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ABSTRACT

Technology has improved to the point where web-sites for every course taught by an instructor are possible. This has produced many instructional benefits; however, it has also created a new set of problems. The problem addressed by this paper is the question of which web-site components to include in the class web-site. This is important because different web components support different student learning styles. Because it is not feasible to include all known web-components, the instructor must select those components that are most useful and support the broadest group of students. To address this question, a survey instrument was developed and administered to 220 undergraduate business students. This questionnaire asked students for their perceptions of the usefulness of thirty-seven web components in four component categories. The results of this survey were analyzed and discussed. Several useful findings for the instructor were presented.

INTRODUCTION

The availability of Internet-based technology and infrastructure has progressed to the point to where college-level instructors are able (and expected) to maintain a class web-site for each course that is offered. These web-sites provide continuous on-line access to class materials for both remote and local students. The benefits of this arrangement are well documented in the literature. There are, however, a host of complications created by the expectation of web-based technology inclusion. One of these complications is the question of which web-based components to include in the class web-site. In this usage, a "component" is any content contained on a web-site that provides information or a link to resources for the student. There are literally dozens of potential components that could be incorporated into a class web-site. Were time and maintenance effort not an issue, the instructor could simply include them all. Unfortunately, instructor time is extremely limited and web-site maintenance can be exceptionally tedious and time consuming, so this is not reasonable.

A perfect solution to this problem would be to include only those web-site components that students find useful. This would allow the instructor to concentrate their efforts on creating and maintaining web-sites that do not include superfluous components. It would also assure that the web-site created for the class would better match individual student needs and learning styles. Regrettably, the "science" surrounding the use of web-sites for instruction is relatively new and no such list of "useful" components currently exists.

The research described by this paper attempts to alleviate this situation. A research project was undertaken to determine those web-site components that students find most useful in an actual class setting. This project surveyed 220 undergraduate business students concerning their opinions on thirty-seven web-site components. In the sections that follow, the research background and methodology for the project are described. Following that, the results of the study are presented and discussed in detail. Finally, the conclusions that can be drawn from this project are presented.

RESEARCH BACKGROUND AND MOTIVATION

The rise of the Internet as a major instructional tool has coincided with the development of several new teaching paradigms. These new teaching approaches are know by various names; "engaged learning" (Jones, Valdez, Nowakowski, & Rasmussen, 1992), "knowledge building" (Scardamalia & Bereiter, 1993), "active learning" (Bonsell and Eison, 1991), and others. All of these variations strive to achieve the same general goal--to involve the student in actively creating knowledge by interacting with real-life constructs. This is closely related to the "constructivist paradigm" described by educational theorists. The constructivist approach posits that knowledge does not have independent existence; rather, it resides and is created in the mind of the learner (Cronin, 1997; Jonassen, et al., 1995). Thus, according to this theory, learning should be an active process of constructing knowledge as opposed to passively acquiring it thru memorization. Under this approach, a successful learning environment should encourage active exploration of the knowledge realm, facilitate discussion among students, and promote communication between students and the instructor.

In contrast to this, the "objectivist paradigm" is a competing theory based upon an entirely different set of assumptions. Knowledge, according to this theory, is assumed to have an external existence independent from the learner. In this way, objective knowledge can be known by the learner because it resides outside of the learner (Cronin, 1997). Teaching under this set of assumptions is the process of presenting the reality of this knowledge and learning is the process of accurately memorizing the details (Jonassen, et al., 1995). A learning environment based on this theory would tend to concentrate on the structural component of knowledge and would be concerned with the accurate presentation of this knowledge. The objectivist approach is best represented by the traditional lecture-based classroom.

Both of these learning paradigms (along with numerous variations) are key components to an area of active educational research concerning student learning styles (Carver, Howard, and Lane, 1999; Schellens and Valcke, 2000). A goal of this line of research is to determine those teaching approaches that are most effective for the various student learning styles. In the past,

research into this area was limited because instructors were unable to effectively address the full range of learning styles. This changed with the widespread use of class web-sites. A class web-site connected to the Internet is the ideal vehicle to explore a variety of educational paradigms in the classroom. It allows for the combination of numerous learning resources and promotes various learning styles. According to Khalifa and Lam (2002), web-based learning is capable of supporting multiple learning environments; from distributed passive learning (which coincides with the objectivist approach) to distributed interactive learning (closely related to the constructivist approach). This versatility makes the Internet the perfect vehicle for educational experimentation.

The current state of the research into student learning styles via class web-sites has produced many valuable results. It has not, however, determined those specific web components that work best for the majority of student learners. Consequently, it is up to the instructor to determine the best mix of web components to support students. As was stated above, including all components is unrealistic due to the time required to maintain the web-site. Because of this, the project described by this paper was undertaken. This research attempts to be a modest first step toward a general discussion about those components that are most useful in actual classrooms.

THE RESEARCH STUDY

In order to determine those web-site components that students find most useful, an experiment was designed around a survey questionnaire.1 This questionnaire asked the participants to give their perceptions of the usefulness of thirty-seven web-site components. The specific components selected for inclusion represented those typically found in modern college web-sites. While this does not purport to be an exhaustive list of all possible web components, it was felt that it covered the range of components that are feasible for class web-sites. These components were divided into the four categories of "course content", "feedback and communication", "multimedia", and "external resources."

Participants in the experiment were asked to rate each web component using a 7-point Likert-type scale with values ranging from "not useful" on one extreme to "extremely useful" on the other. In addition to this, the questionnaire asked participants to indicate if they had ever used the component. This aspect of the survey instrument was included to help distinguish those students who had actual experience with a component from those who did not.

The environment for the research project was an undergraduate-only college of business administration with approximately 1,100 students within a state supported university of about 11,000 students. The student population within the college of business is traditional; that is, they are generally full-time students in the 19 to 24 age group who are pursuing their first degree. All students in the college of business are familiar with the Windows™ operating environment and

1 A copy of the portion of the survey instrument discussed by this paper can be found in Appendix A.

basic Internet tools, as this is a course prerequisite for business classes. Thus, lack of knowledge about computers and Internet tools should not impact the research results.

The survey was administered as a paper-based questionnaire to 220 students during class. Classes selected for the experiment came from each of the five majors offered by the college of business. Within the sample, student classifications ranged from Freshman to Senior. Thus, the full range of major emphasis and student classifications are represented in the sample. Participation in the survey was completely anonymous and voluntary. The results of the survey were coded into SPSS 11 and analyzed using basic frequency distribution, descriptive, and chi-square goodness-of-fit statistics. The results of this analysis are presented in the next section.

RESEARCH RESULTS

The four tables below present the statistical results of the research experiment. The SPSS analysis for each question from the survey was performed strictly on those responses where the student indicated that they had actually used the component. Thus, the 'N' value for each question is different. This was done because it was felt that the opinion of students who had actual experience with the components was more valid than those who did not. In addition, the seven "response frequency" columns show the distribution of the raw data with a value of '1' representing "not useful" and a value of '7' meaning "extremely useful." The "mean" and "standard deviation" columns statistically describe the distribution. Finally, the "Chi-Square" column provides information to help determine if the results are statistically significant.

Course Content Components

The course content components are commonly found in class web-sites. These include those components that archive and reinforce the material actually presented in class; such as on-line notes and slide sets, on-line quiz and simulations, and completed examples. The perceived usefulness responses for these ten components are given in table 1 below.

Web Components	N	Response Frequency (%)							Mean	Std. Dev.	Chi-Sqr. Sig.
		1	2	3	4	5	6	7			
Course syllabus on-line	164	1.1	.6	4.3	10.4	22.6	25.6	35.4	5.71	1.31	<.001
Course notes on-line	163	.6	0	1.2	8.0	11.0	32.5	46.7	6.13	1.07	<.001
Lecture slides on-line	163	.6	2.5	3.7	5.5	12.9	28.8	46.0	5.98	1.30	<.001
Project assignments on-line	165	0	1.2	3.6	7.9	13.3	33.9	40.1	5.95	1.17	<.001
Completed examples on-line	101	0	4.9	2.0	5.0	21.8	20.8	45.5	5.88	1.36	<.001
Working simulations on-line	57	0	0	5.2	10.5	24.6	19.3	40.4	5.79	1.24	<.001
On-line quiz systems	121	2.4	5.0	3.3	8.3	16.5	29.8	34.7	5.60	1.55	<.001
On-line drill and practice tutor Systems	63	1.6	7.9	7.9	9.5	17.5	19.0	36.6	5.37	1.72	<.001
Peer-review of your work via web-site	60	3.3	6.7	6.7	5.0	18.3	33.3	26.7	5.35	1.67	<.001
Textbook web-site	110	1.7	1.8	5.5	15.5	15.5	22.7	37.3	5.58	1.49	<.001

Table 1--Course Content Components

This group of components had the highest overall 'N' values of the four survey categories. This implies that the majority of class web-sites include these components. The table also shows that, in all cases, the majority of students found these specific components useful. The chi-square value for these results is at or below the .001 level for all ten categories, so this indicates that the results are significant. Of particular note are the four components of "course notes", "lecture slides", "project assignments", and "completed examples." These are among the most basic, easy to maintain web components that exist; yet they are the overall highest rated components in the group. Each of these four had at least 87% of the students rate them as "useful" (i.e., a rating of 5 or above). This shows that students appreciate the good, solid web components that most instructors normally supply. It also indicates that a useful web-site does not depend solely on high maintenance, high-bandwidth web components.

The three least used web components as reported by their 'N' values (specifically, "on-line simulations", "on-line drill and practice", and "peer-review of work") still received a respectable "useful" rating of 84.3%, 73.1%, and 78.3% respectively. Interestingly, the "textbook website" component was well represented with an 'N' value of 110; however, its frequency distribution and overall "useful" rating of 75.5% imply that students appreciate the instructor generated material at least as much (if not more) than the professional web-sites provided by the textbook publishers.

Feedback and Communication Components

The feedback and communication components are those web-site resources designed to allow students to communicate electronically via the Internet with each other and the instructor. This communication can be synchronous or asynchronous as represented by the live "chat rooms" versus "e-mail to instructor" components. It can also be one-way or bi-directional communication as exemplified by the "class announcements" and the "virtual office hours" components. The participant responses to the usefulness of these components are shown in table 2.

Web Components	N	Response Frequency (%)							Mean	Std. Dev.	Chi-Sqr. Sig.
		1	2	3	4	5	6	7			
Class announcements page	143	.6	1.4	4.9	7.0	17.5	27.3	41.3	5.86	1.30	<.001
Frequently asked questions	58	3.4	5.2	13.8	8.6	25.9	20.7	22.4	5.00	1.68	.004
E-mail to instructor	161	0	0	1.2	3.1	11.2	22.4	62.1	6.41	.90	<.001
E-mail to other students	86	0	2.3	3.5	9.3	14.0	33.7	37.2	5.85	1.25	<.001
Threaded discussion group	74	2.6	4.1	9.5	23.0	16.2	27.0	17.6	4.97	1.55	<.001
Chat room with instructor	18	5.5	11.0	5.6	16.7	5.6	27.8	27.8	5.00	1.97	.264
Chat room with other students	32	6.2	6.2	6.3	18.8	15.6	28.1	18.8	4.91	1.77	.144
Virtual office hours with instructor	15	0	6.7	0	6.7	13.3	33.3	40.0	5.87	1.41	.119
On-line grade lookup	142	0	0	0	2.1	4.9	24.6	68.4	6.59	.69	<.001

Table 2--Feedback and Communication Components

By far, the most popular communication and feedback components appear to be "e-mail to the instructor" and "on-line grade lookup" with 95.7% and 97.9% respectively rating these as

"useful" (i.e., a rating of 5 or above). The next tier of useful components is the "class announcements" (86.1%) and "e-mail to other students" (84.9%) components. Rounding out the list of "useful" communication components are the "FAQ page" (69.0%) and the "threaded discussion group" (60.8%). In all cases, the usefulness ratings for the components listed above were significant at or below the .004 level for the chi-square goodness-of-fit test. The three remaining communication components (specifically, "chat room with instructor", "chat room with students", and "virtual office hours") received respectable usefulness ratings; however, the "N" value of students who had used them was somewhat low and the chi-square test showed these results to be non-significant (i.e., chi-square > .05).

Multimedia Components

The multimedia component set generally represents the cutting edge of web-site technology. This includes streaming video technology, animation, and on-line audio. They also represent the components that require the most bandwidth infrastructure to deliver over the Internet. Because of this, fewer students have had actual experience with this category of components. Table 3 shows the survey results for this category.

Web Components	N	Response Frequency (%)							Mean	Std. Dev.	Chi-Sqr. Sig.
		1	2	3	4	5	6	7			
Audio recordings of class material	44	0	2.3	6.8	18.2	40.9	13.6	18.2	5.11	1.24	<.001
Audio recordings of past lectures	13	0	15.4	0	7.7	53.8	0	23.1	4.92	1.61	.094
Audio-video recordings of past lectures	22	0	4.5	4.5	9.1	27.3	13.6	41.0	5.64	1.47	.016
Live video of lectures while they occur	4	0	0	0	25.0	0	0	75.0	6.25	1.50	.317
Multimedia demonstrations via Web site	15	0	0	6.7	0	13.3	33.3	46.7	6.13	1.13	.108
PC based video conferences	5	0	20.0	0	0	20.0	40.0	20.0	5.20	1.92	.896
Animated slideshows	68	2.9	1.5	1.5	8.8	16.2	33.8	35.3	5.76	1.39	<.001
Slideshows with narration	51	2.0	0	3.9	15.7	7.8	29.4	41.2	5.80	1.40	<.001
Slideshows with media clips	44	2.2	2.3	2.3	9.1	9.1	36.4	38.6	5.84	1.41	<.001

Table 3--Multimedia Content Components

Student responses for five of the nine multimedia components were significant (i.e., chi-square value of < .05). These are the "audio of class material", "audio-video of past lectures", "animated slideshows", "slideshows with narration", and "slideshows with media clips" components. These five components also had large enough 'N' values to render the results meaningful. Of this group, the "animated slideshows", "slideshows with media clips", and "audio-video of past lectures" components were rated as most useful overall with ratings of 85.3%, 84.1%, and 81.8% respectively. Coming in a very close second were the "slideshows with narration" (78.43) and "audio of class material" (72.7%) components. While the distinction between these two groups is too close to be statistically significant, it is interesting to note that the components that include some type of video all rate higher (i.e., more useful) than those that are audio only. This could indicate that the impact of television and video games on students has

shaped their learning preferences; however, no firm conclusions can be drawn concerning this without further study. The remaining four multimedia components either had frequency results that were not statistically significant or an 'N' value too low (or both).

External Resources Components

The final category of web components is the group that links students to learning resources outside of the university. This group has the potential to provide the greatest impact on the university experience, as it literally opens the world to the classroom. However, this group also has significant coordination issues (e.g., "joint projects with other schools" and "live external data feeds") and resource availability issues (e.g., "access to industry experts" and "commercial web-based training"). Despite these problems, external web resources represent an exciting component category with tremendous potential. The student responses for this group of components are given in table 4 below.

Web Components	N	Response Frequency (%)							Mean	Std. Dev.	Chi-Sqr. Sig.
		1	2	3	4	5	6	7			
Links to library resources	123	.8	.8	4.9	3.3	20.3	24.4	45.5	5.97	1.25	<.001
Links to commercial web-sites	114	0	0	2.6	7.9	32.5	26.3	30.7	5.75	1.06	<.001
Links to independent external web-sites	98	0	.9	4.1	8.2	25.5	32.7	28.6	5.70	1.15	<.001
Access to external databases	63	0	0	0	9.5	17.5	31.7	41.3	6.05	.99	.002
Live external data feeds	12	0	0	8.3	8.3	8.3	41.7	33.4	5.83	1.27	.176
Commercial web-based training	10	10.0	0	20.0	10.0	20.0	20.0	20.0	4.70	1.95	.977
Web access to industry experts	19	0	0	0	5.2	5.3	47.4	42.1	6.26	.81	.008
Internet contact with student from other universities	8	0	0	0	0	37.5	12.5	50.0	6.13	.99	.417
Joint projects with students from other universities	7	0	0	0	14.2	14.3	28.6	42.9	6.00	1.15	.666

Table 4--External Resources Components

The student responses for five of the nine external resource components produced statistically significant results. These include the "links to library", "links to commercial web-sites", "links to external web-sites", "access to external databases", and "access to experts" components. Each of these components had a combined "useful" rating of at least 86.8%, with "web access to experts" reporting the highest overall useful rating of 94.8%. This implies that students truly appreciate and desire access to external data resources. Also, given the range of external resource types represented in this set, the students do not appear to have any preference of one type of external access over another. The remaining four categories reported non-significant results primarily because the 'N' values were too low to produce statistically valid conclusions.

DISCUSSION

Several patterns become clear when one examines the results of this research. First, students generally tend to like all of the components represented by the survey. In no case did statistically

significant survey results indicate that a majority of students found a component to be "not useful" (i.e., the sum of the ratings from 1 to 3). Apparently, the student participants have never seen a web component that they do not like. Even the "least useful" component in the survey, the "threaded discussion group", had an overall "useful" rating of 60.8 compared to a combined "not useful" rating of 16.2%. This implies that the instructor designing a class web-site first needs to select those web components that have overwhelming student support. For example, "on-line grade reporting", "e-mail to the instructor", "course notes on-line", "access to external databases", and "access to experts" all enjoyed student "useful" ratings above the 90% level. Later, if time allows, the instructor can add the other components with weaker student support. In this way, the instructor can provide the best web-site possible for the amount of time and effort available.

A second finding from this research is that students have great appreciation for the basic course content and communication components. These include the "on-line notes", "lecture slides", "project assignments", components along with the "instructor e-mail" and "grade-lookup components". This is important reinforcement for the instructor who does not have the time or expertise to incorporate high-maintenance, high-bandwidth multimedia components into the class web-site. Apparently, a tremendous amount of student benefit can be achieved by making these basic components available.

Finally, the third major finding from this research is that students appear to have strong support for multimedia components despite the fact that relatively few have had actual experience with them. Said another way, those students who have had experience with the multimedia components tend to like them and find them useful. This result is consistent with prior research (Nowaczyk, Santos, and Patton, 1998; Scanlan, 2000). Given that hardware prices continue to drop while the capabilities increase and Internet infrastructure is continually being upgraded, it is likely that these components will have significant student demand in the future. To prepare for this demand, instructors need to begin experimenting with some forms of multimedia components in their class web-sites. These components are complex and require some expertise, so it is best to begin early. In this way, instructors can prepare today for the demands of tomorrow.

SUMMARY

Class web-sites are commonly used in university education. These web-sites are typically created by the instructor with the intent of providing the information and resources needed to support the various learning styles of the students in the class. Ideally, the instructor would create a web-site that includes just those components that students find most useful. This would make the web maintenance task more efficient while effectively satisfying student needs. Unfortunately, there has been little research into which web-site components best support student needs and learning styles. This was the primary motivation for the research described by this paper.

An experiment was devised to help determine those web-site components that students perceive to be most useful. The experiment relied on a survey questionnaire that asked students to rate

thirty-seven web components on a one-to-seven Likert-type scale for usefulness. The survey was administered to 220 undergraduate business students and the results were analyzed.

The results of the survey show that the majority of students found all thirty-seven components to be "useful." None were rated as being "not useful" by more than 30% of the participants. Given this, it was determined that the instructor creating a class web-site should concentrate first on those components with the strongest support and later, if time permits, add those components with weaker support. A second finding of this research was that students perceive the basic course content and communication components to be very useful. The strength of this support reinforces the notion that class web-sites do not need to have high-bandwidth, high production-value multimedia components to be appreciated by the students. The last major finding from this research was that students do value multimedia web components despite the fact that few had actual experience with them. The recommendation from this finding is that instructors should begin experimenting with multimedia components so they will be prepared when the time comes that more students are able to access to this type of component. By following these suggestions, it is hoped that instructors will produce more useful class web-sites that better support the needs and learning styles of students.

APPENDIX A

The questions below refer to the usefulness of Internet based components used to augment a traditional lecture-based course. They are <u>not</u> specific to this particular class or instructor.

For the web-based items listed below, indicate the usefulness of each component using the 1 to 7 scale provided. **<u>In addition</u>**, indicate if you have had actual experience using each component on a web-site by checking the column labeled "**have used**". <u>This means that you will **always** check one box using the 1 to 7 scale in each line and may **also** check the "have used" box in the same line</u>.

	Not Useful						Extremely Useful	
Course Content	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Have Used**
Course syllabus on-line	9	9	9	9	9	9	9	9
Course notes on-line	9	9	9	9	9	9	9	9
Lecture slides on-line	9	9	9	9	9	9	9	9
Project assignments on-line	9	9	9	9	9	9	9	9
Completed examples on-line	9	9	9	9	9	9	9	9
Working simulations on-line	9	9	9	9	9	9	9	9
On-line quiz systems	9	9	9	9	9	9	9	9

On-line drill and practice tutor systems	9	9	9	9	9	9	9	9
Peer-review of your work via web-site	9	9	9	9	9	9	9	9
Textbook web-site	9	9	9	9	9	9	9	9

	Not Useful						Extremely Useful	
Feedback and Communication	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Have Used**
Class announcements page on-line	9	9	9	9	9	9	9	9
Frequently asked questions page on-line	9	9	9	9	9	9	9	9
E-mail to instructor	9	9	9	9	9	9	9	9
E-mail to other students in course	9	9	9	9	9	9	9	9
Threaded discussion group for class	9	9	9	9	9	9	9	9
Chat room with instructor	9	9	9	9	9	9	9	9
Chat room with other students in course	9	9	9	9	9	9	9	9
Virtual office hours with instructor	9	9	9	9	9	9	9	9
On-line grade lookup	9	9	9	9	9	9	9	9

	Not Useful						Extremely Useful	
Multimedia Content	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Have Used**
On-line audio recordings of class material	9	9	9	9	9	9	9	9
Audio-only recordings of past lectures	9	9	9	9	9	9	9	9
Audio-Video recordings of past lectures	9	9	9	9	9	9	9	9
Live video of lectures while they occur	9	9	9	9	9	9	9	9
Multimedia demonstrations via web site	9	9	9	9	9	9	9	9
PC based video conferences	9	9	9	9	9	9	9	9
Animated slideshows	9	9	9	9	9	9	9	9
Slideshows with narration	9	9	9	9	9	9	9	9
Slideshows with media clips	9	9	9	9	9	9	9	9

	Not Useful						Extremely Useful	
External Resources	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Have Used**
Links to library resources	9	9	9	9	9	9	9	9
Links to commercial web-sites	9	9	9	9	9	9	9	9
Links to independent external web-sites	9	9	9	9	9	9	9	9
Access to external databases	9	9	9	9	9	9	9	9
Live external data feeds	9	9	9	9	9	9	9	9
Commercial web-based training	9	9	9	9	9	9	9	9
Web access to industry experts	9	9	9	9	9	9	9	9
Internet-based contact with students from other schools	9	9	9	9	9	9	9	9
Joint projects with students from other universities	9	9	9	9	9	9	9	9

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