Assessing The Impact Of Course-Related Electronic Communications On Student Performance in an Introductory Programming Course

ABSTRACT: This paper describes a system which utilizes a campus computer network to facilitate class-related faculty-student communication. The system uses electronic mail, system utilities and application programs to provide students and faculty with menu-driven access to an electronic gradebook, a class bulletin board, and to the electronic exchange of assignments. We report on an experiment in which one section of the introductory programming course used this system while another did not. Surveys and usage data from this experiment indicate a favorable perception of the system by student users, but analysis of student achievement shows no significant correlation between student performance and system usage.

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INTRODUCTION

As data communication networks expand to include more faculty offices, student labs and dormitories it is inevitable that the campus community will seek to use this new tool for faculty-student communication in support of learning. Many faculty members routinely use electronic mail to communicate with individual students and with whole classes via distribution lists. As the distribution of data and processing power increases, students will come to expect electronic access to course-related functions as well as to registration, financial aids, degree requirement audits and other clerical functions.

At Buffalo State College we have developed and implemented a set of programs designed to support course-related faculty-student communication via our campus network. The Grading and Bulletin Board System (GBBS) is a menu-driven system that allows an instructor to use the network for both clerical functions (assignment distribution, collection, grading and return; grade posting and display) and instructional purposes (creation and maintenance of a class bulletin board). The student menu in this system allows quick access to individual grades and current course average, and to instructor-mediated electronic discussions

of course material on the bulletin board. The same student menu also gives access to class materials, assignments, and the student's degree audit (a display showing graduation requirements met and those remaining). The GBBS system was developed over the past two years and at present about a dozen faculty members in a variety of departments are using it in their classes. Faculty users so far agree that the system has reduced their clerical burden. In this article we survey student response to the system and address the question of whether the use of this system has any measurable impact on student performance.

Several authors have reported positive reactions to the use of electronic mail in place-based (as opposed to distance learning) environments [1,2,3]. These authors cite more timely feedback, time and space independent access to the instructor, an increased potential for class interaction and having a record of the discourse as the main benefits to the student. Bulletin boards (more generally, computer-mediated communication) as a learning tool may be expected to have both logistical advantages (when face to face access to the instructor is constrained) and potential pedagogical benefits. Unlike classroom discourse students have more time to ponder their

questions and comments, and the act of writing them rather than speaking may increase understanding [4]. Peer interaction [5], a greater feeling of control and choice [6], and a more active learning environment [7] might be expected to contribute to student satisfaction and performance.

However, it may be that the primary benefits of these electronic tools are logistical rather than pedagogical. Laurillard [8] suggests that the pedagogical benefits of computer-mediated communication depend heavily on dialogue content and that maintaining an active and interesting bulletin board dialogue may be as time consuming for the instructor as face to face communication would be. One study of two classes [9] reports a higher student course average in the computer-assisted section, but in this case the students had self-selected the sections and the prior GPA for the computer-assisted section was higher than that of the control section. A study of CAI reported positive student perceptions but no performance impact [10]. Clark [11] has suggested that positive student perceptions and performance in these situations may result as much from the novelty of the environment as from the impact of the technology on the teaching process.

THE GBBS SYSTEM

Overview

The Grading and Bulletin Board (GBBS) system brings together several functions for supporting college-level teaching in an environment where students and faculty have access to a campus-wide data communication network. At our college we are serving an increasing number of commuter, non-traditional and evening-only students whose access to their instructors outside of class time is severely limited. Since the advent of electronic mail on our campus we have seen an increasing amount of instructor-student communication via this medium. The intent of the GBBS system is to provide an efficient, user-friendly environment to support class related communication outside the physical and temporal boundaries of classroom and office hours. The system permits electronic dissemination and collection of assignments, provides quicker and more accurate feedback to students on their performance and supports a bulletin board for class discussions.

The GBBS consists of about 15 programs which are resident in a single account on our VAX system. These programs support the menu-driven access (see Figures 1 and 2) and update functions for files of grades, assignments, distribution lists and bulletin boards which reside on the accounts of individual faculty members who use the system. The programs make use of system utilities for electronic mail, editing and file handling. The intent of this system is to provide easy access by unsophisticated users to course related management and communication applications.

Grading Functions

The GBBS allows an instructor to maintain an electronic gradebook for up to eight different classes on the mainframe. Each class can have an unlimited number of students and up to 40 numerical grades per student. Students can access their own grades (and only their own) at any time and see their current average for the course. Grades are available to students as soon as they are posted by the instructor. Instructors can post grades from paper assignments by entering the first letter of a student's last name and selecting the correct student from a display.

In addition to posting grades from paper assignments, the system accepts assignments submitted electronically. Such assignments are automatically coded by class and assignment number and stored on the instructor's account. The instructor can

Figure 1: FACULTY MENU

Grading And Bulletin Board System

RF	Receive files	Rs	Grade electronic input
Qs	Update quiz or project		
SS	Run spreadsheet	MSGP	Prints student messages
O	Grades for one student	L	Print logins for a class
DIR	List of files	HLP	Help
EDs	Edits grade files	BBs	Edit bulletin board
GET	Get new student lists	BBREPORT	Bulletin reporting
LOG	Check log file	CKID	Check file names
QUIT	Quit grading system	s = A B C D section

DIRECTORIES➤ STUDENT MSG REPORT TEMP ZFILE

Figure 2: STUDENT MENU

Welcome to the Student Grading and Bulletin Board System

Give instructor vax user id   : CLARKRA
Give the section letter A B C D: A

Accessing data for professor   CLARKRA   section   A ➤
   1.   Get your grades
   2.   Access the bulletin board
   3.   Do a directory of the faculty student account
   4.   List a file in the faculty student account
   5.   Copy a file from the faculty student account
   6.   Change the professor vax user id
   7.   Student degree audit program
   Q.   Quit and return to where you were
Give the number of your choice : Q

grade such assignments electronically, using the system to retrieve each assignment, insert comments, and assign a grade. The graded assignment, with instructor comments, is automatically returned to the student via electronic mail and the assigned grade is automatically posted in the electronic gradebook. Backup copies of the original and graded assignment are made automatically.

Bulletin Board Functions

The system allows the instructor to maintain a separate bulletin board for up to eight classes. The instructor can receive student questions or comments by electronic mail, edit the message (deleting parts or adding a reply), and post the resulting message to the class bulletin board. The bulletin board can also be used to post announcements for the class. The same message or announcement can be posted to many class bulletin boards.

Students can access the bulletin board at any time. When accessed, the system displays a directory of messages to the student listing the messages in reverse posting order and showing for each message either "unread" or the date last read by that student. The system also keeps a log of student bulletin board activity.

The instructor can request a summary of student activity at any time. The system uses the student activity log to generate reports of bulletin board use by student or by posting.

THE EXPERIMENT

The course CIS 151 offered at Buffalo State is an introductory programming course which uses Pascal. Students wishing to major in CIS must earn at least a C in this course before entering the major. The course is also taken by a students in a variety of other majors and used as a general education elective.

In the Fall 1993 semester two daytime sections of this course were taught by the same instructor. The same text, assignments, tests and lectures were used in both sections. One section was introduced to the GBBS at the beginning of the term and used it throughout the semester to submit projects, access grades and read bulletin board postings. The other section was

Figure 3: TYPICAL BULLETIN BOARD POSTING

Dr. Scott :
   Can constants be defined locally or should they always be defined globally?
This has to do with #5 in the homework. Should we localize the constants or
leave them alone?
                                              Thanks,
===
You can define constants globally or locally.

One of the main reasons for defining a variable locally is to protect the procedure
against "side effects" which can occur when a global variable's value is changed in a
different procedure. When this happens it may cause unanticipated and unwanted side
effects in other unrelated procedures that reference that same global variable.

However, since the value of a constant cannot be changed anywhere in the program
there is no danger of such side effects. You may still want to define some constants
locally for reasons of program organization or reusability.

You do not need to worry about the constants in the homework. Leave them all global.

Figure 4: SURVEY QUESTIONS

17.	I used electronic mail frequently to communicate with the instructor or with classmates regarding course content.
18.	Electronic mail is an effective way to communicate with instructors, and should be used in all classes.
19.	Electronic mail should be used only for brief messages, not for submitting and returning assignments.
20.	The online gradebook was easy to use.
21.	I accessed the online gradebook often to review my grades.
22.	The use of the online gradebook should be continued in this class.
23.	The online gradebook should be used in all classes.
24.	The class bulletin board was easy to use.
25.	I accessed the bulletin board often to read messages.
26.	The use of the class bulletin board in this class should be continued.
27.	A class bulletin board should be used in all classes.

shown how to use electronic mail to submit programs, but did not have access to their grades or to a class bulletin board.

The bulletin board was used primarily to respond to specific student questions that had been transmitted by electronic mail. These questions typically concerned current homework or programming assignments. Most of the postings consisted of the student's question and the instructor's response. Figure 3 shows a typical posting.

Performance of individual students was measured by their final total points for the course. Each student's grade point average prior to the term was also recorded.

Student perceptions were measured by a survey given prior to the final exam. All sections in our department are surveyed every term for student evaluation of course and instructor. To the 16 standard questions on this instrument, we added three questions concerning the use of electronic mail and eight questions about the use of the GBBS. All questions (see Figure 4) were answered using a five point scale varying from 1 (strongly disagree) to 5 (strongly agree) with 3 being neutral. Both sections answered the 16 standard questions and questions 17-19 concerning electronic mail. Only the GBBS section answered questions 20-27 on GBBS usage.

For the students in the GBBS section, the activity log provided a count of how many different bulletin board postings each student had read, and how many total postings were read (one posting could be read several times). No log was available for the grade access at that time, so no count of how many times a student looked up their grades was available for analysis.

ANALYSIS
Descriptive Statistics
Twenty-one students completed the course in the GBBS section and 23 completed the control section. Some of the students were in their first term at the college and therefore had no prior GPA on which to base an expectation of performance. Because of this, in statistical analyses involving GPA only 15 students from the GBBS section and 19 from the control section could be used. The prior GPA for the two sections was nearly identical, each section had a mean prior GPA of 2.82.

A total of 28 items were posted on the bulletin board. Most of these items consisted of a student question (via email) and the instructor's explanation. Nine of the 21 students in the GBBS section had read all of the messages at least once and 14 of the students had read over half of the messages. The average number of different messages read was 17. Most students read some messages more than once. The average number of all reads was 24. The instructor received far more than 28 email messages from the GBBS section and replied to all individually, but chose to post only 28 for public consumption. Most of these dealt with specific questions about homework assignments, projects, syntax errors and running jobs. There was no "discussion" among students where one message commented on a previously posted message or reply.

Student Perceptions
Overall student perceptions of the GBBS system were strongly positive. The average rating for the 8 GBBS related questions was 3.92. By comparison, the overall rating for the instructor in the standard questions was slightly lower at 3.72 on the 5 point scale. Student ratings for the GBBS questions (20-27) are summarized in Table 1. In this table the two positive responses (4-agree and 5-strongly agree) have been combined, the two negative responses (2-disagree and 1-strongly disagree) have been combined, and the neutral responses (3-no opinion or neutral) are not shown.

Comparison of GBBS and Control Sections
There was no significant difference between the treatment and control section in total points earned in the course. Controlling for GPA did not affect the result. Neither were there any significant differences between two classes on the student survey ratings of the instructor questions (1-16) or the electronic mail questions (17-19). The greatest differences between the two sections on the survey were in response to question 16 ("Instructor gives students feedback"), where the GBBS section had a mean response of 3.7 compared to 3.2 for the control; and in response to question 19 ("Email should be used for messages, not

assignments"), where the GBBS section disagreed strongly (1.7) compared to the control section mean response of 2.5. Both of these differences are in the expected direction, indicating the GBBS section was more comfortable with electronic mail and perceived greater instructor feedback, but neither was significant at the 0.05 level.

Analysis of Individual Student Performance

Within the GBBS section, the measures of student performance were tested for correlation with the measures of bulletin board use. As shown in Table 2, no significant correlation was found between total points and bulletin board activity (as measured by the number of different postings read or by total reads). The total points in the course was strongly correlated with prior GPA, as might be expected, but a partial correlation of total points with bulletin board activity while controlling for GPA revealed no significant correlation.

The GBBS system was well received by the students in the treatment section. That, coupled with the positive feedback from various instructors, indicates the system should be sustained. However, there was no indication of any correlation between system use and student performance. We were surprised at this because we had expected that the more motivated and conscientious students would be more likely to use all available materials (including the bulletin board) and also be more likely to earn better grades than less motivated students.

The positive student perceptions could arise from factors not connected with academic achievement (such as the logistical convenience of the system or its novelty). It also might be that the measures of performance used were not appropriate or sufficiently sensitive, or that the sample size was too small. The nature of a beginning Pascal course, or this instructor's style, may not lend itself to productive debate and dialogue, Socratic or electronic. However, we cannot reject the hypothesis that use of the GBBS had no effect on academic performance in this course.

Future tests of the GBBS in courses from different disciplines, with different pedagogical styles, and perhaps with different strategies for using the bulletin board could reveal the degree to which our findings are dependent on the "fit" between the course, system and instructor.

Table 1. SUMMARY OF STUDENT SURVEY RATINGS

| QUESTION | Percent of Responses (Neutral not shown) | | | |
| | Gradebook Responses | | Bull. Bd. Responses | |
	Disagree	Agree	Disagree	Agree
It was easy to use	14	76	10	66
I used it often	24	76	19	67
Continue use in this class	14	81	14	76
Use it in all classes	14	76	20	70

Table 2. CORRELATION OF BULLETIN BOARD USE, PRIOR GPA AND COURSE POINTS EARNED

	Postings Read	Total Reads	Prior GPA	Course Points
Postings Read	1.00	0.95 **	0.56 *	0.16
Total Reads		1.00	0.43	0.11
Prior GPA			1.00	0.66 **
Course Points				1.00

** $p < 0.01$ * $p < 0.05$

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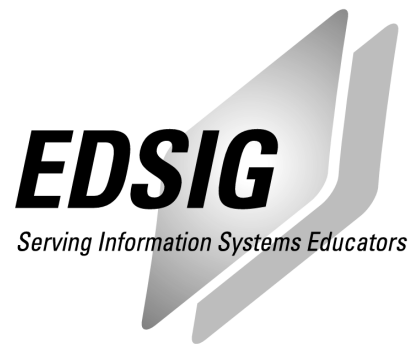
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