Correlates of Effectiveness of Learning Networks: The Effects of Course Level, Course Type, and Gender on Outcomes

Raquel Benbunan-Fich* and Starr Roxanne Hiltz**
* Zicklin School of Business, Baruch College, CUNY
** CIS Department, New Jersey Institute of Technology
Rbfich@yahoo.com, Roxanne@vc.njit.edu

Abstract

Data for almost 2000 students allow us to contrast learning outcomes for courses in three different modes of delivery (completely online, mixed, and completely on campus). The analyses are based on three different factors: course level (graduate vs. undergraduate), course type (more technical computer science and engineering courses vs. less technical courses in CIS, humanities, and management), and gender. In terms of final grades, we found that online students achieved higher grades than those in face-to-face (FtF) courses did. However, the perception of learning was similar across conditions. We also found a significant interaction between mode and course level: graduate students in mixed mode courses reported the highest levels of perceived learning. The results of this study enable us to further generalize the finding that ALN modes of delivery tend to produce results equal to or better than those for FtF modes of course delivery.

1. Introduction

Learning networks are defined as groups of people who use computer networks (the Internet and World Wide Web) to communicate and collaborate in order to build and share knowledge [7]. "Asynchronous" refers to "anytime, anywhere" use of the technology, rather than at the same time or in the same room. In using ALN, the instructor structures online discussions and/or group assignments and activities as a substantial part of the coursework. (See [3] for a description of the ways in which teaching roles evolve towards a style that might be termed the "digital Socrates" in ALN courses.)

There have been three multi-year research projects at NJIT on the Virtual Classroom®, our version of an Asynchronous Learning Network (ALN) system for delivery of courses via the Internet. In the 1980's, our initial project built the first version of the software, used it to offer a small number of undergraduate courses in several disciplines, and explored issues such as effective online teaching techniques and the comparative outcomes of online vs. in-seat courses [8, 9]. In the early 1990's, we produced and delivered via ALN all of the major courses for undergraduate degrees in Computer Science and Information Systems [10]. For both of these projects, we found that the outcomes of ALN courses were equal to, or better, than those for traditional face-to-face courses.

In 1997-2000, the research was expanded to include graduate as well as undergraduate programs of study, located in several departments throughout the university. This most recent project, called "From Virtual Classroom® to Virtual University," was aimed at institutionalizing ALN as a mode of delivery and providing the necessary infrastructure to allow these programs to continue after the financial support from research grants ended.

Since the previous project had been confined to undergraduate courses in CIS, the third project was designed to achieve two main extensions. First, to complete ALN course offerings for the remaining (non-CIS) undergraduate courses needed for the degree programs. Second, to develop a variety of other graduate and undergraduate ALN programs involving other departments throughout the university, such as Humanities and Social Sciences, the School of Management, and the Department of Electrical and Computer Engineering, as well as CIS.

The project used the web-based version of the Virtual Classroom® (VC) system in combination with video or CD-ROM or other multimedia modes. The objective was to develop and offer master's programs in CIS; three "bridge" programs (the courses that a non-major in a field has to take to be able to matriculate in a masters program), and three graduate level certificate programs. These certificate programs can be a stepping stone to a full master's program, both for the student and the department. Evaluation research goals included gaining a better understanding of how the role of the instructor changes to adapt to ALN [3], and testing the generalizability of our earlier results to different levels and types of courses.

0-7695-1435-9/02 $17.00 (c) 2002 IEEE

Data were collected on three modes of delivery: completely distance courses using ALN for class discussions and assignments plus other recorded media for lectures; mixed mode courses using face to face lectures plus ALN; and traditional face to face (FtF) courses with no use of ALN.

This paper focuses on the analysis of effectiveness of ALN courses as it may vary according to gender of the students, the level of the course (undergraduate vs. graduate), and the type of course (less technical vs. more technical). Two main determinants of effectiveness are reported here, learning perception measured through a student survey and learning performance as evidenced by the final grades obtained by the students in each course.

2. Literature Review and Hypotheses

Each medium of communication has its advantages and disadvantages for pedagogical strategies. Implementations that capitalize on the strengths of a medium, and circumvent or adjust for its limitations, are more successful in terms of outcomes than the ones that disregard its strengths and weaknesses. Although media can make a difference, other factors may be more important than, or interact with the communication medium in affecting educational outcomes for students. A primary goal in studying information technology for educational delivery must be the identification of effective and ineffective ways of incorporating such technology, and of the types of students or courses that are most or least likely to benefit from use of a particular medium.

In the call for "greater depth and breadth of research" on technology-mediated learning, [1] state that research in this area must look at ***how*** technology influences learning. This involves an "explicit consideration of relationships among technology capabilities, instructional strategy, psychological processes, and contextual factors involved in learning" (p. 1).

The theoretical framework that guided the research design and data gathering and analysis for this project was developed during previous projects and modified slightly for this study. In this model, characteristics of the system, the individual, the group (course or class), and the organizational setting (college or university), as well as mode of use of the system (for collaborative vs. individual activities) are expected to influence access to the professor, motivation, active participation, media richness and collaborative learning, which in turn will determine outcomes. The overall theoretical model is presented in Figure 1.

Any use of ALN technology is nested within a particular social context. At the lowest levels, characteristics of the user and of the hardware-software system shape the dynamics of human-computer interaction.

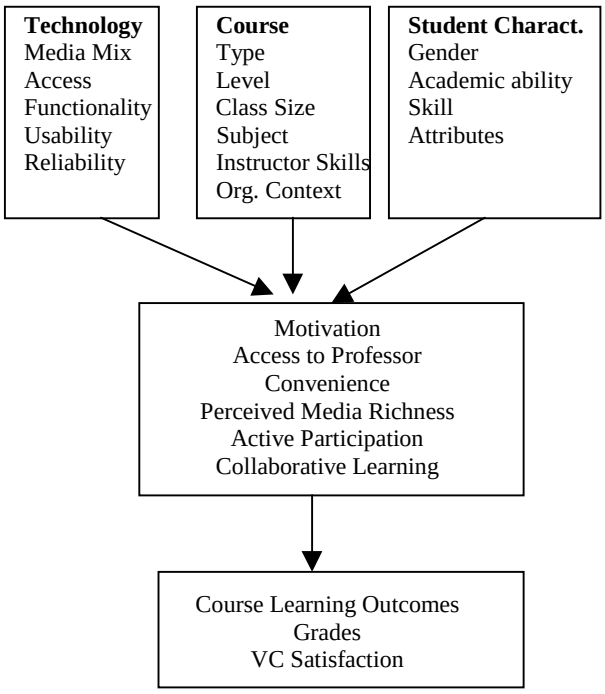

Figure 1. A Causal Model for the Virtual Classroom Study

The three factors in the upper part of Figure 1 (Technology, Course and Student Characteristics) create the context in which each specific student employs the technology in each course. These variables interact to form a complex system of determinants. Favorable outcomes are contingent upon certain levels of student ability and motivation, and upon the skill and level of effort of the teacher [9]. Thus, characteristics of the course and of the individual students are hypothesized to affect amount and type of use of an ALN.

The middle portion of the framework characterizes the perceptions of and mode of use of the system by the instructor and the students. For example, students may sign on and passively browse, rather than contributing to online discussions. The instructor may or may not provide a daily presence online. The students may or may not engage in collaborative assignments with other students, depending upon the way the course is structured by the instructor, and their own regularity in interacting with their peers. They may or may not perceive the class interactions as a “rich” medium of participation, which includes social-emotional interaction as well as task-oriented interaction, and

Proceedings of the 35th Annual Hawaii International Conference on System Sciences (HICSS-35'02)
0-7695-1435-9/02 $17.00 © 2002 IEEE

conveys a sense of "social presence" of others [4, 12]. Relative convenience of online interaction vs. in-classroom sessions is a product of both technology and the students' schedules and conflicting time demands.

The intervening variables, in turn, are conceptualized as leading to the presence or absence of the various (desired) outcomes, such as subjective satisfaction with the system, and quality of learning. The latter is measured through objective and subjective indicators. Objective learning refers to the actual or observed learning, measured by an exam or other graded activity in which the student is asked to repeat or apply the concepts "learned". Subjective learning deals with the students' perception of their own learning process and is measured by a survey [2].

Therefore, the dependent variables are measures of the quality of the learning experience. They include course outcomes (e.g., learning facts and learning relationships among ideas); subjective satisfaction with the Virtual Classroom system (as compared to traditional classes); and measures of student mastery or performance, such as grades.

This initial analysis of the data looks at several of the contextual factors that may be important: the technology in terms of the total media mix; the level and type of subject matter of the course; and one characteristic of the learners, gender; and the effects of these factors on learning outcomes. Subsequently, we intend to explore additional factors, such as variations in whether the media, as used in a specific course, are psychologically perceived as adequately "rich" or "sufficient" media for course delivery.

An ALN learning environment differs in terms of its communication dynamics not only from the traditional classroom, but also from technology-enhanced classrooms, where synchronous (same time) computer-mediated communication is used in conjunction with face-to-face interaction. Of fifteen published empirical studies that compared face-to-face with online classes, ten have found "no significant difference" in the outcomes measured, while five have found the ALN mode to be superior in some way [14] (for additional studies see http://www.alnresearch.org). Therefore, we expected that in this new study:

H1a: Grades earned by students using the Virtual Classroom® ALN system will be equal to or better than those earned by students in traditional FtF courses.

H1b: Perceptions of learning outcomes by students using the ALN system will be equal to or better than those earned by students in traditional FtF courses.

2.1. Gender Differences

Studies of gender inequity in traditional face-to-face classes tend to indicate that class participation is male dominated [15, 16]. However, with asynchronous computer-mediated communication, the tendency is toward more equal participation. In a study of e-mail, [6] found that there was no difference in use associated with gender, but that there were differences in perceptions of the medium: females perceived a higher social presence and usefulness of e-mail.

Another study [11] examined whether the frequency of ALN use is the same for male and female students, whether male and female students use ALN differently, and whether male and female students differ in their attitudes about using ALN in courses. Survey results for students over two semesters in various courses found no significant difference in gender use of ALN.

There have been only a few studies reporting gender differences in outcomes of ALN courses. [13] report results for 1974 students answering course questionnaires in Spring 2000 in a wide variety of courses at SUNY. They found small but significant differences indicating that women students, compared to male students in ALN, interact more with the instructor and other students, participate more and at higher levels than in the traditional classroom, and are more satisfied with online learning. Another study [5] indicated that more female than male students perceived that the use of computer-mediated communication helped in their course-related tasks. Therefore, we hypothesize that:

H2a: Female students will achieve better grades than male students in ALN courses.

H2b: Female students will be more likely than male students to perceive favorable learning outcomes from ALN.

2.2. Undergraduate vs. Graduate courses

Prior studies have indicated that student motivation and maturity are important correlates of outcomes in ALN. For example, in the first Virtual Classroom® study, the least successful courses were required freshman level courses; it seems that such students frequently lack both motivation and the self-discipline to schedule regular participation online [9]. Graduate students are much more likely to be studying topics that are directly related to their careers, and they are also more likely to be self disciplined enough to participate regularly. Therefore, we hypothesize:

H3a: Final grades in ALN courses will be higher for graduate students than for undergraduate students.

H3b: Graduate students will be more likely than undergraduate students to perceive course outcomes in ALN to be positive.

2.3. Type of Course

One of the most interesting aspects to explore is the effectiveness of ALN in different subject matters and courses. Very few studies have included a systematic examination of various courses from different departments. For example, [17] conducted an exploratory field study on several networked classrooms, same time/different place, in different courses such as accounting, chemistry, computer science, etc. Although this study did not include control conditions for comparison purposes, it served to develop recommendations to increase the effectiveness of networked classrooms.

Courses can be classified according to the technical nature of the material they cover. More technical courses would include substantial mathematical analysis (algorithms, programming, all of the Engineering and Mathematics courses), while less technical courses would be more oriented towards qualitative analysis and discussion (e.g., Computers and Society and Computer Systems Management in the CIS department; all of the Humanities and Social Sciences courses, and all of the Management courses). It would seem that less technical courses, because of their qualitative nature, are more suited for a text-based ALN environment. (While it is possible to compose equations, flow charts, etc. online, it is much more tedious than writing on a blackboard or paper with chalk or a pencil). Thus, we hypothesize:

H4a: The use of ALN in less technical courses will result in higher student grades.

H4b: Students taking less technical courses and using and ALN will report better learning perceptions than students in other conditions.

3. Research Methods

In order to examine the effectiveness of ALN courses, three modes of delivery were studied:

(1) "Pure ALN" sections, which used videotapes (or in a few cases, CD-ROMS or web pages) for the delivery of “lecture” type material, and the web-based version of the Virtual Classroom® (VC) system to support class discussions and collaborative assignments.

(2) “Mixed mode” sections, combining ALN interaction with FtF lectures, and

(3) "Comparison sections" taught by the same instructor or set of instructors, in traditional on-campus FtF sections.

This is a field study, rather than a controlled experiment. Faculty were free to choose the modes in which they would teach their courses, and the ways in which they would use these modes. Sections of courses selected for inclusion as "comparison" sections to ALN ones involved the same instructor or set of instructors teaching in different modes. Students self-selected the sections they wanted to enroll in. This increase in realism in comparing a field study to a controlled laboratory experiment comes at the expense of having less control over the distribution of courses and students among conditions.

A course survey was administered to students enrolled in all the sections of courses in the project. Instructors in the target sections were requested to hand out the questionnaire at the final exam, if there was one; otherwise, the questionnaire was mailed. For many either there was no on campus final exam, or the instructor did not cooperate in handing out the questionnaire or urging its completion.

Sources of data included students' responses to the post-course questionnaire and final grades earned by the students in their courses. Table 1 presents a summary of the distribution of responses by condition, and shows the breakdown by department and by level (graduate vs. undergraduate). It is noteworthy that even though the study included courses from many different departments, because of the high enrollments in CIS, these students still represent a majority of the sample. Likewise, undergraduate students also make up the majority of the sample.

A total of 1978 questionnaires were processed and analyzed, 31% from ALN sections, 22% from mixed mode courses, and 46% from students in traditional sections. The response rate, calculated as the number of questionnaires received divided by the final enrollment numbers in sections of the courses eligible for inclusion in the study, was very low for pure ALN and FtF comparison sections.

Some faculty did not distribute the questionnaires, and some students did not attend the session where the questionnaires were handed out. Several mailed out questionnaires could not reach the students because the addresses were out of date. Attempts were made to increase response rate, including a drawing to win a $50.00 prize for those who completed a questionnaire each semester, cookies given out at final exams where questionnaires were distributed to thank students for their participation, and a mailed questionnaire to those who had not completed one.

Proceedings of the 35th Annual Hawaii International Conference on System Sciences (HICSS-35'02)
0-7695-1435-9/02 $17.00 © 2002 IEEE

Table 1. Post-Questionnaire Data

	ALN	FtF + ALN	FtF only	Total
Breakdown by dept.				
CIS	547	410	629	1586
ENGIN.	7	-	116	123
HSS	29	19	112	160
MATH	-	-	23	23
MGMT	33	-	46	79
Other	3	1	3	7
Breakdown by level				
Undergrad.	483	260	811	1554
Graduate	136	170	118	424
Total	619	430	929	1978
% of total	31	22	47	100%
Response Rate	15	46	17	

Sections of the questionnaire contained sets of items designed to measure various aspects of the process and outcome of courses, such as perceived quality of the instructor's performance, perceived learning, and overall evaluation of the "Virtual Classroom" ALN experience (the latter only for sections using ALN). This paper reports the effects on learning outcomes.

The unidimensionality of the learning perception construct was validated using factor analysis. Items loading on the same factor were retained and scale reliability was checked using Chronbach's Alpha. Table 2 shows the composition of the Perceived Learning index, which was selected as the subjective measure of effectiveness for the analyses in this paper.

Table 2. Factor and Reliability Analysis of the Perceived Learning Index

Index	Items	Factor Loadings
Perceived Learning*	Gained more interest in the subject	.79
	Learned a lot of factual material	.82
	Gained understanding of basic concepts	.83
	Improved ability to communicate clearly	.84
	Skill in critical thinking increased	.83
	Improved ability to integrate facts	.76
	More confident in expressing ideas	.69

* Cronbach's Alpha = .90

Note that we also use an objective measure, course grades. Each of these measures has different limitations. Course grades are very strongly related to previous Grade Point Averages, and thus measure the student's academic ability more than the effect of a medium of delivery. Perceived Learning as experienced and reported by students may be distorted by other factors, such as overall reactions to the course, including such factors as convenience of access and how much the student liked the instructor.

4. Results

An analysis of variance was performed to compare grade distribution and learning perception across modes. Table 3 presents these results.

Table 3. Anova on Dependent Variables by Mode of Course Delivery[1]

	ALN	FtF+ ALN	FtF Only	F	p
Final Grades[2]	3.16 (1.19) [445]	3.16 (1.06) [320]	2.90 (1.11 [708]	9.30	<.0001
Perceived Learning	26.37 (4.68) [369]	26.55 (4.74) [311]	26.57 (4.92) [556]	0.22	0.80 (n.s)

[1] Shown in each cell: mean (stdev) [n]; n.s = not significant
[2] Grades: A=4.0, B+= 3.5; B= 3; C+=2.5; C=2; D=1; F=0; Excludes Incompletes, Withdrawals and pass/fail

As hypothesized, students in ALN sections obtained higher grades than those in comparison sections. Duncan tests on final grades showed that online conditions (ALN and FtF+ALN) are significantly higher than the FtF mode. Thus, H1a is supported by the data. The perception of learning, however, is about the same across modes and no significant differences were detected. H1b, which predicted learning perception levels similar or higher for ALN conditions, is also supported by the data.

In order to test the remaining hypotheses, two-way analyses of variance were performed combining the three modes with each of the predicted factors (gender, course level and course type) over the dependent variables (final grades and learning perception). For each one of these 3X2 matrixes, we computed the cell means, standard deviations and sample size, and the significance of the model, the factors and their interaction.

Analysis by mode and gender for final grades are presented in Table 4. Female students obtained higher grades than their male counterparts, and this

achievement is not affected by the mode in which the course was delivered. Overall, students in ALN sections earned significantly higher grades, but there is no interaction between condition and gender as hypothesized in H2a. In terms of learning perceptions, all conditions report similar levels and these perceptions are not affected by gender. Thus, H2b is not supported by the data.

Table 4. Two-way Anova on Final Grades by Mode and Gender

	ALN	**FtF+ ALN**	**FtF Only**	***Gender Means***
Male	3.12 (1.27) [244]	3.05 (1.20) [169]	2.86 (1.15) [448]	*2.97 (1.20) [861]*
Females	3.23 (1.13) [130]	3.33 (0.88) [81]	3.06 (0.98) [172]	*3.17 (1.02) [383]*
Condition Means	*3.16 (1.23) [374]*	*3.14 (1.12) [250]*	*2.91 (1.11) [620]*	
	F	**p**		
Model	**4.22**	**.0008*** **		
Condition	4.87	.008**		
Gender	6.87	.009**		
Condition X Gender	0.39	0.67		

Significance levels: * p<.05; ** p<.01; *** p<.001;

Course level was defined at two levels (undergraduate and graduate). As would be expected, final grades are higher for graduate courses than for undergraduate courses, regardless of the delivery mode. However, there is no significant interaction between mode and course level, thus H3a is not supported by the data.

Table 5 presents the results of the two-way Anova of mode by course level, on perceived learning. In this case, there is a significant interaction effect between condition and level. A post-hoc comparison of the means via a Duncan testing reveals three groups of means: graduates in mixed mode, undergraduates in mixed mode and all the other conditions. This test confirms that graduate students in mixed mode courses report the highest perceptions of learning while undergraduates in the same mode report the lowest, which supports H3b.

Table 5. Two-way Anova on Perceived Learning by Mode and Course Level

	ALN	**FtF+ ALN**	**FtF Only**	***Course Level Means***
Undergrad	26.20 (4.69) [260]	25.47 (4.25) [171]	26.60 (4.92) [481]	*26.27 (4.75) [912]*
Graduate	26.76 (4.67) [109]	27.88 (5.00) [140]	26.41 (4.95) [75]	*27.16 (4.90) [324]*
Condition Means	*26.37 (4.68) [369]*	*26.55 (4.75) [311]*	*26.57 (4.92) [556]*	
	F	**p**		
Model	**4.24**	**<.0008*** **		
Condition	0.14	0.87		
Course Level	8.22	0.004**		
Condition X Level[1]	5.69	0.003**		

Significance levels: * p<.05; ** p<.01; *** p<.001

[1] Duncan tests identified three groups of means: A: Grad in mixed mode; B: Grad in ALN, Grad in FtF, Ungrad in ALN and Ungrad in FtF; C: Ungrad in mixed mode.

In order to determine "course type," the courses were divided into two groups, "technical" and "less technical". The former refers to courses that convey a higher degree of technical knowledge (e.g. calculus, programming languages, operating systems), while the latter contains courses that address more social or managerial subject matters (e.g. Computers and Society, Human-Computer Interfaces, Computer Systems Management and Advanced Information Systems).

Table 6 presents the results of two-way analysis of variance on final course grades by condition and course type. Students in less technical courses received higher grades than those in technical courses, and students in ALN conditions also earned higher grades, but there is no interaction between mode and course type. Therefore, H4a is not supported by the data. In looking at the results for perceived learning by condition and course type, no significant differences in learning perceptions could be attributed to the mode, the course type, or their interaction. Thus, H4b is not supported.

Proceedings of the 35th Annual Hawaii International Conference on System Sciences (HICSS-35'02)
0-7695-1435-9/02 $17.00 © 2002 IEEE

Table 6. Two-way Anova on Final Grades by Mode and Course Type

	ALN	**FtF+ ALN**	**FtF Only**	***Course Type Means***
Technical	3.06 (1.27) [298]	2.54 (0.95) [25]	2.87 (1.16) [462]	*2.93 (1.20) [785]*
Less Technical	3.35 (1.00) [147]	3.21 (1.06) [295]	2.97 (1.04) [246]	*3.15 (1.04) [688]*
Condition Means	*3.16 (1.19) [445]*	*3.16 (1.06) [320]*	*2.90 (1.12) [708]*	
	F	**p**		
Model	**6.90**	**<.0001*** **		
Condition	8.67	.0002***		
Course Type	14.79	.0001***		
Condition X Type	2.80	0.06		

Significance levels: * p<.05; ** p<.01; *** p<.001;

5. Summary, Discussion and Limitations

These findings suggest that students in ALN courses earn higher grades than those in traditional classrooms. Due to the benefits of asynchronous interaction, and continuous learning environments, students are able to perform better. Their learning perception, however, does not seem to be affected by the medium and students report similar perceptions to those for traditional sections.

In terms of grades, female students earned higher grades than their male counterparts regardless of the delivery medium. Likewise, graduate students outperform undergraduates, but this achievement is not affected by the use of an ALN environment. Similarly, students in less technical courses earned higher grades than those in technical courses, but again this is not influenced by the medium. In summary, for grades, there is no significant interaction effect between mode and any of the predicted factors (gender, course level and course type).

Learning perception results are similar across gender and course type. However, there is a significant interaction effect between mode and course level, and graduate students in Face-to-Face courses enhanced with ALN (FtF+ALN) report the highest perceptions of learning. It seems that the combination of FtF contact with asynchronous interaction is especially beneficial for graduate students.

These findings must be analyzed bearing in mind the limitations of the study. First, this was a field experiment where both students and teachers "self-selected" into communication modes for courses. As a consequence, subjects were unevenly distributed among conditions. Second, the study took place at a technological university with a long tradition of ALN courses. Therefore, the results may not be applicable to other institutions that are starting to experiment with the medium. Third, specific implementations of ALN differ in terms of the features included. Different systems may therefore yield somewhat different results. The specific dimensions/features behind the ALN construct should be isolated in future research to see if variations have any impact on outcomes of use.

6. Conclusions

This study advances our understanding of the effects of ALN across a variety of courses at a technological university. Major findings of this research support the notion that students in ALN courses (whether pure ALN or mixed mode) are able to learn as well or better than their counterparts in traditional sections.

Future research should "open up the black box" to investigate what specific characteristics of the ALN medium and which pedagogical techniques help students to earn better grades and be more satisfied in this environment. Other useful avenues of inquiry include the investigation of the mediator factors conducive to successful online environments. Longitudinal quasi-experimental field studies that look at the process as well as the outcome of specific types of learning and assessment activities in closely matched sections of courses using different media would help to explain some of results presented in this study.

7. Acknowledgments

This research was partially supported by the Alfred P. Sloan Foundation, and by the New Jersey Center for Multi-Media Research and the New Jersey Center for Pervasive Information Technology. Among the student research assistants who made substantial contributions to data collection, coding and processing are Beth Mardekian, Chris Rodriguez, Michael Dellavecchia, Yi (Jenny) Zhang, and Hitesh Kshatriya.

Proceedings of the 35th Annual Hawaii International Conference on System Sciences (HICSS-35'02)
0-7695-1435-9/02 $17.00 © 2002 IEEE

8. References

[1] Alavi, M. and Leidner, D.E. (1991). "Research commentary: Technology-mediated learning-- A call for greater depth and breadth of research." *Information Systems Research*, 12, 1 (March), 1-10.

[2] Benbunan-Fich, R. (1999) "Assessing Learning Effectiveness of Asynchronous Computer-Mediated Communication in the Classroom." *Journal of Computer Information Systems*. Vol. XXXIX, n. 4, Summer, 82-97.

[3] Coppola, N., Hiltz, S.R. and Rotter, N. (2001). "Becoming a Virtual Professor: Pedagogical Roles and ALN." *Proceedings of the 34th Hawaii International Conference on Systems Sciences*, IEEE Computer Society Press, Los Alamitos, CA, (Maui, January 3-6, 2001), CD-Rom.

[4] Daft, R.L. and Lengel, R.H., (1986) "Organizational information requirements, media richness, and structural design." *Management Science*, 32, 5, 554-571.

[5] Gay, G., Sturgill, A. Martin, W. and Huttenlocher, D (1999). "Document-centered peer collaborations: An exploration of the educational uses of networked communication technologies." *JCMC*, Vol 4, No 3, (March).

[6] Geffen, D. and Straub, D.W. (1997). "Gender differences in the perception and use of e-mail: An extension to the technology acceptance model." *MIS Quarterly*, 21, 4, 359-388.

[7] Harasim, L.; Hiltz, S. R.; Teles, L. and Turoff, M. (1995). *Learning Networks: A Field Guide to Teaching and Learning Online*. MIT Press, 1995.

[8] Hiltz, S.R. (1986). "The Virtual Classroom: Using Computer-Mediated Communication for University Teaching." *J. of Communication*, 36,2 (Spring): 95-104

[9] Hiltz, S.R. (1994). *The Virtual Classroom: Learning Without Limits Via Computer Networks*. Norwood, NJ, Ablex Publishing, Human-Computer Interaction Series. Currently available from Intellect at www.intellect-net.com.

[10] Hiltz, S.R., Benbunan-Fich, R., Coppola, N., Rotter, N., and Turoff, M.(2000). "Measuring the Importance of Collaborative Learning for the Effectiveness of ALN: A Multi-Measure, Multi-Method Approach." *JALN*, 4, 2. Available online at: http://www.aln.org/alnweb/journal/jaln-vol4issue2-3.htm)

[11] Ory, J., Bullock, C.D., and Burnaska, K.K. (1997). "Gender Similarity in the Use of and Attitudes about ALN in a University Setting." *JALN*, 1, 1.

[12] Rice, R.E., (1992) "Task analyzability, use of new media, and effectiveness; A multi-site exploration of media richness." *Organization Science*, 3, 4 November, 475- 500.

[13] Shea, P., Fredericksen, E., Pickett, A., Pelz, W. and Swan, K. (2001). "Measures of Learning Effectiveness in the SUNY Learning Network." In In J. Bourne an J.C. Moore, eds., *Online Education*, Volume 2: Learning Effectiveness, Faculty Satisfaction and Cost Effectiveness. Needham, MA., Sloan Center for Online Education, pp. 31- 54.

[14] Spencer, D. and Hiltz, S.R. (2001) "Studies of ALN: An Empirical Assessment." *Proceedings of the 34th Hawaii International Conference on Systems Sciences*, IEEE Computer Society Press, Los Alamitos, CA, (Maui, January 3-6, 2001-

[15] Spender, D. (1982). *Invisible Women*. London: The Women's Press.

[16] Stalker, J. (1996). "Women and Adult Education: Rethinking androcentric research." *Adult Education Quarterly*, 46, 2.

[17] Webster, J. and Hackley, P. (1997) "Teaching effectiveness in technology-mediated distance learning." *Academy of Management Journal*, Vol. 40, N. 6, pp. 1282-1309.