members that was collected from the universities consisted of 23,860 individuals. Because approximately 500 responses to the survey were desired, and a 20 percent return rate was estimated, a random sample of 2,500 faculty members was chosen. The random sample was selected by putting all 23,860 names in a spreadsheet. Each name was then assigned a random number using the random number function built into the spreadsheet program. The names were then sorted according to the assigned random numbers and the first 2,500 names, or the 2,500 names with the smallest random numbers, were chosen as participants and made up the survey sample.

Once the sample of the 2,500 faculty members had been randomly selected, the participants' e-mail addresses were collected. The survey was encoded on a Web page at Georgia Tech and a Perl script was created to send each faculty member a unique e-mail and identifier for the survey. By using these identifiers, responses could be tracked and a follow-up e-mail reminder could be sent to participants who had not completed the survey. Participants for whom an e-mail address could not be found were also mailed or faxed a copy of the survey. For e-mail that was returned as undeliverable (due to wrong e-mail addresses or full disk space), a copy of the survey was also mailed or faxed.

Data collection for the survey was automatically performed via the Web page survey form. Participants, upon completing their answers and submitting them, allowed the storage of their data in a database on the Web server. The responses received back via fax and postal mail were manually entered into the Web server database.

The survey was originally sent to faculty members in early May, 2001. The follow-up e-mail notices were sent in June. Data analysis began in early August, 2001, at which point responses to the survey were no longer being received.

Standard forms of statistical measures were used for analysis of the collected data. The Pearson chi-square test of association was used to compare demographic information to Internet usage to see if there were any relationships between usage and certain faculty characteristics. Cramer's V was used to test the strength of such a relationship, if it existed. If the chi-square test revealed a difference, post-hoc tests were required to determine the nature of the relationship. For this analysis, the standardized residuals (a standardized form of the difference between the expected and actual counts) were compared to standard normal probabilities (also know as "Z" scores) at the 95 percent confidence level ($\alpha = 0.05$). If more than one post-hoc comparison was required, the possibility of error increases and so the α level as well as the corresponding critical "Z" score must be adjusted. To compare Likert scale ratings used in the survey, the Mann-Whitney test was used. Difference of proportions tests [7] were used to compare usage rates. All are reported here with the calculated value and the significance level used. For example ($Z = 3.54$, $p < 0.05$) reports that Z was the test statistic used and it was calculated to be 3.54 and that the probability of this Z score being caused by sampling error is less than 5 percent (the α, or significance level).

III. Survey Data Results

A. Participants

A total of 369 participants responded to the survey. Most of these were assistant (26.4 percent), associate (22.2 percent), or full (42.5 percent) professors though there were some lecturers, emeritus, and adjunct faculty. Nearly all (93.3 percent) had earned a Ph.D. and had various amounts of experience in teaching, research, and industry. A majority of the respondents (42.5 percent) reported that they balanced their time between teaching and research, while others reported that they had an emphasis on research (24.1 percent) or teaching (33.4 percent). Very few (4.5 percent) taught more than seven courses per academic year, whereas most (49.0 percent) taught three to four courses per year. Still, some taught one or two courses (28.0 percent) or five or six courses (18.5 percent) per year. Many of the participants taught mainly senior (72.4 percent) or graduate (70.2 percent) level courses. Most (46.3 percent) respondents came from large (15,000+ students) universities and most (63.9 percent) also taught classes with fewer than 30 students. The ages of the participants varied, but most (88.3 percent) were male. Responses came from 175 different universities and a number of different departments, though civil/environmental, chemical, computer, electrical, industrial and mechanical engineering made up most of the population.

B. Sample Verification

Participant demographic information was compared to some population characteristics to ensure that the sample obtained for this survey was representative of the actual population of engineering faculty. Four demographic areas were compared to statistics available from the American Society of Engineering Education (ASEE) [8]: 1) gender, 2) rank by males, 3) rank by females, and 4) department affiliation. In these four areas, there were no significant differences between sample participants' data and population data as reported by ASEE except in the area of rank by males. A chi-squared test revealed a significant difference between these two distributions ($\chi^2(4) = 17.28$, $p < 0.01$). Post hoc comparisons revealed that the difference occurred specifically among male assistant professors ($Z = 13.17$, $p < 0.01$). In other words, slightly more male assistant professors responded to the survey than would be expected based on population statistics available from ASEE [8]. No other significant differences were found. Because just one small discrepancy occurred between population and sample data, the project continued with the assumption that the sample accurately represented the larger population set of engineering faculty.

C. Internet Usage

The first question on the survey asked participants whether or not they use the Internet in their courses. Of the 356 participants who responded to this question, 75 (21.1 percent) said that they have not used the Internet whereas 281 (78.9 percent) indicated that they had. These responses were compared to the demographic information to see if there was any correlation between Internet usage and faculty profile characteristics. The Pearson chi-square test revealed statistically significant relationships between Internet usage for instruction and three demographic categories: gender, age, and number of courses taught. Specifically, 1) instructors who teach fewer than three classes per year reported using the Internet less than those that taught three or more; 2) instructors over the age of 60 reported using the Internet less than those 60 and under and; 3) females reported using the Internet more than males. There was no reported relationship between Internet usage and faculty position, degree earned, time teaching, time in industry, time researching, emphasis of time (on research or teaching), level of courses taught, university size, class size or department.

The first chi-square test that resulted in a significant relationship revealed that instructors who teach only one or two classes a year are less likely to use the Internet for instruction than those who teach more often. Table 1 displays the responses, and percentage of responses within each category, to the Internet usage question by the number of classes taught per academic year. A chi-square test revealed that there is a statistically significant ($\chi^2(2) = 6.011$, $p < 0.05$) relationship between Internet usage and the number of courses taught per academic year. The strength of this association was tested using Cramer's V and was found to be weak ($V = 0.132$).

Post-hoc comparisons were performed that compared the adjusted residuals to standardized normal probabilities (Z scores). The alpha level used to determine the appropriate Z score was adjusted for a familywise error rate of 0.05 using the Bonferroni method. For three comparisons at an error rate of $\alpha = 0.05$, the critical Z is 2.3954. These comparisons revealed that there is a statistically significant difference ($Z = 2.4458$) between the actual and expected responses in the 1-2 category. The data in Table 1 illustrates this point; nearly 80 percent of the total population reported using the Internet whereas only 71.4 percent of those who teach one or two classes a year reported using it.

Another test revealed that people over the age of 60 reported using the Internet less in their courses than do people aged 60 and under. Table 2 presents the data concerning age and Internet usage. A chi-square test revealed that there is a statistically significant ($\chi^2(4) = 16.214$, $p < 0.05$) association between age and Internet usage. The strength of this association was found to be moderate ($V = 0.215$).

Post hoc tests were again carried out. A familywise error rate of $\alpha = 0.05$ was desired and a Bonferroni correction was made for five pairwise comparisons yielding a critical Z score of 2.5758. The adjusted residual for the 60+ age group ($Z = 3.4295$) exceeded this critical Z.

Table 3, which summarizes the relationship between reported Internet usage and gender, shows that a greater percentage of females than males reported using the Internet for instruction. A Pearson chi-square test revealed this relationship to be statistically significant ($\chi^2(1) = 5.438$, $p < 0.05$). Fishers Exact Test, which is used when both variables have only two categories, was also run; this test verified the chi-squared results. The strength of this association was again tested using Cramer's V and was found to be weak ($V = 0.125$). Post hoc tests were not needed because only one comparison needed to be made, and the chi-squared test already revealed the significance of that comparison.

D. Effectiveness of Tools

The second section of the survey asked the participants to rate various Internet tools according to how effective they, the instructors, perceived the tools to be at enhancing student learning. As stated previously in the study purpose, the perception of faculty regarding the effectiveness of technology for teaching and learning can be a banner for adoption. Respondents either rated the effectiveness of the tool, or answered that they had not used the tool. A five-point scale, ranging from very effective to very ineffective, was used for each tool type. The results of the effectiveness ratings are presented in Figure 1. The tools are listed on the left side of the bar chart. Note that these are all online tools, so syllabus actually means online syllabus, quizzes means online quizzes, etc. Only those who used the tool actually ranked it, so the total length of the bar represents how many of the respondents reported using the tool. Each bar is also broken up into five sections, each section representing how many respondents chose a particular rating for that tool.

Three tools were similar in their usage rates: online syllabus, e-mail sent to the entire class, and e-mail sent to individual students. Two of these, both of the e-mail tools, were also the only tools to have a median rating of "very effective." Two of the four least used tools, chat rooms and online exams, were also ranked the lowest, with median ratings of "neutral." The remaining tools had various usage rates and median ratings of "effective," with the exception of online help activities, which had a "neutral" median

	Internet Used in Courses			
	Yes		No	
Age	responses	percent	responses	percent
20-30	13	72.2%	5	27.8%
31-40	84	88.4%	11	11.6%
41-50	78	83.9%	15	16.1%
51-60	71	78.0%	20	22.0%
60+	33	62.3%	20	37.7%
Total	279	79.7%	71	20.3%

Table 2. Internet usage by age.

	Internet Used in Courses			
	Yes		No	
Number of Courses Taught per Academic Year	responses	percent	responses	percent
1-2	70	71.40%	28	28.60%
3-4	141	83.40%	28	16.60%
5+	66	82.50%	14	17.50%
Total	277	79.80%	70	20.20%

Table 1. Internet usage by number of courses taught per academic year.

Gender	Internet Used in Courses			
	Yes		No	
	responses	percent	responses	percent
Female	39	92.9%	3	7.1%
Male	238	77.3%	70	22.7%
Total	277	79.1%	73	20.9%

Table 3. Internet usage by gender.

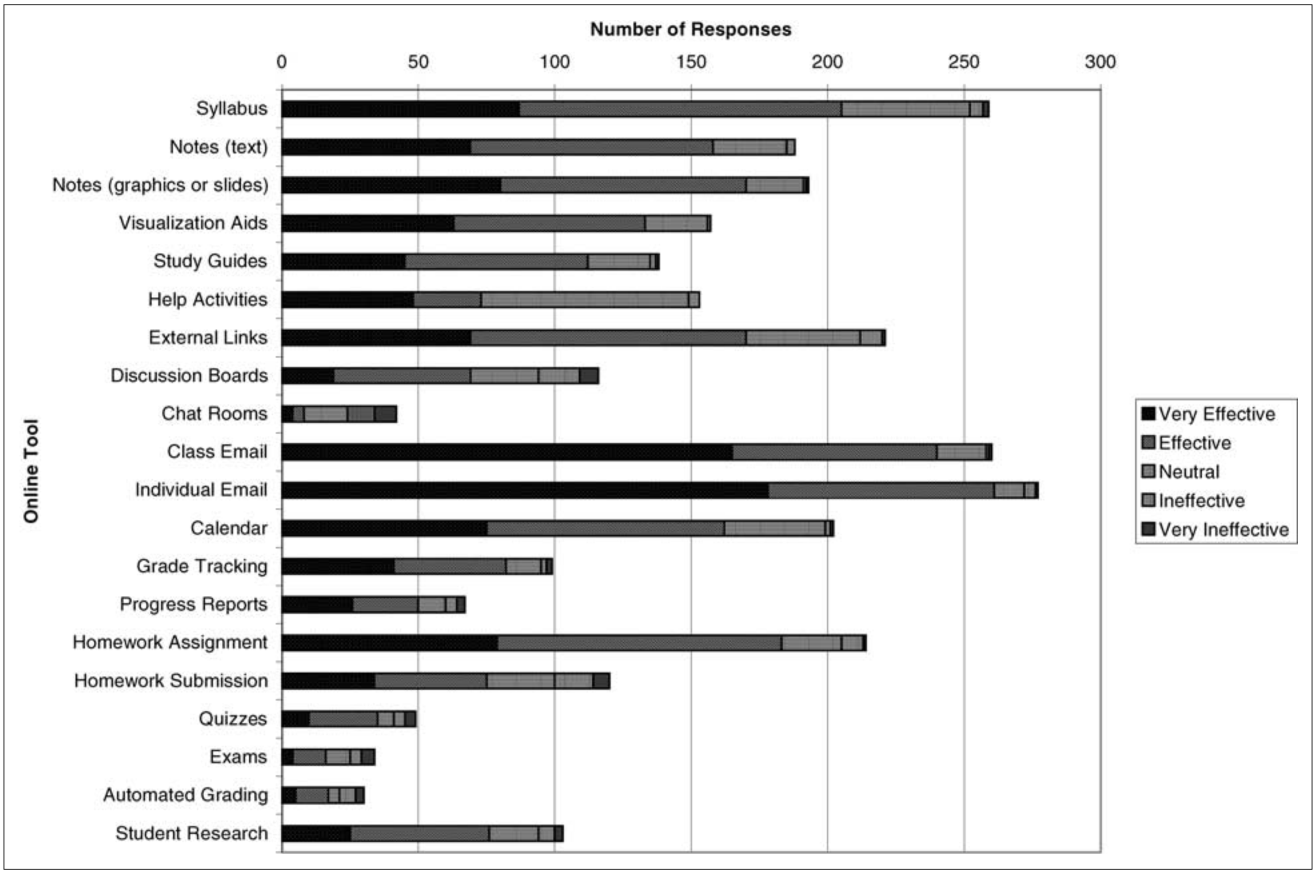

Figure 1. Perceived effectiveness of Internet tools for instructional purposes.

rating. Two of the three most used tools were also the highest rated tools and two of the four least used tools were also rated the lowest.

E. Efficiency of Tools

Respondents were also asked to rate how efficient these tools were with respect to their time and resources. These ratings are simply faculty opinions; times for accomplishing tasks were not measured. The rating scale was similar to the effectiveness scale mentioned above except the word *efficient* replaced the word *effective*; the results of these ratings are presented in Figure 2 and are very similar to the results of the effectiveness ratings. Only two tools, e-mail to entire class and e-mail to individual students, had median ratings of "very efficient." Only two tools had median ratings of "neutral" as well: chat rooms and online exams. Again, two of the three most used tools were also the highest rated tools and two of the four least used tools were also the lowest rated tools.

F. Comparison of Effectiveness and Efficiency

In an effort to compare effectiveness to efficiency, a number of Mann-Whitney tests were run to compare the effectiveness ratings of each tool to the efficiency ratings of that tool. In most of the cases in this study there was no statistically significant difference between effectiveness and efficiency. In a few cases effectiveness was rated significantly higher than efficiency. However, there were no cases in which efficiency was rated significantly higher than effectiveness. The tools that did have a statistically significant difference were online notes with text only ($U = 14{,}321.50$, $Z = 3.304$, $p < 0.05$), online notes with graphics ($U = 13{,}302.5$, $Z = 4.786$, $p < 0.05$), online visualization aids ($U = 8238$, $Z = 4.651$, $p < 0.05$), online study guides ($U = 7816.5$, $Z = 2.249$, $p < 0.05$), online help activities ($U = 9093.5$, $Z = 2.950$, $p < 0.05$) and e-mails to the entire class ($U = 28{,}897.5$, $Z = 2.486$, $p < 0.05$). Thus, respondents consider these six tools to be more effective for the students than they are efficient for faculty.

G. Ease of Use

The respondents were asked whether or not the Internet was easy for them to use and also whether or not the Internet was easy for the students to use for learning purposes. A five point scale was used for these questions as well, with the labels being "yes," "somewhat," "neutral," "not really," and "no." The Mann-Whitney test was again used to compare the ratings. Both questions had median ratings of "somewhat," but the Mann-Whitney test revealed that there is a statistically significant difference ($U = 32{,}826$, $Z = 3.953$, $p < 0.05$) between faculty ratings for themselves and students. Thus, professors perceive the Internet to be easier for students to use than it is for themselves.

H. Time Saving

Respondents were also asked whether or not the Internet saved time as compared to standard instructional methods both for themselves and their students. The same scale was used as for the "ease of use" question, and again the Mann-Whitney test was used to compare ratings. The median rating for faculty was "neutral" and the median rating for students was "somewhat." Again, there was a statistically significant difference ($U = 32{,}269$, $Z = 4.434$, $p < 0.05$) between the ratings, which suggests that for learning purposes, faculty perceive the Internet to be more time-saving for students than it is for themselves.

I. Tools Used

Participants in the survey were asked to check which of the listed tools, both for CMTs and WPTs, they had used to publish information on the Internet. A number of difference of proportions tests were conducted to see where breaks in usage rates might have occurred. Due to the fact that more than one comparison was being made on the same data, Bonferroni adjustments were made to the alpha levels and associated critical Z scores.

The usage rates for the most popular (those with use rates over 5 percent) WPTs are given in Table 4. The most popular WPTs were FTP, e-mail, and Adobe Acrobat, and there was no statistically significant difference between their usage rates. There was, however, a statistically significant difference ($Z = 5.2152$, $p < 0.00714$)

WPT	Respondents Using	
	Count	Percent
FTP	130	57.78 percent
E-mail	128	56.89 percent
Adobe Acrobat	128	56.89 percent
Dreamweaver	73	32.44 percent
Secondary Software	71	31.56 percent
Netscape Composer	54	24.00 percent
Frontpage	31	13.78 percent
Pagemill	21	9.33 percent

Table 4. Most used WPTs.

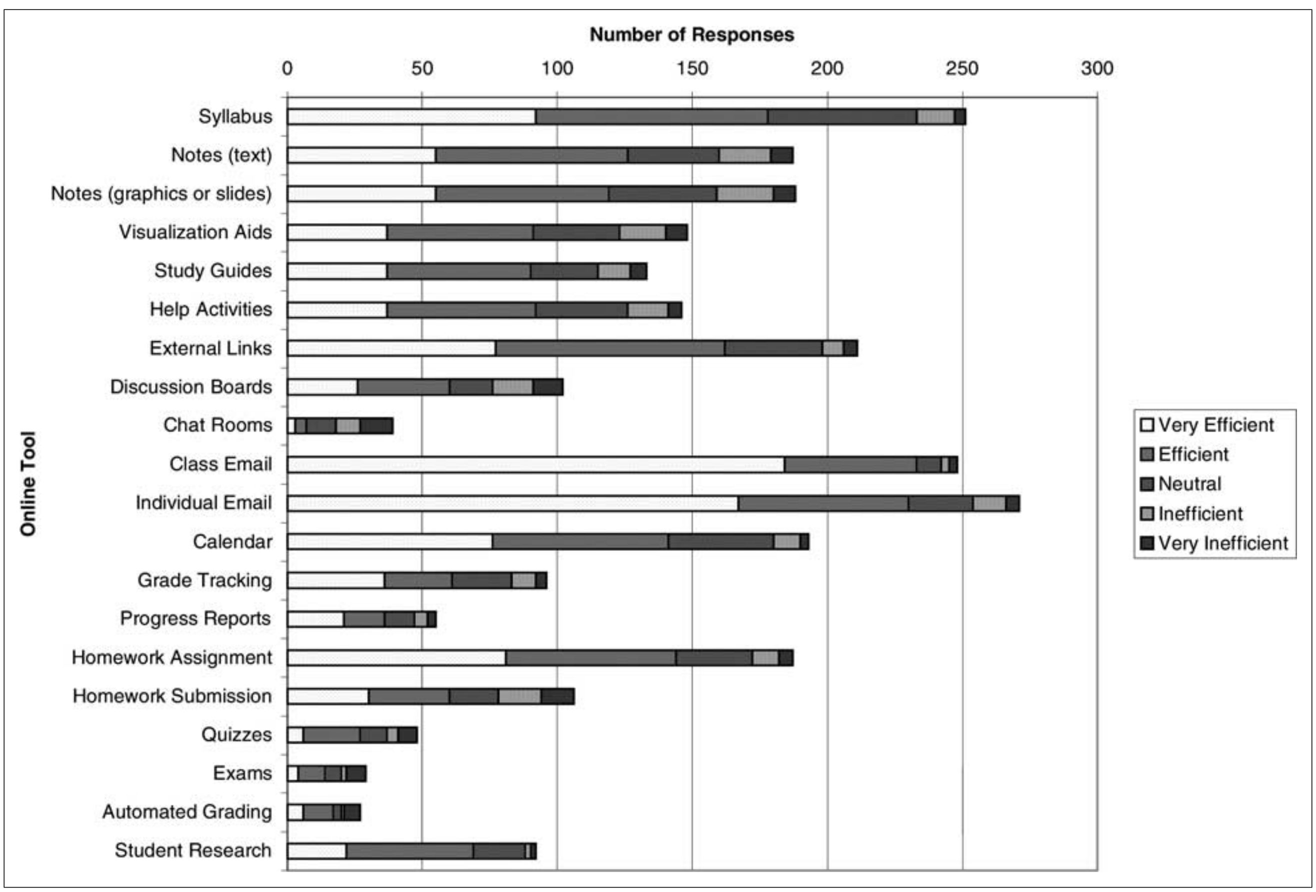

Figure 2. Efficiency of Internet tools for instructional purposes.

between Adobe Acrobat and Dreamweaver, meaning that all the remaining tools were used significantly less than the first three. The next statistically significant difference ($Z = 2.770$, $p < 0.00714$) occurred between Netscape Composer and Frontpage, and there was no significant difference between Frontpage and Pagemill. Table 4 lists all the tools that had usage rates greater than 5 percent along with their corresponding usage rates. The dashed lines in the table indicates where significant breaks in usage rates occurred.

A similar analysis was performed with the CMTs. Table 5 contains the usage rates for the most popular (those with usage rates over 5 percent) CMTs. Tools designed in-house were significantly ($Z = 2.748$, $p < 0.0167$) more popular than any other tools. WebCT and Blackboard had no statistically significant difference in their usage rates, but there was a significant difference ($Z = 3.898$, $p < 0.0167$) between Blackboard and CourseInfo. Again, the dashed lines in the table indicate where significant breaks occur.

CMT	Respondents Using	
	Count	Percent
In-house	75	40.54 percent
WebCT	50	27.03 percent
Blackboard	45	24.32 percent
CourseInfo	17	9.19 percent

Table 5. Most used CMTs.

J. CMT and WPT Use

Participants were given a list of tasks that could be completed either through the use of a CMT or WPT and asked which type of tool they used. Figure 3 gives the tasks and the percentages of people who used each type of tool to accomplish the tasks. A difference of proportions test was conducted on the usage rates for each task to see whether or not there was a statistically significant difference between the number of people who used CMTs for a specific task and the number of people who used WPTs.

The tasks that were reported as being completed more often with WPTs are generally those for which WPTs were specifically designed, and thus it logically follows that WPTs were used more often to accomplish them. These tasks were as follows:

- Create text only Web pages ($Z = 7.59$, $p < 0.05$)
- Create pages with graphics ($Z = 8.44$, $p < 0.05$)
- Create complex online tools ($Z = 3.43$, $p < 0.05$)
- Create links to outside info ($Z = 5.71$, $p < 0.05$)
- Create maintain calendars ($Z = 4.35$, $p < 0.05$)
- E-mail entire class ($Z = 2.27$, $p < 0.05$)
- E-mail individual students ($Z = 3.38$, $p < 0.05$)
- Create homework ($Z = 4.06$, $p < 0.05$)
- Assign homework ($Z = 3.74$, $p < 0.05$)
- Facilitate in student research ($Z = 4.46$, $p < 0.05$)

The tasks that were reported as being completed more often with CMTs seem to be fairly complex tasks that would be hard to accomplish if starting from scratch, even with a WPT, but are built into most CMTs. It seems logical that these would be the tasks accomplished more often with CMTs. These tasks were as follows:

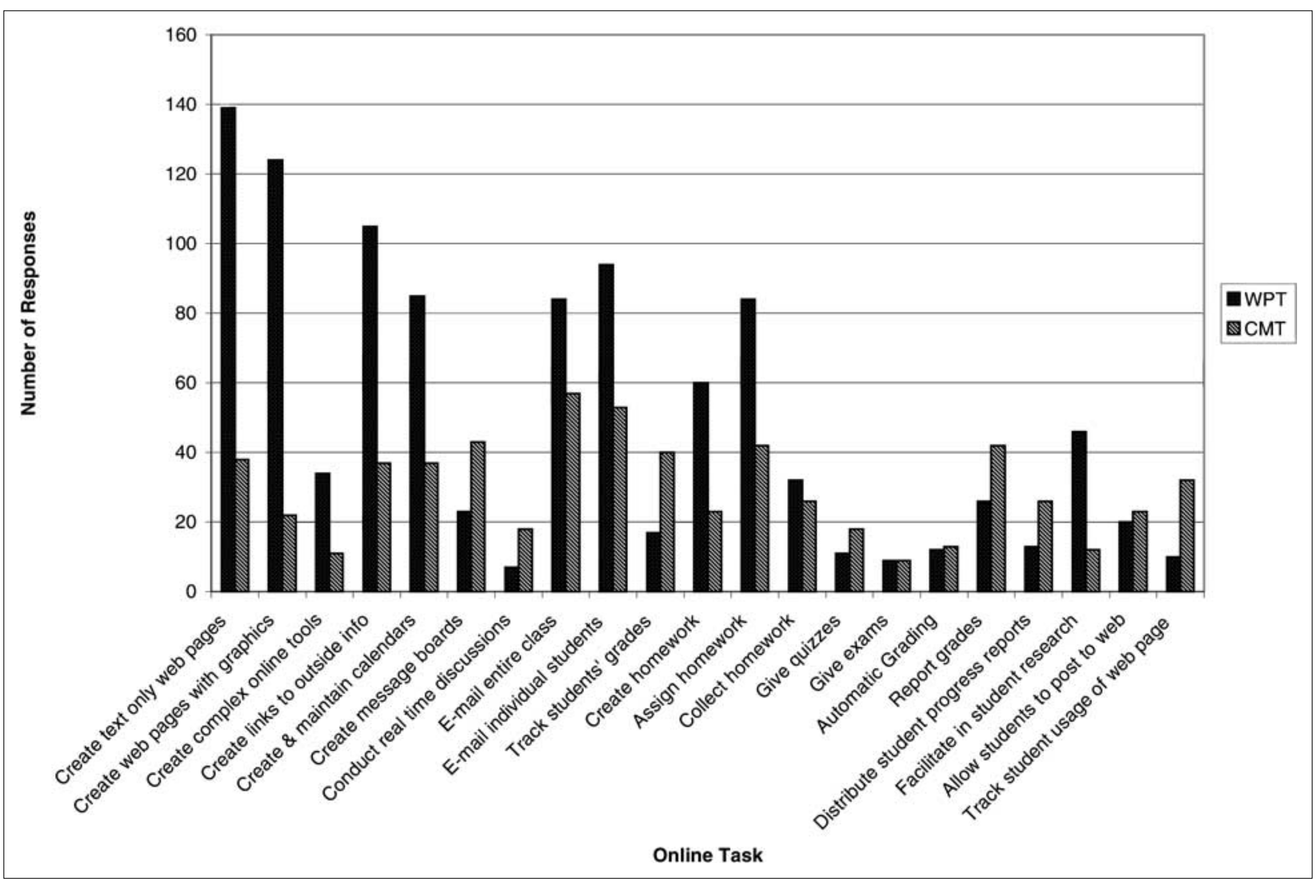

Figure 3. Reported usage of CMTs and WPTs.

- Create message boards ($Z = -2.46, p < 0.05$)
- Conduct live discussions ($Z = -2.20, p < 0.05$)
- Track students' grades ($Z = -3.05, p < 0.05$)
- Distribute progress reports ($Z = -2.08, p < 0.05$)
- Track students usage of Web pages ($Z = -3.39, p < 0.05$)

There were six tasks that were completed equally through the use of CMTs and WPTs: collecting homework, giving quizzes, giving exams, automatic grading, reporting grades, and allowing students to post to Web pages. Some of these tasks had very low usage rates, and perhaps the rates were too low to accurately test for significance. Some of these tasks, however, do seem as if they could be accomplished equally well through both the use of CMTs and WPTs. For example collecting homework or reporting grades can be done equally well with some standard functions of CMTs or through e-mail, which was considered a WPT in this study.

K. CMT and Web-Publish Effectiveness

Finally, participants were asked to rate the effectiveness of either the CMT or the WPT (whichever one they choose to accomplish the task) at accomplishing the task. The five-point effectiveness scale used earlier was used again. The results of these ratings are given in Figures 4 and 5. Both types of tools had median ratings of either "effective" or "very effective" for all tasks except giving exams online, for which both tools had a median rating of "neutral."

Mann-Whitney tests were run for each task to see if there was a statistically significant difference between the effectiveness ratings for CMTs and WPTs. The tests revealed that there were two specific tasks in which WPTs were reported as being more effective than CMTs: creating Web pages with text ($U = 1756.5$, $Z = 2.901$, $p < 0.05$) and conducting real-time, online discussions ($U = 21$, $Z = 2.154$, $p < 0.05$). For all other tasks, there was no statistically significant difference between the effectiveness ratings for CMTs and WPTs.

IV. Summary and Conclusions

In order to effectively implement technology into the classroom, instructors have to perceive the technology as being effective. As such, the purpose of this study was to assess instructor perceptions of instructional technology. Instructor Internet usage rates as well as the types of tools used by faculty members were also part of this study.

Some of the survey findings confirmed the researchers' expectations. It was expected that the Internet is primarily being used for simple tasks, such as e-mail and posting of syllabi, notes, assignments, links and calendars. These results suggest that most instructors simply used the Internet to replace the common paper form of such tools. Engineering instructors appeared to be hesitant to use the Internet for dynamic types of tasks such as the submission and grading of homework and exams, online chats, and discussion boards.

This study revealed that the easiest tools to use were also most often used and were perceived as being the most effective and efficient

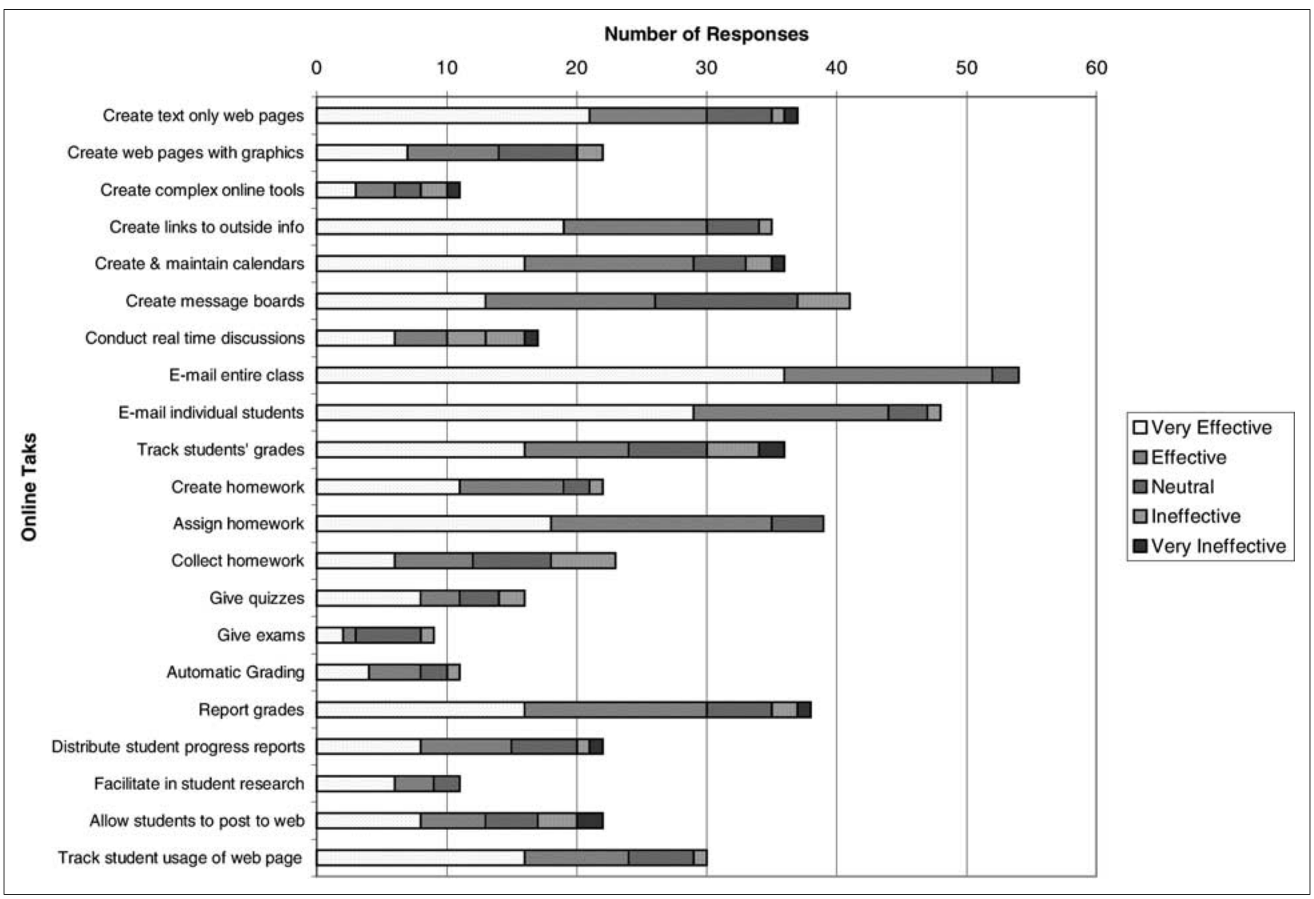

Figure 4. Effectiveness of CMTs.

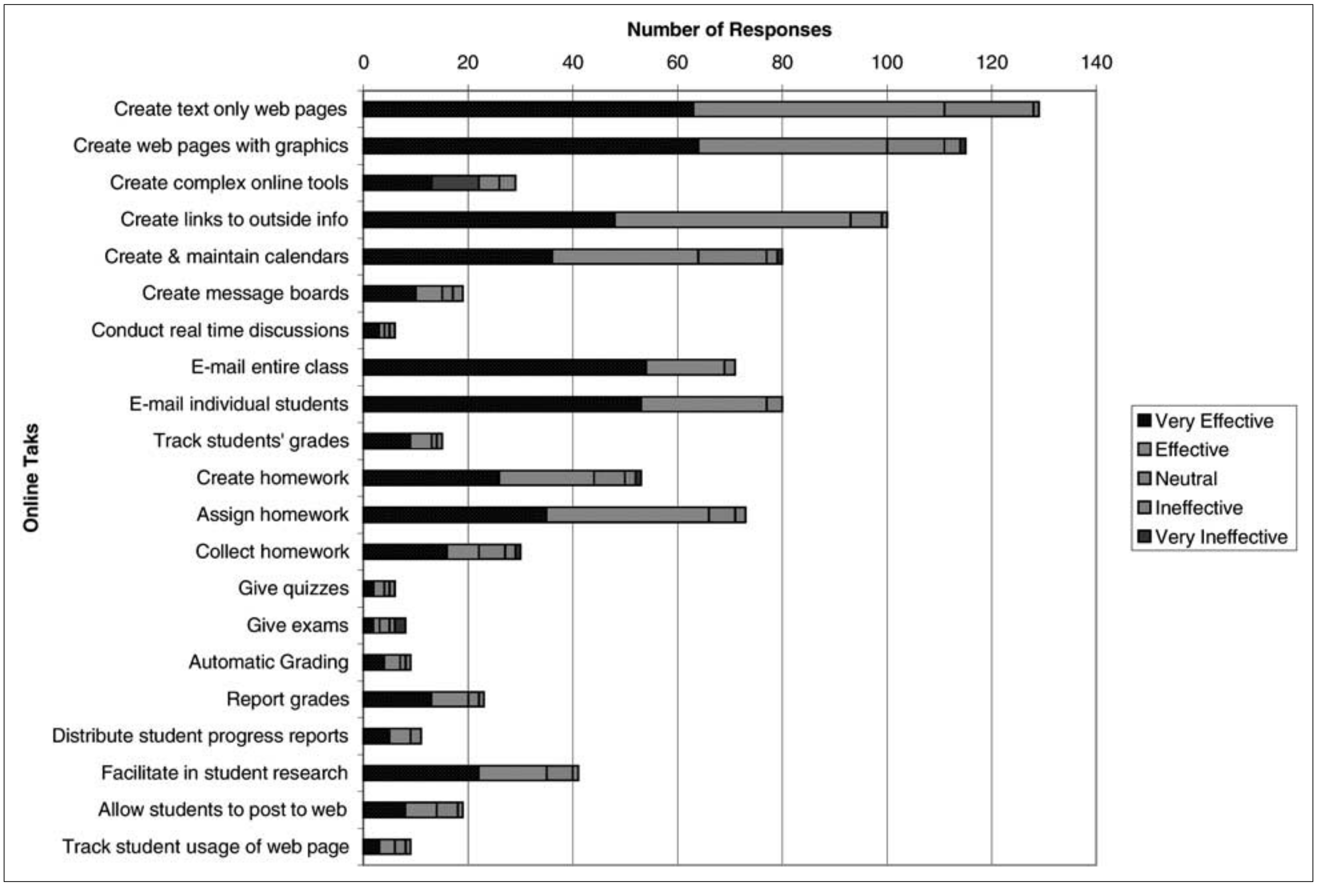

Figure 5. Effectiveness of WPTs.

while more complex tools were used less often and rated lowest for effectiveness and efficiency. However, the direction of causality is not known; it could be that instructors are not using the tools because they are less effective or it could be that they are perceived as being less effective because they are not widely used.

The survey results also revealed, as expected, that instructors reported that they thought the Internet was both easier to use and more time saving for students to use than it was for themselves. Instructors also perceived a number of tools to be more effective for the students than they were efficient for the instructors. Perhaps this is because for most college students, the Internet has been around for a good fraction of their lives and is extremely familiar to them. For some faculty, using computer tools by themselves is not necessarily a daunting task, but developing new material to replace familiar lectures as well as securing hardware and software to do so can be time consuming.

Although usage rates of CMTs and WPTs varied for specific tasks, the effectiveness of these two types of tools at accomplishing those tasks did not vary. Most of the tasks that were reported as being accomplished more through the use of WPTs were the creation of static pages such as text pages, graphical pages, calendars, homework, and informational links. Tasks that were reported as being accomplished more often with CMTs were more dynamic tasks such as creating message boards, tracking grades, and tracking student usage of Web pages. CMTs are generally equipped with the capability to perform these complex tasks but may be more cumbersome for creating static pages, thus the disparity in usage rates is as expected. What is surprising is that whichever type of tool was used to accomplish a task, it was rated equally effective as the other type of tool. For example, despite the fact that CMTs were used significantly more than WPTs for the creation of message boards, there was no significant difference between the effectiveness of each type at accomplishing the task. A possible area of further research would be to investigate why the usage rates differ between the two tools if both are perceived to be equally effective.

There are other areas of research that stem from this survey. This study only measured faculty impressions; a possible future study could measure both student and faculty perceptions and compare them. Another study could answer the causal question raised by the relationship between complexity, use, and effectiveness; a detailed study could determine whether tools are effective because they are easy to use, or if they are easy to use because they are effective. Perhaps the most important study stemming from this work, however, would be to perform an experimental assessment to determine whether or not these tools are actually effective as opposed to being perceived as effective. These studies would shed even greater light into how to use technology effectively in higher education.

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