

The Effect of Software Facilitated Communication on Student Outcomes in Online Classes

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Abstract

This research project examined the question of the relationship between the frequency and method of software-facilitated communication employed and the student outcomes achieved in online university courses. This question directly addressed the issues of 1) the increasing focus by businesses on maximizing their employees' educational outcomes and leveraging the corporation's investment and 2) identifying Management Information Systems that support improved student outcomes.

The research project was comprised of three related research studies, a preliminary proof of concept, a large-scale study and a validation study to provide a further measure of reliability and validity. The three studies combined incorporated data from 116 online courses and over 1700 students.

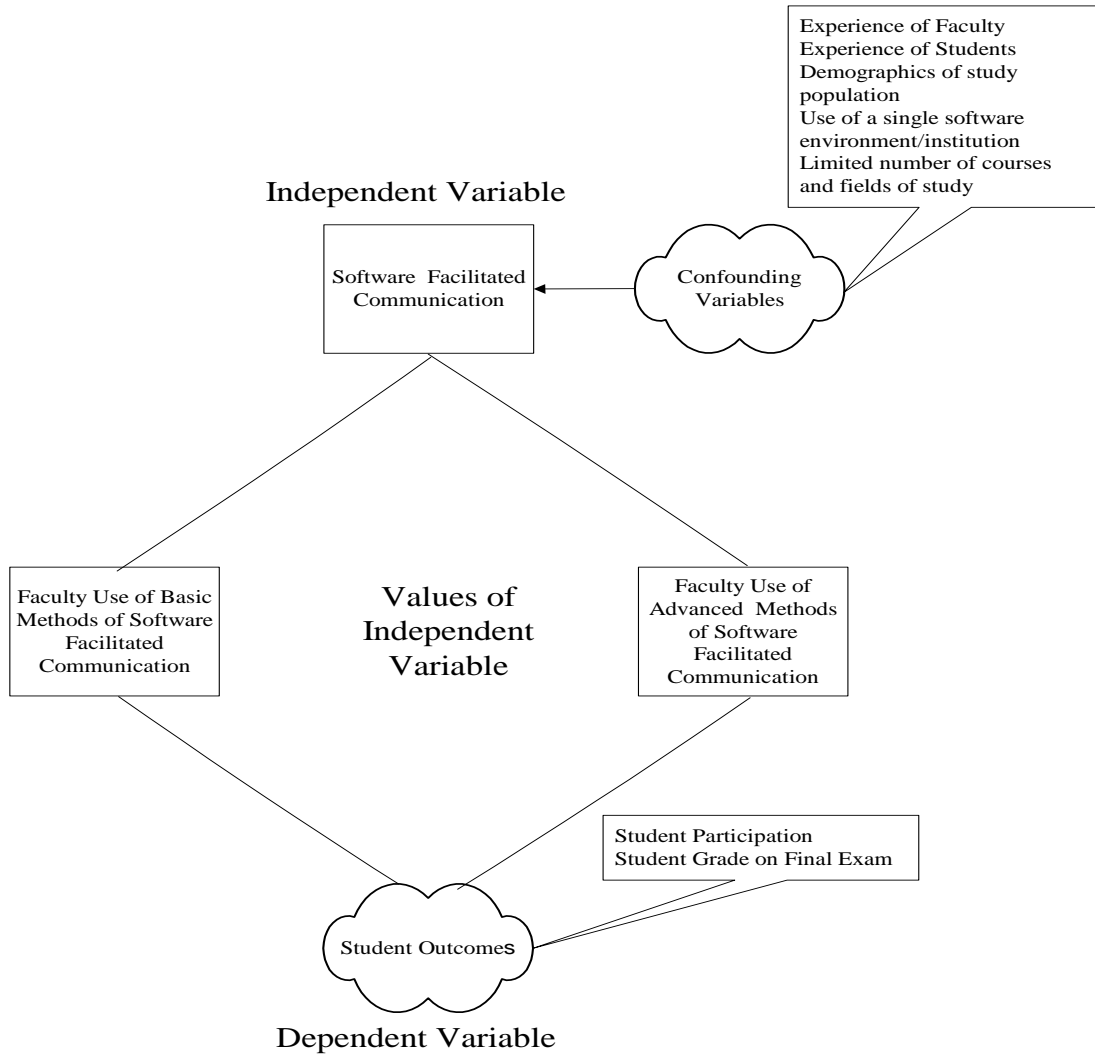
The results indicate that there is a statistically significant relationship between the method of software-facilitated communication utilized (basic or advanced) and the student final exam grade. The results of the research project indicated that the use of advanced software facilitated communication features, which provide an environment that fosters more sophisticated and feature rich interaction, is important in terms of determining student outcomes. It is not sufficient to create online interaction; rather it is the inherent quality of that interaction which is important in determining student outcomes.

Introduction

The purpose of this research project was to address the question: is the participation and achievement of working adult students in an online class directly related to the frequency and specific method of software facilitated communication used by faculty? This question directly addressed the issues of 1) the increasing focus by businesses on maximizing their employees' educational outcomes and leveraging the corporation's investment and 2) identifying Management Information Systems that support improved student outcomes.

The research project examined the relationship between the independent variable, software facilitated communication, and student outcomes, the dependent variable, among working adult students in online courses (Figure 1). Through an analysis of archival course communication records and student final exam grades, the researcher developed course-based indices as measures of the frequency of software facilitated communication, the methods of software facilitated communication, and student outcomes. These indices were then used to conduct statistically appropriate tests to analyze the relationships between software facilitated communication, and student outcomes.

Figure 1. Relationship between software facilitated communication & outcomes



Importance of the Project

Corporate employees and working professionals are increasingly participating in online distance education. As institutions of higher education expand or begin online education programs to meet this burgeoning trend, the need to identify instructional technology that promotes working adult student outcomes in online programs becomes increasingly important. As businesses continue to increase their expenditures for employee education, there is progressively more focus on maximizing employees' educational outcomes to leverage the corporation's investment. Dunn (2000) predicts that large corporations will develop their own approval systems for higher education programs similar to the current regional accreditation process.

The National Center for Education Statistics (NCES) study of 2001 found that 80% of undergraduate students are employed to at least some extent, with 39% employed on a full-time basis (Kridl and Livingston, 2002). According to the American Society for Training and Development, American businesses spent over \$55 billion for education and training in 1995 or approximately 1.4% to 1.8% of an average firm's payroll expenditures (Bassi & Van Buren, 1998). The National Alliance of Business estimates that 20% to 30% of that amount is spent on colleges and universities (National Alliance of Business, 1997).

As working business professionals participate in distance learning at increasingly higher rates, it is important to identify specific instructional technology that supports positive outcomes for these students. Businesses provide substantial funding for their employees' continuing education and are therefore concerned with the quality, value and results achieved from expenditures related to online educational programs. Business leaders have increasingly applied pressure to the higher education establishment to focus on the results of the educational process (Cetron & Daview, 2003).

Universities, from a business perspective, act as providers of an educational service to these companies and their employees. Universities are investing substantial monies in the development and deployment of online distance learning environments to meet the needs of adult students and to provide an online modality for education that can compete effectively in the marketplace. In

Ohio alone, a \$600 million system has been developed to link students and instructors (Hammer, 2001).

Since different technology supported methods of interaction (e.g., two-way interactive TV, text-based chat, email) have different characteristics in regard to immediacy of feedback, realism and student user control (Smith & Dillon, 1999), the method of software facilitated communication is an important consideration. The method of software facilitated communication is critical to the learning process as it affects the provision of feedback to the student (Kearsley, 1995). Distance learning environments that support synchronous communication can provide immediate feedback to the learners, a feature that may serve to motivate some learners. Distance learning environments that support asynchronous communication can provide the student with more control over where and when communication occurs as well as more time to reflect on and respond to course content and communications (Moore & Kearsley, 1995). Garrison and Shale (1990) conclude, "one of the things to be certain of is that the quality of effectiveness of education at a distance is directly attributable to the kind of communication between teacher and student."

Quilter and Chester (2001) emphasize that few formal research studies have been conducted to examine the relationships between online communication technologies and teaching and learning and reaffirm that "research with empirical documentation of the use of communication technologies is lacking". Duffy & Kirkley (2004) state that most higher education research relies on survey data, e.g., class ratings and specialized survey's like the National Survey of Student Engagement (Kuh & Hu, 2001), to infer, based on student report, that learning has occurred.

This research project was the only study identified that made use of the database capabilities of course management software to provide raw data for quantitative analysis. The new generation of course management software incorporates built-in features that automatically record all course interactions in a database and therefore provides new possibilities for the quantitative analysis of variables such as the amount of online interaction that occurred in a class. Instead of creating a survey questionnaire and proper scale and encoding scheme to allow for the opinions and perceptions of respondents to be analyzed, the researcher was able to provide an exact count of

the amount of times students and faculty were active in the course and the type of activity which was performed. There was no attempt made in this project to determine the innate quality of a given interaction such as an individual post to a class discussion topic.

This project advanced the research by including in the analysis a broader spectrum of software facilitated communication techniques than has previously been analyzed and also by the utilization of data obtained directly from the course management software database. The comparison of software facilitated communication features by basic or advanced functionality was an approach which, when combined with the use of quantitative data from the course management software, added a new dimension to the body of research.

Methodology

The online learning program that was evaluated in this study is a regionally accredited, university offering a range of undergraduate and graduate degree programs to students in both online and face-to-face formats. The university offers programs in business, management and technology specifically directed toward working adult professionals. Online courses from each of these programs were included in the study.

The research project consisted of a combination of three individual studies covering a total of 116 courses and approximately 1700 students that together provide a detailed analysis of the topic. Courses for each study were selected using a stratified random sampling technique. A stratified random sampling technique assures that the samples represent not only the overall population but also each sub-group (Trochim, 2001).

The first or preliminary study provided a proof of concept to test the instruments and measures developed and to identify any significant issues. The second study was the main research effort involving 80 courses and building upon the results of the preliminary study. The third and final study was a validation study to further evaluate the repeatability of the results and assure the reliability of the instruments and measures.

For the purposes of this project, software facilitated communication was defined as computer mediated communication between instructor and student or between students which discusses some aspect of course content, assignments or student progress in an online course. The methods of software facilitated communication were defined by this project as the communication options made available to the faculty and students by the software features of the course management system. The project studies examined outcomes of courses that were supported by both synchronous (simultaneous) and asynchronous (delayed) methods of software facilitated communication.

Archival data collected from course management software administration statistics included: (a) how often students used each method of software facilitated communication, and (b) student final exam grades. The database recorded actual class activity and grades only and did not include any information related to end of course student surveys or student satisfaction. Therefore, it was not possible from the available data to determine the level of student satisfaction with a course or to relate the level of student satisfaction to the method of software facilitated communication employed.

Data analysis was performed using appropriate statistical techniques, including the use of indices to represent study variables. The use of indices allowed for the statistical analysis and comparison of the aggregated levels of activity. The following indices were created as measures for this study:

- a) per course combined methods student participation index (STUPART)
- b) This index was defined as the mean of the student participation activity counts for the course
- c) per course combined student final exam grade index (STUFIN)

This index was defined as the mean of student scores achieved on the final exam for the course

Software features provided by the course management software and used by new online faculty were divided into two categories; basic methods of software facilitated communication and

advanced methods of software facilitated communication. The methods were grouped as either basic or advanced based on the complexity of the method, multi-media aspects and the utilization of the specific method in delivering the online course (Table 1). For example, basic methods included those features which are essential to the creation and delivery of an online course and without which the class could not function effectively, such as the gradebook and threaded discussions. Advanced methods included optional items that are typically employed to add value or richness to the learning environment, such as interactive multi-media labs.

Table 1. Basic vs. Advanced Methods of Software Facilitated Communication

Basic Methods	Unit of Measure	Advanced Methods	Unit of Measure
Threaded discussions	Number of postings	Interactive chat rooms	Number of instances for faculty, number of students participating
Gradebook	Number of postings	Whiteboard	Number of instances for faculty, number of students participating
Multi-media introductory notes	Number of instances	Group teleconferences	Number of instances
Animated graphics	Number of instances	Customized course calendar	Number of instances
Class announcements	Number of postings	Simulations or project labs	Number of instances
Lecture Notes/PowerPoint presentations	Number of lectures /presentations	Camtasia screen capture/audio presentation	Number of presentations
Webliography	Number of entries	Streaming audio/video embedded in body of course material	Number of uses
Document sharing	Number of entries		

The final exam process was designed so that final exams were administrated consistently and included comprehensive coverage of the entire course. All final exams were designed with a wide range of questions, covering both lower level and higher level cognitive skills. The consistent nature of the final exam structure and process throughout the university and the wide range of disciplines and number of classes included in the study served to increase internal validity.

If a student withdrew from the course prior to taking the final exam, all records of that student's communications were automatically deleted from the course records. There was no record in the database of the number of students that started but did not complete a course. This action eliminated the mortality threat to the study as activity related to students who were active for only a portion of a course was not included in the results.

Summary of Findings

In each of the three studies, comprising this project there was a statistically significant difference in the average final exam grade achieved for students in courses utilizing advanced methods of software facilitated communication vs. the average final exam grade achieved for students in courses utilizing basic methods of software facilitated communication. The analysis was done in two stages, first using student's t-test for comparison of the group means of the STUFIN index and then supported using ANOVA to compare the group means. In each of the three studies the results of both types of analysis were significant at the .01 level. The advanced methods courses always returned higher average final exam scores. The conclusion was that the method of software facilitated communication selected was more important in determining the grade on the final exam than the frequency of utilization. The average values for the STUFIN and STUPART indices are shown in Table 2. The t scores, ANOVA F scores and related significance levels for the comparison of the group mean values for STUFIN in each study are shown in Table 3.

Table 2. Study Index Averages

Faculty used only Basic Methods of Software Facilitated Communication		
	STUPART	STUFIN
Preliminary Study	67.05	73.01
Main Study	69.90	70.87
Validation Study	72.55	72.19
Faculty used both Basic and Advanced Methods of Software Facilitated Communication		
	STUPART	STUFIN
Preliminary Study	67.34	82.96
Main Study	70.30	82.57
Validation Study	74.85	83.90

Table 3. Summary of Statistical Analysis of STUFIN

	t-test		ANOVA	
	t	Significance level - Two tailed	F	Significance level - Two Tailed
Preliminary Study	-3.583	0.003	12.837	0.003
Main Study	-9.832	0.000	96.663	0.000
Validation Study	-6.081	0.000	36.975	0.000

The results of this project indicate that there is a clear relationship between the method of software facilitated communication employed (basic or advanced) and the results achieved on student final exams. In contrast, the overall level of student participation when analyzed in the same manner (t-test and ANOVA) did not appear to be significantly impacted by the method of software facilitated communication employed or by the frequency of faculty communication.

There was no significant difference between the group means of the STUPART index in any of the studies at either the .01 or .05 levels. The t scores, ANOVA F scores and related significance levels for the comparison of the group mean values for STUPART in each study are shown in Table 4.

Table 4. Summary of Statistical Analysis of STUPART

	t-test		ANOVA	
	t	Significance level - Two tailed	F	Significance level - Two Tailed
Preliminary Study	0.068	0.947	0.005	0.947
Main Study	-0.159	0.875	0.025	0.874
Validation Study	-0.449	0.934	0.21	0.659

The results of the research project indicated that the use of advanced software features, providing a more sophisticated and feature rich interaction, is more important to student outcomes than the overall quantity of communication.

The results are consistent with earlier research by Smith and Dillon (1999) who refer to the media/method confound, a concept stating that the technology alone does not cause the effect, rather it is the combination of the technology and the way the technology is employed that impacts student outcomes. Garrison and Shale (1990) state that "one of the things to be certain of is that the quality of effectiveness of education at a distance is directly attributable to the kind of communication between teacher and student."

Implications

As course management systems become increasingly sophisticated, the associated acquisition, licensing and maintenance costs will also tend to increase. Therefore, it was important to

determine whether these more sophisticated features do, in fact, have a significant impact on the results achieved. The research project results suggest that the investment in these software systems is a valid decision which can assist in yielding positive results for both the universities and the businesses investing in the education of their employees. The incremental cost of these software systems can provide a superior educational environment for the online student.

The results of this project also suggest that it will be a solid investment for universities to focus on the development and training of faculty who will teach adult students in online courses. This will enable faculty to effectively leverage the increasingly advanced methods of software facilitated communication present in the course management software. It is incumbent upon faculty to be proactive and take advantage of the opportunity that increasingly sophisticated features offer. Examples of specific opportunities include the use of capabilities such as online simulations or interactive labs as well as streaming multi-media presentations to augment the more standard approach of a lecture or slides and discussion questions.

Limitations of the Study

The use of packaged course management software is a relatively recent development in the history of instructional technology. Faculty and student use of software facilitated communication tools will continue to evolve over time. As new software features are developed, new methods of software facilitated communication may become available. This factor represents a potential limit on the external validity of the study to generalize these findings to different course management systems or to future upgraded releases of the course management system that was used in the study.

The course management system database contained data focused solely on the class interactions and grades and did not incorporate any information related to end of course surveys or student satisfaction. The use of archival data from the course management system database limited the opportunity to study factors such as the level of student satisfaction with the course.

The experience level of the faculty member with technology, and specifically with online educational technology, was a factor that may have potentially influenced the internal validity of

the study results. This factor was mitigated by limiting the faculty group to new online faculty. All new online faculty participating in the study received (a) identical on-site training in the use of the software toolset, (b) identical internet based training in the use of the software toolset, and (c) individual ongoing mentoring throughout the initial course delivery process.

Similarly, the experience level of the student with the technology may have impacted the internal validity of the results. Incorporating a wide mixture of courses ranging from beginning to advanced levels served to mitigate this effect.

As a single university setting was used in the research, there was no control group against which to measure the results of the research. This may limit the external validity of the study and the generalization of findings to other institutions and other forms of course design and use. This issue was mitigated by the fact that the collected data is similar to data provided by the course management systems in use at many universities.

There may be indirect relationships supported by multiple factors impacting outcomes in online classes including (a) student perceptions and attitudes toward the frequency and method of communication employed or (b) institutional requirements such as the required minimum level of participation in class. The analysis of these indirect relationships was outside the scope of the proposed study.

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