

## Some Characteristics of Student Use of Electronic Communications in Second-Year Science Classes

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**Abstract** - This study is based on an analysis of student e-mail messages to the instructor and postings to a class electronic bulletin board over a three year period in two second-year Biology courses. The study examines the time of day at which students use both e-mail and the electronic bulletin board, the amount of use in the different courses and instructional formats (on-campus lecture, off-campus correspondence, and Web-based) and a content analysis of the various messages. An analysis of the relationship between the level of e-mail and Web forum use and final course scores shows that there is a positive correlation between Web forum use and course grades. The connection between research on student writing and posting notes on the Web forum is also explored.

**Key Terms** - E-education Systems, Computer Communications, World Wide Web, Distance Education.

### 1 INTRODUCTION

In 1997, *The Atlantic Monthly*, a popular North American magazine, published an article about the Clinton administration's pledge to bring a computer to every student's desk in the U.S. The article stated "in 1922, Thomas Edison predicted that 'the motion picture is destined to revolutionize our educational system and ...in a few years it will supplant largely, if not entirely, the use of textbooks.' Twenty three years later, in 1945, William Levenson, the director of Cleveland public schools' radio station claimed that 'the time may come when a portable radio receiver will be as common in the classroom as is the blackboard.' Forty years after that the noted educational psychologist B.F. Skinner, referring to the first days of his 'teaching machines' in the late 1950's and the early 1960's, wrote, 'I was soon saying that, with the help of teaching machines and programmed instruction, students could learn twice as much

in the same time and with the same effort as in a standard classroom.' " [13] (p. 45)

While this quote could just as easily be applied to computers, it is clear that computers, by themselves, have not revolutionized the practice of teaching any more than any other previous educational technologies have. However, computers have become useful tools which are beginning to change the face of education. One area which has seen such a change is the use of computers in Electronic Messaging (EM) or Computer-Mediated Communication (CMC).

### 2 ELECTRONIC COMMUNICATIONS

Chickering and Gamson [4], along with other educators, have identified interaction as one of the seven principles for good practice in undergraduate education. All courses then if they are to be successful, should include this key element of interactivity. While there are many aspects to interactivity in courses, we

believe that one of the major elements in promoting student interactivity, particularly in large on-campus courses, and in distance education courses, is through the medium of Electronic Messaging (EM) also called Computer-Mediated Communication (CMC). Slovacek [14] found a significant correlation between student use of interactions on e-mail between the instructor and the students could add to the overall quality of instruction. The majority of students in her study also agreed that the use of e-mail had a positive effect on the learning process. More recently Zack [15] has used the term "electronic messaging" (EM) as a broad term that refers to several modes of computer-mediated communication, including electronic mail and electronic bulletin boards (or computer conferencing), in addition to electronic talk or chat, and electronic document exchange. In his study of EM use in a business administration class he concluded that "this study clearly showed that EM can usefully be employed in the traditional classroom to improve the quality of education and interaction." (p.206)

Coombs [9] used both e-mail and computer conferencing with an off-campus American history telecourse. He found that computer conferencing not only provided for questions and answers but also served as a platform for sharing opinions and differing perceptions about course content.

In 1994 one of us (MC) first used EM with a large on-campus, second-year, non-major Biology course in an attempt to overcome some of the interactivity problems inherent in such large classes.[5],[6] E-mail was used for 'private communications between the instructor and individual students, while an electronic bulletin board was used for students to ask questions of the instructor outside of class time, and to encourage discussion of topics between students outside of the classroom. The results of this initial experiment were extremely gratifying with almost 90% of the students in the

class making use of the electronic bulletin board, and nearly three-quarters of the students rating it as excellent or very good on an end-of-term questionnaire. The following are some of the quotes about the electronic bulletin board

"Everyone could communicate interesting and important information to each other."

"The ability to ask questions and receive answers."

"You could ask a question outside of class time i.e. available at all times."

"Creates useful discussion outside of the class atmosphere."

"Many are too timid to ask questions in class, this way there is no embarrassment. Also questions could be about anything (about Biology) and they would be answered."

"Being able to discuss certain topics was an incentive to take interest in the course overall and produced better study habits because of this interest." [6] (p.84)

In a study looking at the use of electronic communication in a computing course at the Open University (UK) Carswell et al. [2] found that "Electronic communication encouraged an increased interaction between student and tutor, with an average four times as many interactions as compared with conventional (non-Internet) communication methods (i.e. telephone, mail etc.)." (p.43) Their study showed that "...the Internet offers students a rapid and convenient medium that can enable increased interaction with fellow students (both within and beyond their tutor group)." (p.44) They concluded that "Electronic communication can support distance learning students by providing them with flexible, convenient interaction that is neither *time nor place dependent*." (p.45)

### 3 THE STUDY

Biology 2040 (Human Biology) and Biology 2041 (Environmental Science) are two large enrolment second-year, non-major Biology courses which are regularly offered in both on-campus lecture and off-campus correspondence formats. Biology 2040 is also offered as a Web-based course. During the period 1997-1999, student contributions to a Web-based discussion forum and e-mail messages sent to the instructor were collected. An analysis of these data included time of day used, levels of use, types of communications, and the relationships between the use of electronic communications and the final course grades of the students. A comparison of the performance of students in the different instructional formats of Biology 2040 is described elsewhere. [7]

#### 4 SOME CHARACTERISTICS OF EM USE

In Table 1 the time of day that students used both e-mail and the Web forum is shown in four-hour blocks throughout the day.

period		forum	
12:01 - 4:00 am	23 (3.2%)	9 (6.1%)	32
4:01 - 8:00 am	19 (2.6%)	0	19
8:01 - 12 noon	135 (18.6%)	22 (15.0%)	157
12:01 - 4:00 pm	266 (36.6%)	51 (34.6%)	317
4:01 - 8:00 pm	162 (22.3%)	35 (23.8%)	197
8:01 - midnight	122 (16.8%)	30 (20.5%)	152
Totals	727	147	874

As the table shows, while the majority of both the e-mails (55.2%) and the Web forum postings (51.6%) took place during regular classroom hours, over forty percent of use was in times outside of the regular classroom hours. This finding reinforces Cavalier's [3] assertion that EM allows students to participate in "round-the-clock dialogues."

Table 2 shows the levels of use of the two different methods of electronic communication for the different courses and instructional formats.

**TABLE 1**  
**Time of day students use e-mail and the electronic bulletin board**

Time	E-mail	Web	Totals
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**TABLE 2**  
**Levels of use of e-mail by**  
**course and instructional format**

Course	Format	E-mail use	Mean # of e-mails
2040	Lecture	22.0%	2.36
2040	Correspondence	8.9%	1.97
2040	Web	48.7%	1.90
2041	Lecture	13.5%	1.65
2041	Correspondence	10.8%	1.54

As the table shows, the students in the Web-based version of Biology 2040 were much more likely to send e-mail messages to the instructor than students in the lecture and correspondence versions. Since students who enroll for the Web-based version have to be familiar with computers, the Internet, and e-mail as a prerequisite for enrolment, it is not surprising that they would be more comfortable with using e-mail than the students in the non-Web classes. While use of e-mail was lower in the lecture classes, its use in the off-campus correspondence classes was even lower. This is surprising given the fact that distance education students' main method of communication with the instructor was by e-mail, while on-campus students had access to the instructor in both the classroom and in his office. This particular finding clearly warrants further investigation.

Table 3 shows a content analysis of the e-mail messages.

**TABLE 3**  
**Content analysis of the e-mail messages**

Type of e-mail	Format		
	Lecture	Correspondence	Web
Assignment	96 (21.6%)	30 (12.3%)	14 (10.5%)
Tests	119 (26.7%)	97 (39.8%)	44 (33.1%)
System	12 (2.7%)	13 (5.3%)	27 (20.3%)
Content	17 (3.8%)	15 (21.7%)	12 (9.0%)
Admin.	74 (16.6%)	53 (21.7%)	26 (19.5%)
Other	31 (6.9%)	36 (14.8%)	10 (7.5%)

As this table shows the main use of e-mails in all three instructional formats was for messages related to tests and examinations. The second most frequent use for both the correspondence and Web classes was for administrative purposes (scheduling meetings, marks etc.). In the lecture classes the second most frequent use was for messages related to assignments, but this is a reflection of the fact that assignments were more frequently used in these classes. Messages related to course content were more frequent in the correspondence and Web classes than in the lecture classes. This is probably due to the fact that on-campus students had greater access to the instructor to have questions answered than the off-campus classes.

These results are broadly similar to those in an earlier study [6] concerning an on-campus lecture class which also indicated that test-related messages were the most frequent

student e-mail messages (54.1%), then assignment related messages (31.3%), system-related (8.3%), and course content (4.2%).

## 5 RELATIONSHIPS BETWEEN FINAL COURSE SCORES AND EM USE

In a previous paper [8] it had been shown that while there was hardly any difference between the final course scores of e-mail users and non-users, there did seem to be a positive relationship between the level of Web forum use and final course scores. Since this earlier study examined just one individual class (Biology 2040 - Web; Summer 1999) it was decided to expand the analysis to include all the classes for which we had data during the period 1997-1999. The present study, therefore, examined the relationships between final course scores and use of e-mail, the Web forum, and total EM. Table 4 shows the data for e-mail use and final course scores.

**TABLE 4**  
**Mean final course grades by use**  
**and by instructional format**

Course	Format	Mean Final Score	
		Users	Non-users
2040	Lecture	77.27 (130)	76.25 (461)
2040	Correspondence	73.98 (59)	75.88 (602)
2040	Web	73.84 (56)	73.73 (59)
2040	Overall	75.69	75.92
2041	Lecture	78.35 (61)	76.96 (291)
2041	Correspondence	81.91 (44)	82.49 (394)
2041	Overall	79.84	80.14

As the table shows there was no relationship between the mean course scores of e-mail users and non-users, and overall the mean final course scores of the non-users were, in fact, slightly higher than those of the users. This was not unexpected and confirmed an earlier study [8] that showed no clear relationship between e-mail use and final course scores. In this study, therefore, there does not appear to be a relationship between e-mail use and final course scores as Slovacek [14] had found in his study.

In the period of the present study (1997-1999) the Web forum was only used with three classes all of them Web sections of Biology 2040. The next table shows the mean final course scores for e-mail, Web forum and total electronic messaging for just these three Web sections.

**TABLE 5**  
**Mean final course grades and use of e-mail,**  
**Web forum and total EM**

EM type	Users		Non-users	
	Mean	n	Mean	n
E-mail	73.60	50	73.17	41
Web forum	75.25	40	71.96	51
Total EM	73.80	64	72.41	27

As the table shows there was virtually no difference between the mean final course scores of e-mail users and non-users for these three Web classes, similar to the situation seen above for all the courses and instructional formats. However the Web forum users showed much higher mean final course scores than the non-users (difference = 3.29) while the mean final course scores for the total EM users were also

higher than the non-users but not to such a great extent (difference = 1.39). These data then tend to suggest that there is a positive relationship between Web forum use and mean final course scores even though no such relationship was evident for e-mail use. These data are further analyzed in the next four tables which show the relationships between the frequency of use of the various types of EM and final course scores and letter grades.

**TABLE 6**  
**Levels of use of different types of EM and mean final course scores**

Level of use	E-mail	Web forum	Total EM
Very frequent	80.00 (n=1)	85.00 (n=2)	80.00 (n=4)
Frequent	77.50 (n=2)	73.75 (n=4)	71.8 (n=11)
Infrequent	73.29 (n=47)	74.85 (n=34)	73.78 (n=49)
None	73.17 (n=41)	71.96 (n=51)	72.41 (n=27)

While there seemed to be no overall relationship between e-mail use and mean final course scores in the previous table this table shows that there is a relationship between the level of e-mail use and mean final course scores in the three Web classes examined here, although the number of users in the very frequent and frequent categories is too low (n=3) to be statistically significant. There is hardly any difference between the mean final course scores of the low users and non-users.

While very frequent users of the Web forum achieve the highest mean final course scores again the number of students in the category is too small to be statistically significant and while frequent and infrequent users achieve higher

mean scores than non-users, the infrequent users achieve a higher mean score than the frequent users.

With Total EM the very frequent users once again recorded the highest mean scores but again the number of students in this category is too low to be statistically significant. While infrequent users achieve higher mean scores than non-users the frequent users recorded lower mean scores than either the infrequent users or the non-users.

Overall then while there is a relationship between levels of e-mail use, and to a lesser extent Web forum use, and final course scores, there does not seem to be such a relationship for total EM use.

The next few tables examine the same data but this time the relationship between levels of use of EM and letter grade (A, B, C, D and F) achieved in the course are analyzed.

**TABLE 7**  
**Frequency of use of e-mail and final letter grades**

Level of use	Course grade				
	A	B	C	D	F
Very frequent	1	0	0	0	0
Frequent	1	1	0	0	0
Infrequent	19	20	3	1	4
None	21	8	8	2	2
<b>TOTALS</b>	<b>42</b>	<b>29</b>	<b>11</b>	<b>3</b>	<b>6</b>

The table shows that while all the very frequent and frequent e-mail users gained 'A's or 'B's in the course, none of the students attaining a 'C', 'D', or 'F' was a very frequent user. In fact over one-half of all (42 of 71) those attaining 'A's or 'B's were e-mail users, while over one-

half of all the students attaining 'C's, 'D's, and 'F's were non-users. It seems then that students attaining 'A's and 'B's are not only more likely to be users than other students, but they are also more likely to be very frequent or frequent e-mail users.

**TABLE 8**  
**Frequency of use of the Web forum and final letter grades**

Level of use	Course grade				
	A	B	C	D	F
V. frequent	2	0	0	0	0
Frequent	1	2	0	0	0
Infrequent	18	10	4	1	2
None	21	17	7	2	4
<b>TOTALS</b>	42	29	11	3	6

Table 8 shows that the relationship between letter grade achieved and the level of Web forum use is even clearer than for e-mail use. Only 'A's were very frequent users, and only 'A's and 'B's were frequent users. Only about one-third of 'C's, 'D's and 'F's were infrequent users while two-thirds made no use of the Web forum. Students achieving an 'A' in the course were much more likely to be Web forum users (21 of 42) than 'B's (12 of 29), who, in turn were more likely to be users than 'C's, 'D's, and 'F's (only 7 of 20).

**TABLE 9**  
**Frequency of use of EM and final letter grade**

Level of use	Course grade				
	A	B	C	D	F
V. frequent	3	1	0	0	0
Frequent	3	3	0	0	1
Infrequent	23	19	6	2	3
None	13	6	5	1	2
<b>TOTALS</b>	42	29	11	3	6

The relationship between letter grade achieved and total EM use is not as clear as that for Web forum use, but does show that 'A's and 'B's are much more likely to be very frequent and frequent EM users than are 'C's, 'D's, and 'F's. While only about 27% (19 of the 71) 'A's and 'B's did not use any form of EM, 40% of the 20 'C's, 'D's and 'F's were non-users.

## 6 CONCLUSIONS

This study has shown that use of both the Web forum and e-mail is virtually 'around-the-clock', as Cavalier [3] had suggested. Levels of use of EM vary between courses and instructional formats, with Web course students being more frequent users than students in the lecture classes. A surprising finding was that students in the off-campus correspondence classes were much less likely to use e-mail in spite of the fact that this constituted their main means of communicating with the instructor. A content analysis of the e-mails showed that students used e-mail messages to the instructor for a wide variety of purposes although there are few major differences between the types of messages sent in the different courses and instructional formats.

The data show clearly that there is a relationship between the use of EM and final

course grades with students achieving 'A' and 'B' letter grades being more likely to be users, and also very frequent and frequent users, while students achieving 'C's, 'D's, and 'F's are more likely not to use EM at all, and if they do, are likely to be infrequent users. The clearest relationship between EM use and grades achieved is for Web forum use.

These findings seem to confirm Chickering and Gamson's [4] assertion that interaction is a key mechanism in enhancing learning, if a student use of electronic messaging can be interpreted as interaction. How then can one explain the finding that Web forum use seems to associate more highly with final course scores than total EM or e-mail use? One explanation might come from the research on writing which shows that students who write about their subject learn that subject better. [1] [11] Moore [12], for example, has shown the connection between writing in Biology and higher course scores as others have demonstrated for other subject areas. While e-mail messages are often short messages about non-content queries which are 'private' and only for the instructor's eyes, postings on the Web forum are 'public' and open to the scrutiny of all the class members. Students then are more likely to be careful and deliberate about what they write on the Web forum, than they are in e-mails, because they are for public consumption, and especially discussion items. Such postings, therefore, could be regarded as legitimate pieces of writing. If this is the case then the question that has to be answered is how to involve more students in using EM, and particularly the Web forum. With small classes it is possible to require students to make such postings and to grade them, but this is not that easy with large classes. The relationship however, seems clear, students who use EM, especially the Web forum, do better in the courses involved in this study.

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