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Online Writing as a Form of Electronic Communication in a Second Year Biology Course

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Abstract - Over the past decade, the proliferation of technology in the realm of teaching has occurred at a phenomenal rate. From the smallest integration of technology into the classroom to entire courses being taught in an online environment, the use of computers by students and teachers has continued to increase.

This paper considers student use of an online discussion forum in a second year Biology course and how that participation may be an indicator of increased student success in the course. The authors discuss how participation in the online discussion forum is a form of public writing in which the students need to have an understanding of the topic about which they are writing. It is this practice of writing with a clear understanding that may increase students' success in the course and not simply the use of online communications.

Introduction

During the 1996 United States presidential campaign, the Democratic team of Bill Clinton and Al Gore made a number of visionary policy statements about the use of the Internet by Americans and, more specifically, by American students. They spoke of building a bridge to the twenty-first century through the use of the Internet and pledged to bring a computer to each and every student desk in America. Shortly after the campaign in 1997, the popular North American magazine *The Atlantic Monthly* published an article that stated

> in 1922, Thomas Edison predicted that 'the motion picture is destined to revolutionise 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 later 1950's and 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. (Oppenheimer, 1997, p. 45)

In hindsight, neither the motion picture, nor the portable radio receiver, nor Skinner's "teaching machine" have become permanent fixtures in classrooms around the world. Can this quote also be applied to computers? Computers by themselves have not revolutionised the practice of teaching any more than these other technologies have, however, computers have become useful teaching tools, both in support of the traditional classroom and in the growing realm of distance education.

One area where computers have made a significant impact is in the realm of computer-mediated communication or electronic messaging. According to Zack (1995), the term electronic

messaging includes "several modes of computer-mediated communications, including electronic mail, electronic talk or chat, computer conferences or bulletin boards, and electronic document exchange." (p. 206) This definition is very broad in its scope and for the purpose of this study, electronic messaging will be limited to electronic mail, messages sent to an electronic listserver, and posts to a web-based discussion forum.

The courses that were considered in this study were two second year, non-major Biology courses. The first, Biology 2040 – Modern Biology and Human Society I (Human Biology), was offered in on-campus lecture, off-campus correspondence and web-based delivery formats. The second course, Biology 2041 – Modern Biology and Human Society II (Environmental Science), was only offered in on-campus lecture and off-campus correspondence formats.

The Study

This particular study was developed from three earlier studies conducted by Collins in 1995, 1996 and 1997. In the 1995 study, Collins (1995) found that the electronic bulletin board had fostered "student-student interaction and student-professor interaction… of course student-professor interactions through computer conferencing will never be a total replacement for face to face interactions, but computer conferencing does provide another channel for such communication." (p. 189) He also stated that "the student responses [from a student questionnaire] seem to suggest that even students who would normally be reluctant to ask questions in class or comment on issues will do so through computer conferencing." (p. 189) This observation is similar to Schwalm's assertion that even formerly silent students can become addicted to communication when the latter is electronic. (in Schoenfeld, 1991, p. 1)

As a 1996 follow-up to that initial study, Collins (1998) again found the electronic bulletin board had fostered both student-student interaction and student-professor interaction. He also found students "noted that the round-the-clock availability of the system allowed them to ask questions, and often receive answers, at any time of day and night rather than just being restricted to class time or contacting the professor." (p. 85) This conclusion supported an earlier observation by Cavalier (1992) that the electronic bulletin board allowed students "reflect and compose at their own pace and convenience, resulting in round-the-clock dialogues of surprising depth and insight." (pp. 34-35) Collins also reported that "one of the students commented that joining in discussions was an incentive to take interest in the course overall, and that this interest also led to better study habits." Collins (1998) speculated that this comment may indicate "that becoming more actively involved in a peripheral activity such as discussion leads to becoming more involved with the course as a whole and, therefore, to better student learning." (p. 86)

Unlike his 1995 and 1996 studies, in which an on-campus lecture format class used an electronic bulletin board, in 1997 Collins conducted a comparison of students' final scores in three versions of the same course over a period of four semesters. Collins (2000a) found "that the [off-campus] correspondence section achieved the higher mean final scores in three of the four semesters while the Web course achieved the higher mean score in only one semester." He continued by stating that "the data suggests that at best there is little difference between the final mean score, and at worse that the students in the Web sections do not achieve quite as high overall mean scores as those in the correspondence sections." (pp. 22-23) This finding appeared to contradict those of Wideman and Owston (1999) and Navarro and Shoemaker (1999), who reported that "on the whole students in Internet and in-class courses scored significantly higher than their counterparts in correspondence courses, although no significant difference was found between Internet and in-class students." (Wideman and Owston, 1999, p. 2)

These three studies presented a number of questions which required further consideration. This further consideration was the basis of the current study. This study considers student use of electronic mail, messages sent to an electronic listserver, and posts to a web-based discussion forum in two different courses over a three year (nine semester) period.

During the period 1997 to 1999, data on student use of electronic messaging, as defined above, were collected. An analysis of these data included time of day used, level of use, type of communications, and relationship between the use of electronic messaging and the final course grades of the students.

Characteristics of Electronic Messaging

There are four characteristics of electronic messaging that were considered in this study: time of day used; time in semester used; content analysis; and level of participation. As has been stated earlier, Cavalier (1992) described a "round-the-clock" discussion that would occur among his students in their use of an electronic bulletin board. Table 1 illustrates the time of day that different types of electronic messaging were used in this study.

Table 1 - Time of day electronic messaging used

Type of electronic messaging	12:01am-4:00am	4:01am-8:00am	8:01am-12:00pm	12:01pm-4:00pm	4:01pm-8:00pm	8:01pm-12:00am
Electronic mail	48	22	154	311	202	147
Listserver			6	5	4	
Web forum	8		16	46	31	30
Total	56 *(5%)*	22 *(2%)*	176 *(17%)*	362 *(35%)*	237 *(23%)*	177 *(17%)*

As is indicated in Table 1, just over 50% of all messages were posted during the traditional university classroom time periods (e.g., 8:00am-12:00 and 12:00pm to 4:00) and another 25% of all messages were posted during non-traditional university classroom time period (e.g., 4:00pm to 8:00). This would mean that approximately 25% or one in every four messages were posted during times when universities typically do not hold classes at all.

The second characteristic that was considered in this study was at what point in the semester did students make use of electronic messaging. At the beginning of the study, it was hypothesised that electronic messaging would be more frequent around the time tests were given or assignments due. However, as Table 2 illustrates, that was not the case.

Table 2 - Time in semester when students used electronic messaging

Time in semester	Electronic mail	Listserver	Web forum	Total
Before semester began	37		1	38 *(3%)*
Week 1	43		5	48 *(5%)*
Week 2	47		16	63 *(6%)*
Week 3	42	6	12	60 *(6%)*
Week 4	45	8	10	63 *(6%)*
Week 5	45	2	8	55 *(5%)*
Week 6	46		3	49 *(5%)*
Week 7	58		9	67 *(7%)*
Week 8	37		8	45 *(5%)*
Week 9	57		11	68 *(7%)*
Week 10	81		12	93 *(9%)*
Week 11	80		5	85 *(8%)*
Week 12	64		15	79 *(8%)*
Week 13	111		5	116 *(11%)*
Week 14	55		9	64 *(6%)*
After semester concluded	27			27 *(3%)*

As Table 2 indicates, the use of electronic messaging throughout the 14 week semester was relatively equally distributed, with slightly more usage towards the end of the semester.

The third characteristic that this study considered was a content analysis of the students' use of electronic messaging. Tao, Montgomery and Pickle (1997) suggest "if a previous model has been adopted, relevant literature should be fully presented to justify one's choice of categories." (p. 480) The following categories were used by Collins (1998) in an earlier study, namely:

- Discussion topics
- Assignments
- Access to the system
- Announcements
- Course content inquiries/responses
- Course-related inquiries/responses
- Comments
- Other (p. 81)

However, these categories were created for messages posted to a text-based, DEC-Notes software platform. Due to the differences between this system and the forms of electronic messaging being considered by this study, it was decided to modify these categories slightly.

- Discussion
- Assignments
- Tests/Exams
- System Related
- Course Content
- Administrative
- Other

Based upon these new categories, Table 3 illustrates the content analysis performed on the students' use of electronic messaging.

Table 3 - Content analysis of electronic messaging

Type of electronic messaging	Discussion	Assignments	Test/Exams	System Related	Course Content	Administrative	Other
Electronic mail		179	308	52	62	188	92
Listserver		4	2			4	6
Web forum	24	5	55	2	30	13	40
Total	24 *(2%)*	188 *(18%)*	365 *(34%)*	54 *(5%)*	92 *(9%)*	205 *(19%)*	138 *(13%)*

As is indicated in Table 3, the main use of electronic messaging was for messages related to tests and exams. Student also made significant use of electronic messaging for messages about assignments and messages of an administrative nature.

The fourth characteristic of electronic messaging that was considered in this study was the level of participation by students in each class, that is the number of students using electronic messaging. Table 4 illustrates the percentage of students who made use of some form of electronic messaging on a class by class basis over the three year period.

Table 4 - Student participation by semester by course and delivery format

Semester	2040 On Campus	2040 Correspondence	2040 Web	2041 On Campus	2041 Correspondence
Winter 97	20%	5%	67%		
Spring 97		5%	20%		
Fall 97	20%	17%	25%		
Winter 98				13%	15%

Spring 98		10%			8%
Fall 98	23%				9%
Winter 99		5%	63%	21%	
Spring 99		10%	88%		8%
Fall 99	28%				17%

As the table indicates, the students in the web-based version were much more likely to make use of electronic messaging than students in the on campus or correspondence versions. Since students who enroll for web-based courses have to be familiar with computer, the Internet, and electronic messaging as a prerequisite for enrollment, it is not surprising that they would be more comfortable with using electronic messaging than the students in the non-web classes. While the use of electronic messaging was lower in the on campus classes, its use in the off-campus correspondence classes was even lower. This was surprising given the fact that distance education students' main method of communication with the instructor should be through electronic messaging, while on-campus students had access to the instructor in both the classroom and in his office. (Collins and Barbour, 2001, p. 4)

Student Achievement and Electronic Messaging Usage

Two aspects of student achievement were also considered in this study. The first was a follow-up comparison with Collins 1997 study. As discussed earlier, Collins found that students in off-campus correspondence had a higher class average than students in web-based classes, the opposite situation to that found in other studies. The second was a consideration of the relationship between student use of electronic messaging and the student's final mark.

Over a period of three years, this study found similar results to the earlier study (Collins 1997). Table 5 illustrates these findings on a class by class basis.

Table 5 - Class average by semester by course and delivery format

Semester	2040 On Campus	2040 Correspondence	2040 Web	2041 On Campus	2041 Correspondence
Winter 97	77.1%	75.2%	73.1%		
Spring 97		76.0%	74.8%		
Fall 97	77.0%	78.7%	75.2%		
Winter 98				78.2%	83.5%
Spring 98		72.2%			82.9%
Fall 98	75.7%				84.4%
Winter 99		79.5%	73.4%	76.3%	
Spring 99		74.5%	63.8%		76.6%
Fall 99	76.5%				84.4%
Average	76.6%	76.0%	72.1%	77.3%	82.4%

As is indicated by this table, in the Biology 2040 course there was little difference between the on-campus lecture format and the off-campus correspondence format. However, both of these delivery formats had a higher average than the web-based class. In the case of the Biology 2041, the off-campus correspondence class had a higher average than the on-campus lecture format.

These initial findings point to the notion that students in off-campus correspondence classes perform better than students in on-campus lecture classes, who perform better than students in web-based classes. However, these findings are still preliminary and more research is needed to substantiate the above notion.

Collins (2000b), found that in the web-based version of Biology 2040 during the Spring 1996 semester, there seemed "to be a relationship between the level of web forum use and final course scores." More specifically,

that very frequent users achieved an 'A' for the course while frequent users achieved 'B's. It is interesting to note that those achieving 'C's and 'D's in the course were either infrequent users or did not post notes to the forum at all. None of the three students failing the course posted notes. There is, therefore, a relationship between web forum use and final course scores with very frequent users achieving higher marks, while students not using the web forum are more likely to fail. (p. 7)

These results were similar to ones found in this study. According to Table 4, there were three classes during the three year period that had enough participation to determine whether or not this trend has continued as the students become more familiar with the use of technology.

The first class that had a participation level of more than 50% was the web-based version of Biology 2040 from the Winter 1997. Considering the student usage of both e-mail and the discussion forums (a combination of a web forum and an e-mail listserve), an initial relationship between the students use of electronic messaging and their final course scores begin to emerge. This relationship is illustrated in Table 6.

Table 6 - Frequency of use of electronic messaging and final letter grade

	Course grade				
Level of use	A	B	C	D	F
Very frequent	1	0	0	0	0
Frequent	1	0	0	0	0
Infrequent	7	2	3	0	1
None	2	1	2	2	1
Totals	11	3	5	2	2

The relationship which begins to emerge is that students who participate in online discussion forums have a greater chance of success in the course than students who do not participate. However, this relationship is not present in the second class that had a participation level of more than 50%, as illustrated by Table 7.

Table 7 - Frequency of use of electronic messaging and final letter grade

	Course grade				
Level of use	A	B	C	D	F
Very frequent	0	0	0	0	0
Frequent	1	1	1	0	1
Infrequent	9	8	5	0	0
None	9	2	2	1	0
Totals	19	11	8	1	1

In the web-based version of Biology 2040 from the Winter 1999 semester, there was no difference between the final course scores of students who made frequent use of electronic messaging than students who made no use of electronic messaging.

The third class with a participation level of more than 50% was the web-based version of Biology 2040 from the Spring 1999 semester. When the students use of e-mail was consider, as illustrated in Table 8, there was again no relationship between students use and final course score.

Table 8 - Frequency of use of e-mail and final letter grade

	Course grade				
Level of use	A	B	C	D	F
Very frequent	0	0	0	0	0
Frequent	0	0	0	0	0
Infrequent	3	4	1	0	2

| None | 5 | 2 | 3 | 1 | 1 |
| Totals | 8 | 6 | 4 | 1 | 3 |

However, when considering the relationship between student use of the web forum and final course score a familiar pattern emerges. This consideration is illustrated in Table 9.

Table 9 - Frequency of use of the web forum and final letter grade

	Course grade				
Level of use	A	B	C	D	F
Very frequent	2	0	0	0	0
Frequent	1	2	0	0	0
Infrequent	18	10	4	1	2
None	21	17	7	2	4
Totals	42	29	11	3	6

Unlike the relationship between the letter grade achieved and the level of electronic mail use, which is discussed in Collins and Barbour (2001), this table indicates a clearer relationship.

> [Table 9] shows that the relationship between the 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 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). (p. 7)

Both this study and Collins (2000b) lend credit to the notion that students who participate in online discussion forums have a greater chance of success in the course than students who do not participate.

This notion may be explained by findings from two different areas of research. Over a decade ago, Chickering and Gamson (1987) put forward the concept that interaction is a key mechanism in enhancing learning. This concept could be applied to this study if one were to include electronic messaging as a form of interaction. However, a second area of research may prove a greater relationship. There is a growing body of research that indicates that students who write about their subject learn that subject better. One such piece of research is Moore (1993), who has shown the connection between writing in Biology and higher course scores as others have demonstrated for other subject areas.

Collins and Barbour (2001), speculate that while e-mail messages are often short messages about non-content queries which are 'private' and only for the instructor's eyes, postings to the web forum are 'public' and open to the scrutiny of all class members. Students are more likely to be careful and deliberate about what they write on the web forum because they are for public consumption. (p. 8)

Conclusion

The results of this three year study have provided a number of insights into the characteristics of how students utilise electronic messaging. For example, students make use of both electronic mail and post messages to web-based discussion forums at all hours of the day, which allows for the "round-the-clock" discussion that Cavalier (1992) had first suggested. There were also no "rush periods" when the students used electronic messaging, but their frequency of use was rather consistent through the term.

Another characteristic that was noticed was that the greatest level of electronic messaging use came from students in the web-based sections. This is understandable as the entire course for these students is in an electronic format and they would have to be comfortable with this method of communication in order to have success in this version of the course. However, it was also

interesting to note that students in the off-campus correspondence sections of the course made use of electronic messaging less than their counterparts in the on-campus lecture of the web-based sections. One of the suggested reasons for this finding may be that there are a smaller number of actual off-campus students who are taking correspondence courses. Many of these students may have in fact been on-campus students who would have had access to the instructor through traditional office hours.

Unlike the studies conducted by Wideman and Owston (1999) and Navarro and Shoemaker (1999), the findings of this study indicate that students in the off-campus correspondence sections of the course had a higher class average than students in the on-campus lecture sections. This study also found that students in the on-campus lecture sections had a higher class average than students in the web-based sections. The above mentioned studies found the exact opposite pattern.

The last finding that was discussed by the authors was a consideration of the effects of electronic messaging on student grades. While there was no apparent relationship between the use of electronic mail and student grades, this study found a positive, but not conclusive, relationship between the number of times students posted to the web forum and the grade that the student received. Students who received 'A's and 'B's in the course were more likely to be "frequent" or "very frequent" users of the web form, while students who received 'C's, 'D's and 'F's were more likely to be "infrequent" users or "non-users."

The positive relationship with posts to the web forum and not electronic mail seems to confirm the assertion by Chickering and Gamson (1987) and Moore (1993) that public writing and interaction are key mechanisms in enhancing learning. This is based upon the premise that contributing to a web forum is a carefully planned, deliberate writing activity on the part of the student.

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