Assessing and Comparing Interaction Dynamics, Student Learning, and Satisfaction within Web-based Online Learning Programs

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Abstract

This study measures student learning, satisfaction, and interaction dynamics within Web-based online learning programs. The population of this study was students (n = 208) enrolled in multiple academic disciplines at an East Coast U.S. university. A Web-based research instrument was designed to assess students' characteristics, their perceptions of learning, satisfaction, student-to-student interactions and student-to-instructor interactions. A one-way analysis of variance (ANOVA) was conducted to see whether perceived learning, student satisfaction, student-student instructor interaction, and student-student interaction differed based on the discipline within these programs. No statistically significant differences were found. A one-way ANOVA was conducted to see whether perceived learning differed based on the technology used within these programs. No statistically significant differences were found here either. Research findings, limitations of research, and recommendations for future research are discussed.

Keywords: Online learning, student-student interaction, student-faculty interaction, student satisfaction

Introduction

The use of Web technology in learning settings has begun to change the face of education. The World Wide Web has become a useful instructional medium and provides new learning experiences for students that were not previously possible. In a Web-based environment, at any time and any place, 24 hours a day, 7 days a week, students with the help of an Internet connection, can receive instruction, compose and submit assignments, and ask questions of the instructor and fellow students. They can actively participate in class discussion from home, office, or any computer lab.

The asynchronous nature of a Web-based course not only eliminates the constraints of time and location but it also incorporates interactive communication that was once unique to face-to-face classroom-based instruction. These characteristics are bringing university and college courses within reach of more and more adult learners who would otherwise be unable to attend classes or obtain a university or college degree. Additionally, the explosion of an adult student population, family and work responsibilities, travel costs, and transportation problems have resulted in demands for flexible and convenient learning opportunities.

Problem Statement

Like any other medium, Web-based instruction is not free from criticism. Some are concerned with the intensive commitment of time to both develop and take Web-based courses, the lack of face-to-face interaction among students and their instructors, and the quality of education relative to classroom-based courses (Arbaugh, 2000a). Others contend that this lack of face-to-face physical interaction is one of the major limitations in distance education (Kirby, 1999; Kruger 2000) as students and instructors are physically separated from each other and course communication is mediated through Internet communication tools. This physical separation creates barriers to communication (Sorensen & Baylen, 1999) as many non-verbal cues such as eye contact and facial expressions are missing (Sutton, 2001).

In contrast, proponents contend that Web-based education is superior to learning in crowded college and university halls. Hill (1997) suggests that Web-based instruction is a revolutionary resource tool and a viable option for all types of learners. Canning- Wilson (2001), and Jung (2001) contend that Web-based learning is a practical and viable solution to meet the modern learner's educational needs. It provides learners with more choices and flexibility than they have ever had before (Milligan & Buckenmeyer, 2008). The proponents further suggest that Web-based learning can utilize an array of computer-mediated tools that have the potential to promote interaction and enhance learning (Repman, Zindskie & Carlson, 2005).

One of the major criticisms of distance learning is the loss of face-to-face interaction between students and instructor and among students (Berge, 1999; Saunders & Weible, 1999) as students and instructors are physically separated from each other and communication tools are utilized to facilitate interactions among them. This criticism raises several questions: What is the nature and role of interaction in a Web-based learning environment? What does interaction involve in Web-based learning? Hence, it becomes very important to empirically investigate the level of students' perceived learning, satisfaction, and student-instructor interaction and student-student interaction within a Web-based distance learning environment.

This paper is sub-divided into five sections. The first section of the paper describes theoretical constructs from technology-based distance education. The second section describes the methods of the study using a sample of Web-based courses at an East Coast U.S. university. The third section describes results of the survey. The fourth section discusses the findings and its implications. The final section discusses contribution, limitations, suggestions for future research and major conclusions.

Theoretical Constructs

Several researchers considered interaction an essential element to student learning and to the overall success and effectiveness of distance education (Fresen, 2007; Kearsley, 2000; Moore, 1993; Northrup, 2001; Pauls, 2003; Sutton, 2001; Yildiz & Chang, 2003). Shale and Garrison (1990) stated that "in its most fundamental form, education is an interaction among instructor, student and subject content" (p. 1). Hillman, Willis, and Gunawardena (1994) considered interaction among students and interaction between instructor and students as "educational transaction" (p. 1). Moore (1993) suggested that there is a transactional distance in a distance learning environment as instructors and learners do not interact in the same physical and temporal space. In order to overcome potential shortfalls due to transactional distance, Moore identified three types of interaction essential for learning in distance education:

> Learner-content interaction: It is the method by which students obtain information from the course materials. The content can either be in the form of text, audio or videotape, CD-ROM, computer program, or online communication.
>
> Learner-instructor interaction: This refers to the interaction between the learner and the instructor. This can take the form of instructor delivering information, encouraging the learner, or providing feedback. In addition, this can include the learner interacting with the instructor by asking questions, or communicating with the instructor regarding course activities.
>
> Learner-learner interaction: It is the exchange of information and ideas that occurs among students about the course in the presence or absence of the instructor. This type of interaction can take the form of group projects, or group discussion, etc. The learner-learner interaction can foster learning through student collaboration and knowledge sharing.

Kear, Williams, Seaton, and Einon (2004) suggested that there are three uses of information and communication technology (ICT) in a distance learning course. The first use of ICT is to support a resource-based learning approach where the students are given a wide choice of learning materials. The second use of ICT is to allow students to participate in virtual communication. The third use of ICT is to promote an active approach to learning. And?

Hill (2002) suggested three factors contributed to the increased use of Web-based education. First, there is a perceived ease in moving face-to-face courses to a Web-based environment. Secondly, the educational needs of working adults must be considered. Without this technology, their continuing education might not be possible. Finally, there is the relative convenience of access to the Internet,

especially when compared to other distance education environments that require the learner to travel to a specific space.

A study by Arbaugh (2000b) examined the effects of interaction dynamics on student learning in Internet-based MBA courses. He found that ease of interaction, classroom dynamics and instructors' emphasis on interaction were significantly associated with students' perceived learning. However, the findings might be influenced by the fact that the subjects participating in the study were also attending traditional campus-based courses as they were enrolled in a regular-MBA program. In a study conducted by Volery (2001) within a Web-enhanced course, one of the critical success factors associated with learning effectiveness was classroom interaction. There remains a need to examine the level of interaction and communication dynamics and satisfaction in Web-based e- learning programs. The following research questions were investigated in this paper:

1. Do perceived learning, student satisfaction, student-student interaction, and student-instructor interaction within Web-based learning programs differ based on discipline?

2. Does perceived learning within Web-based learning programs differ based on technology?

Methods

Sample and Data Collection

The sample for the study was taken from the thirty class sections that were conducted using Prometheus course software platform during the Spring semester of 2003. All students (n = 652) were enrolled at an U.S. East Coast university in different Web-based programs including a Master of Science program in the Project Management, a Master of the Tourism Administration program, a Bachelor of Science program in the Health Sciences, and a Master of Science in the Health Sciences. These students were enrolled in only one program and then registered in multiple courses. Each of these courses had no on-site meetings. Class section enrollments ranged from 6 to 20 students. Students completed a password-protected Web-based survey. The student response rate was 31.9 percent (208 of 652).

Measures

Unless otherwise mentioned, each of the items was measured using five-point Likert-type scales, ranging from 1 as "strongly disagree" to 5 as "strongly agree".

Perceived Learning**:** Student learning was measured using Hiltz's six-item scale (1994). This scale has been used in several studies of distance learning environments (Arbaugh, 2000b; Hiltz, 1994) and has been found a reliable and validated measure. The internal reliability of this measure was 0.91.

Student Satisfaction: Student satisfaction was measured via a 6-item validated and reliable scale adapted from Arbaugh (2000a). This scale focuses on students' satisfaction with the Web-based course, their perceptions of its quality, and their intention of taking future courses via distance mode. He validated this scale through factor analysis. The internal reliability of this measure was 0.92 in Arbaugh (2000b). The items are listed in Table 1.

Student-Instructor Interaction: This was measured using 5-item scale adapted from Johnson, Aragon, Shaik, and Palma-Rivas (2000). The coefficient alpha of this measure was 0.85.

Student-Student Interaction: This was measured using 5-item scale adapted from Johnson, Aragon, Shaik, and Palma-Rivas (2000). The coefficient alpha of this measure was 0.84.

Table 1. Student Learning and Satisfaction Variables

Research Variables	Measure	Source
Perceived Learning	1. I learned to interrelate the important issues in the course material 2. I gained a good understanding of the basic concepts of the material 3. I learned to identify the central issues of the course 4. I developed the ability to communicate clearly about the subject 5. I improved my ability to integrate facts and develop generalizations from the course material 6. I learned concepts and principles in this course	Student Survey (6 items) from Hiltz (1994)
Satisfaction	1. The quality of the course compared favorably to my other courses 2. I was very satisfied with this course 3. If I had another opportunity to take another course via this mode I would gladly do so 4. I gained more interest in the subject matter of this course 5. I feel that this course served my needs well 6. I would recommend this course to another student	Student Survey (6 items) from Arbaugh (2000a)

Table 2. Student-instructor Interaction Variables

Research Variables	Measure	Source
Student-to-Instructor interaction	1. The instructor encouraged me to become actively involved in the course discussions 2. The instructor provided me feedback on my work through comments 3. I was able to interact with the instructor during the course discussions 4. The instructor treated me as an individual 5. The instructor informed me about my progress periodically	Student Survey (5 items) from Johnson et al. (2000)

Table 3. Student-Student Interaction Variables

Research Variables	Measure	Source
Student-to-Student interaction	1. I was able to share learning experiences with other students 2. I was able to communicate with other students in this course 3. Increased contact with fellow students helped me more out of this course. 4. A sense of community existed with fellow students taking this course. 5. This course encouraged me to work in small groups/teams	Student Survey (5 items) from Johnson et al. (2000)

Results

The control variables used in this study were gender, level, language, age, prior student experience with Web-based courses, Internet experience, and expected course grade.

Gender: 135 or about (65%) of the total respondents were female, while the remaining 83 (or 35 %) were male.

Level: 151 or about (73%) of the total respondents were graduate students, while the remaining 57 or (27 %) were undergraduates.

Language: English was the first language of 177 or about (85%) of the total respondents, while the remaining 15 % spoke other languages as a first language.

Age: In the age category the distribution of the respondents was as follows: 54 (or 26 %) were between 21 to 30 years old; 77 (or 37%) were between 31 and 40 years of age; 59 (or 28%) were between the ages of 41 and 50 years; and finally 18 (or 9%) were between the ages of 51 and 60.

Previous courses taken/Prior online course experience: Prior to Spring 2003, 40 (or 19.2%) students had taken no online course; 13 (or 6.3 %) took one online course; 28 (or 13.5 %) took two courses; 10 (or 4.8 %) took 3 online courses; 5 (or 2.4%) students took four online courses; 9 (or 4.3%) students took online courses; 23 (or 11.1%) students took 6 online courses; 8 (or 3.8 %) students took 7 online courses; 19 (or 9.1%) respondents took 8 online courses; 11 (or 5.3 %) students took 9 online courses; 15 or (7.2 %) students took 10 online courses; 7 students (or 3.4%) took 11 online courses; 13 or (6.3 %) students took 12 online courses; and finally there were 7 (or 3.4 %) students that took 13 online courses.

Internet Experience: The majority of the students had more than 5 years of Internet experience.

Expected Course Grade: All students reported their expected course grade for the course when they submitted the survey. The majority of the students reported B and above as their expected grade.

Analysis of Study

This research used the Cronbach's alpha value in order to assess the internal consistency of the results across items within a scale. Alpha values were calculated for each multi-item scale. All the calculated alpha values are found to be above 0.83 indicating the fact that all scales are reliable.

Having demonstrated the overall reliability of the instrument, a mean score was calculated for each construct based on the individual student responses for the purpose of hypothesis testing. A single value has the advantage of simplifying the test of the comparison between variables, by reducing the number of variables that need to be tested simultaneously. For the present study, perceived learning was

computed by taking the average score of six items of learning on the instrument, student-instructor interaction was computed by taking the average score of five items of student-instructor interaction, and student-student interaction was computed by taking the average score of five items of student-student interaction on the survey instrument. A brief description of the minimum and maximum values, mean and standard deviation of each construct under study is shown in Table 4.

Table 4. Descriptive Statistics of Constructs

Construct	Minimum	Maximum	Scale Range	Mean	Standard Deviation
Perceived Learning	2.00	5.00	1 to 5	4.08	.70
Student Satisfaction	1.17	5.00	1 to 5	4.11	.84
Student- Instructor Interaction	1.00	5.00	1 to 5	4.00	.76
Student- Student Interaction	1.40	5.00	1 to 5	3.69	.85

A descriptive analysis of study variables under investigation in each program is presented in the Tables 5, 6, and 7. As shown in these tables, students in all programs provided positive views on the perceived learning and student satisfaction. On the student-instructor interaction indicators, students in Health Sciences and Tourism Administration programs displayed more positive views on student-instructor interaction than students in the Project Management program. However, students in the Project Management program provided more positive views on the student-student interaction indicators than students in Tourism Administration and Health Sciences programs.

Table 5. Descriptive Statistics of Study Variables in Health Sciences Program

Study Variable	Mean	Standard Deviation
Perceived Learning	4.06	.75
Student Satisfaction	4.08	.95
Student-Instructor Interaction	4.05	.85
Student-Student Interaction	3.67	.89

Table 6. Descriptive Statistics of Study Variables in Project Management Program

Study Variable	Mean	Standard Deviation
Perceived Learning	3.97	.65
Student Satisfaction	4.05	.61
Student-Instructor Interaction	3.87	.60
Student-Student Interaction	3.83	.88

Table 7. *Descriptive Statistics of Study Variables in Tourism Administration Program*

Study Variable	Mean	Standard Deviation
Perceived Learning	4.29	.53
Student Satisfaction	4.31	.64
Student-Instructor Interaction	3.97	.61
Student-Student Interaction	3.62	.67

Comparison of Programs by Discipline

Data were collected from students enrolled in three online programs at an East-cost university. Analysis of variance (ANOVA) is a technique that is used to test the statistical significance of differences among the mean scores of two or more groups on one or more variables. Prior to applying parametric statistic one-way ANOVA, the validity of the assumptions associated with this statistic must be examined. These assumptions are: Normality of distribution, independence within sample, sample size, unbalanced sample size, and homogeneity of the variance.

Both skewness and kurtosis were verified for the data set that indicates that data are normally distributed. Skewness for survey responses is -0.80, which is within acceptable range of –2.0 to + 2.0; kurtosis is 0.34, which is within acceptable range of –5.0 to +5.0 (Kendall & Stuart, 1958). Subjects were independent of each other. Sample sizes were 125, 46, and 37. Hence, all samples were large enough. Sample sizes are not really unbalanced because the smallest of them is 37 and the largest is 125. Hence, the ratio is about 3.4 which is not big enough. Levene's test was used to examine the equal variance. The F values and p-values for perceived learning, student satisfaction, student-instructor interaction, and student-student interaction are: [F(2,205) = 1.252, p=0.16], [F(2,205) = 10.75, p=0.00], [F(2,205) = 2.039, p=0.133], [F(2,205) = 3.55, p=0.00] respectively.

Table 8. Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Significance
Perceived Learning	1.252	2	205	0.288
Student Satisfaction	10.750	2	205	0.000
Student-Student Interaction	2.039	2	205	0.133
Student-Instructor Interaction	3.550	2	205	0.030

The p-values for student satisfaction and student-instructor interaction indicate that the null hypotheses were rejected. Hence, the analog Kruskal-Wallis, a non-parametric ANOVA test was used to test the differences between student satisfaction and student-instructor interaction between these programs, for the parametric one-way analysis of variance (ANOVA). The results are shown in Table 9.

The results of Kruskal-Wallis test indicated that no significant differences were found between student satisfaction and student-instructor interaction variables among the programs under study based on discipline.

ANOVA was conducted to see whether any of the two variables, perceived learning and student-student interaction under consideration differed based on the discipline. Table 10 contains the results of this ANOVA. The results of ANOVA indicated that no statistically significant differences were found between perceived learning and student-student interaction among the programs under study based on discipline.

Table 9. *Kruskal-Wallis Test*

	Student Satisfaction	Student-Instructor Interaction
Chi-Square	3.70	5.29
Df	2	2
Asym. Sig.	0 .157	0.071

Table 10. ANOVA by Discipline

		Sum of Squares	df	Mean Square	F	Significance
Perceived Learning	Between Groups	2.176	2	1.088	2.26	.11
	Within Groups	98.485	205	.480		
	Total	100.661	207			
Student-Student Interaction	Between Groups	1.170	2	.585	.80	.45
	Within Groups	149.943	205	.731		
	Total	151.113	207			

Comparison of Programs by Technology

Prior to applying parametric statistic one-way analysis of variance (ANOVA), the validity of the assumptions associated with this statistic must be examined. These assumptions are: Normality of distribution, independence within sample, sample size, unbalanced sample size, and homogeneity of the variance. Both skewness and kurtosis were verified for the data set that indicates that data are normally distributed. Skewness for survey responses is -0.86, which is within acceptable range of –2.0 to + 2.0; kurtosis is 0.51, which is within acceptable range of –5.0 to +5.0 (Kendall & Stuart, 1958). Subjects were independent of each other. Sample sizes were 162 and 46. Hence, samples were large enough. Sample sizes are not really unbalanced because the smallest of them is 46 and the largest is 162. Hence, the ratio is about 3.5 which is not big enough. Levene's test was used to examine the equal variance. The F-values and p-values for perceived learning and yielded F(1,206) = .288, p=1.252.

The p-values for perceived learning indicate that the null hypothesis was rejected. Hence, homogeneity of variances was assumed. A one-way analysis of variance (ANOVA) was calculated to see whether perceived learning differed based on the technology used in the online programs under consideration. These three programs used e-mail, and a discussion forum as main communication tools among students and between the instructor and students with the exception of Project Management program that also used telephone. Table 12 contains the results of this ANOVA.

Table 11. Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Perceived Learning	1.252	1	206	.288

Table 12. ANOVA by Technology

		Sum of Squares	df	Mean Square	F	Sig.
Perceived Learning	Between Groups	0.286	1	0.286	0.59	0.44
	Within Groups	100.4	206	0.487		
	Total	100.7	207			

Perceived learning demonstrated F(1,206) =0.59, p =0.44. Hence, no statistically significant differences were found between these programs under study based on technology.

Open-Ended Question Sample Responses

Sixty students responded to the open-ended question, “Any additional comments you would like to make?” Comments were made about of the instructor, advantages of distance learning, interaction, course subject, structure, and about other students. Some of the comments are listed in Table 13:

Discussion

The growth of demand for online courses can be tied to increased technology access and a growing acceptance of technology in general. Technology is valued because it has provided students with tools that have facilitated their acquisition of knowledge in all disciplines. Also, it has provided convenient and immediate availability to course material and course discussions. Given the choice between traditional course offerings and technology-based course offerings, students are increasingly choosing technology as a vehicle for learning. In particular, students are choosing to go online and learn via the Internet. Advances in technology and increased access to the Internet are giving students more flexible time options of learning.

Internet-based technologies are being adopted to enhance face-to-face instruction and to provide instruction entirely online. In the past decade, course management systems, such as WebCT, Blackboard, and Prometheus have been developed, especially for teaching and learning purposes that integrate course development tools, course material (audio, video, and text), e-mail, live chat sessions, online discussions, and the World Wide Web. Using this type of system, instruction delivery and communication between instructors and students can be conducted either synchronously or asynchronously.

Table 13. Open-Ended Responses

Number	Students' responses
1	"Great course. Instructors have been a great help through the entire on-line process/classes."
2	"This course was an excellent example of a successful web course."
3	"I think the main reason why this online course is so successful is because this whole course is based on learning from other people experience and from discussion, not from learning and memorizing new facts and concepts."
4	"I believe the distance course content is more intensive than the traditional classroom instruction."
5	"I really enjoyed taking distance learning program at GWU. I have learned a great deal and highly satisfied. I will recommend to others."
6	"One of the great features of DE courses is that they are well organized and must meet approval before they are placed online."
7	"Distance education makes it possible for self-disciplined students to attend and succeed in higher education. The classroom is missed, but the flexibility gained more than makes up for the lost face to face interaction."
8	"The ability to better schedule my learning around my work and other schedules allows me to pursue a graduate degree. This program has been better than I expected and I really enjoy internet learning!"
9	"DL has worked well for me since I travel for business. Most of the instructors understand that most students taking DL classes have the demands of a family, job and school, and they understand that for some students this can be difficult."

The results of descriptive statistics indicate that there was moderate to high level of satisfaction and learning as perceived by the students. The results also indicate that student-instructor and student-student interaction facilitated through technology was available in the Web-based distance learning courses/programs being studied. This indicates that the use of technology greatly facilitates and enhances interaction among students and between instructor and students. Hence, the efficient and effective use of technology in delivering Web-based courses is of critical importance to learning.

Based on the data in this study, student-student interaction was slightly higher, though not statistically significant, in the Project Management program than in the other two programs, Health Sciences, and Tourism Administration. It might be possible that the Project Management program required more student-student interaction than the other two programs being studied.

No statistically significant differences in student learning between the programs were found based on technology and discipline. These programs used e-mail and a discussion forum as the main communication tools among students and between the instructor and students with the exception of Project Management program that also used the telephone. However, the role of technology cannot be ignored as course delivery and course communications were facilitated through technology. E-mail and discussion forum provide more time for reflection whereas telephone provides immediate feedback.

Due to the physical separation of learners from instructor and other learners, technology plays a vital role in providing a learning experience comparable with a face-to-face class. As technology has made learning possible at a distance, these findings suggest that the use of communication tools incorporated in a distance learning environment bridge both physical and time dimensions to bring the faculty and

students together as a virtual community.

Limitations of the Study

As with any research, particularly a field study, there were a number of limitations to the study. The variables, learning and satisfaction, were perceptual measures, as students were asked a number of questions seeking to assess their perceptions of learning and satisfaction. The construct of perceived learning and satisfaction exhibited good reliability as Cronbach's alpha was 0.91 and 0.93 for perceived learning and student satisfaction, respectively. However, more objective measures of learning and satisfaction would strengthen the conclusions reached in this research. Actual student grades were not available because of the confidentiality of student grade records by the university.

Recommendations for Future Research

A comparative study with an identical research design is needed in different types of higher education institutions, such as community colleges as compared with four-year institutions. A comparative analysis of students' perceptions is needed in Web-based courses with different levels of interaction.

Conclusion

Technology in online learning is becoming increasingly accepted in the system of higher education sector as the use of technology in online learning contributes to the pedagogical experience. As more Web-based courses and programs are offered using course management systems, care should be taken to make certain the interactions of the learner, instructor, content, and technology are successful. The positive level of interaction dynamics and student learning and satisfaction outcomes illustrates that Web-based learning provides successful learning and a satisfying learning environment. It is imperative that Web-based learning programs provide students with what is valued in education: interaction with instructors and other students.

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