

Studies of ALN: An Empirical Assessment

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Abstract

This analysis of research literature seeks to gain insight into the study of the effectiveness of Asynchronous Learning Networks (ALN). A database of material gathered from the papers reporting the studies is described. The current picture of that data is highlighted and discussed. A framework of three sets of factors related to ALN effectiveness is described. Within this framework an analysis of the current collection of papers is offered. From the 15 papers in which the effectiveness of ALN was compared to that for face-to-face classes, 2/3 reported it was more effective, and the remainder reported "no significant difference." Additional papers are expected to be supportive of a need for better research techniques in the ALN community.

1. Introduction

This review of 32 empirical studies of Asynchronous Learning Networks (ALN) is intended to provide a snapshot of how case and field studies are being carried out and what findings are more than singular. This study is a parallel with an earlier assessment of case and field studies of group support systems [2].

The terminology of ALN was coined by the Sloan Foundation to distinguish anytime/anyplace computer-mediated communications (CMC), such as bulletin boards and email, from same time versions of distance learning. Their definition: "Asynchronous Learning Networks (ALN) are people networks for anytime - anywhere learning. ALN combines self-study with substantial, rapid, asynchronous interactivity with others. In ALN learners use computer and communications technologies to work with remote learning resources, including coaches and other learners, but without the requirement to be online at the same time. The most common ALN communication tool is the World Wide Web." (See The Sloan ALN Consortium <http://www.aln.org/alnweb/aln.htm>)

We searched the literature for empirical studies that were of ALN (asynchronous conferencing or email) and

published in English language refereed journals or conference proceedings reporting some findings to a research question.

Though all studies of distance learning use students and teachers as subjects, they are usually not strictly experiments because they lack random assignment to treatment and have internal validity problems such as difficulty measuring outcomes by survey. However, they do have the advantage of good external validity and a large population from which to choose a sample. Many studies of distance learning have been reported, as computer networks become the medium of choice. A large proportion of them are classified as finding "no significant difference" in effectiveness as compared to traditional face-to-face learning [6]. This paper's studies, however, are aimed at comparing just one particular manifestation of distance learning, that is, asynchronous computer mediated classrooms, to traditional on campus classrooms. They can be classified as falling into three types: comparative studies, case studies, and quasi-experiments.

1.1. Comparative Studies

We found studies that were not intended to be controlled experiments, nonetheless measuring results of two modes of teaching. That is, the two modes are each case studies that were compared qualitatively or even, without well-defined hypotheses, quantitatively. In these there is little effort to measure intervening variables or other factors but some comparison and conclusions can be drawn from the cases. The traditional face-to-face mode was considered the control mode, just to compare the two for outcome.

1.2. Case Studies

Reports of the experiences of students and instructors in the semester of one online course are case studies. Some researchers are also the instructor and some are department staff reporting the new thing. A study using the instructor as researcher is classified as 'action'

research, leaving some question as to objectivity but providing greater insight and detail. This was common in case studies reported. Even so, the researcher had expressed a research question that led to the report writing of the case.

1.3. Quasi-experiments

Many studies are purported to be experiments using a control group and defined experimental framework. In these educational contexts the inability to assign subjects randomly to treatment leaves some internal validity missing and thus they are labeled as ‘quasi-experiments’ to caution the reader. The experiment measures independent and intervening factors as well as outcomes in both a qualitative and quantitative style. Analysis of that collected data is expected to entail some statistical reporting and conclusions.

2. Framework

The objective of this study of studies is to give a broad view of work being done in the field of Computer-Mediated Communication (CMC) research as applied to distance learning through ALN. Our research questions are:

- (1) Can the results of studies of ALN be summarized or aggregated as provably significant? The use of ALN can be considered successful if ALN learning outcomes are equal to or better than traditional face-to-face class outcomes. Do the present studies aggregate to a successful outcome when ALN is the teaching mode?
- (2) How often has this comparison been made and if so what is the common result? Is the study of ALN a favorite topic of CMC researchers? Since most researchers are in the academic community, are they investigating the changes in their own community?
- (3) Have various modes of delivering ALN (communication channels, such as synchronous chat, audio conferencing, asynchronous conferencing) been compared and to what extent do some modes result in better outcomes than others?

To give a framework to this research we looked for (and recorded) information in the reports including context, intervening factors, research questions asked, research methodology, and outcomes.

2.1. Context

We looked for class size, subject matter, M/F ratio, age of students and other data about the school and instructor that we consider as possible independent variables in a study. Did the researchers consider any of these

pertinent? Most studies have concentrated on just one factor as the independent variable. Did the researcher use statistical analysis to control for these contextual factors?

Two studies did not report the number of students in the study. Those that did report student numbers usually give the total for each individual class section studied. Eight out of the thirty-one reported the gender totals. The subject matter studied by the students is different for all the studies. Details about the instructor and the school such as experience with ALN were not reported. Generalizing across the thirty-one studies is difficult when it comes to context.

2.2. Intervening Factors:

The general classifications of media type, study method, and class organization are also considered independent variables. Our requirements for asynchronous media include the use of email, asynchronous conferencing, or bulletin boards. The study method was Comparative, Case, or Experimental. Class organizations (or research design) included single classes in the case of some case studies. Multiple classes were either cross-sectional using multiple sections of the same course or the same course studied over time. A few studies used multiple courses over time for the research material and were recorded as multiple cross-sectional.

2.3. Research Questions

We looked for the study’s research questions including purpose of study, goals of the institution and hypotheses. These were sometimes hard to find but crucial to understanding the results of the study. If research questions were not explicitly stated and followed by hypotheses, we looked for general statements that defined the purpose of the paper. This generally could be paraphrased into a research question or expected result. The reported result was often the corroborating evidence of the research question. Goals of the institution setting the reason for the study were seldom reported.

2.4. Outcomes

Results of the study, stated either explicitly in quantitative terms or through qualitative discourse based on the judgment of the researcher, are considered the outcome or dependent variables. These were recorded in reference to the research questions, either stated or inferred.

3. Method

Research on the use of ALN is reported in a broad range of venues. Since ALN is generally used in higher education, educators in the area of the subject matter perform the research to a large degree. Therefore, the reports of the studies are not always in journals and conferences relating to distance learning or CMC in particular. We were able to find these reports of studies by primarily using online search techniques. The refereed online journals also were rich in reports of ALN studies, though not always providing enough information to use here. Much research is conducted in venues other than the standard sociology and information systems areas but is usually too anecdotal to use here.

As we found the papers meeting the acceptance criteria (above) they were read for the information in our framework and that information was entered into a Microsoft Access database. This helped in being consistent in data collection and thorough in the first reading. The database also now is a ready source of data for insertion into a Microsoft Word report in either a complete listing or in summative form. Furthermore the coded data is readily available for statistical analysis. As more papers are added to the collection of this study their entry into the database will update the past reports and statistical data with little extra effort.

4. Analysis

Preliminary analysis reveals serious lack of good research reporting in many of the studies and thus suggests less than adequate research methods. Many studies did not report a research question and hypotheses in a clear and usable manner, though nineteen of the thirty-two did highlight their intent, some even using the H# convention. These hypotheses were recorded verbatim in the database. For the other eleven (37%), we inferred the research question and generated hypotheses to match the reported results. This of course may lead to measurement error on the part of this study but seems unavoidable in the effort of aggregating disparate work.

Twenty (63%) of the papers reported case studies, the rest quasi-experiments, either comparative or multi-section (Table 1). Experiments reported had a control group but did not have the opportunity to randomly assign subjects to treatment at either the student level or the class level. Distance learning students were by dint of location able to attend class only by online access. Most experiments using multiple classes were cross-sectional over one semester. Two experiments studied classes longitudinally though many compared multiple sections over multiple semesters without considering time as an intervening factor.

Table 1. Study Method

	Number of Papers
Comparative	4
Case	20
Experimental	8

No two studies reported the same subject matter in terms of the course being taught. There were a significant number (15) of studies of classes studying management information systems type subject matter such as technology, web development, etc. (Table 2). Many studies were of multiple classes on various subjects. This is a limitation of this study, as we cannot control for subject matter except at a large aggregate level.

Table 2. Subject Matter

	Number of Papers
Management Information Systems	15
Humanities	7
Science and mathematics	3
Various (multiple)	7

Class size was reported in all but one study. The composition of individual classes was generally not reported however when multiple classes were studied. When multiple classes were studied the researchers generally did not consider the class as a unit of study, thus losing an opportunity to analyze groups as entities. The studies were almost evenly divided between the undergraduate and the graduate levels (Table 3).

Table 3. Matriculation Level of Students

	Number of Papers
Undergraduate	18 (56%)
Graduate/Adult	8
MBA	6

Student age and gender were only sporadically reported. Matriculation status could be categorized as undergraduate, masters, or postgraduate in most cases but several studies reported undergraduates of ages ranging from 18 to 40 years. Therefore student age seems not a definable factor. Gender ratio was reported in only eight

(25%) of the studies leaving that factor also without sufficient data for analysis.

ALN technology used was reported in detail in most papers. Most of the studies used computer conferencing or email only, though eleven included some use of synchronous technology (Table 4). Our selection criteria required some form of asynchronous communication, email or bulletin board conference. We also recorded use of synchronous media such as video conferencing, interactive TV, Chat, Video and Audio streaming. When the medium was synchronous we noted if the class was held in a "same room" format. This might have been the case if the class was additionally expected to meet asynchronously via computer conference. Twenty of the thirty-two studies reported the students were campus based and presumably could meet face-to-face. Only one study reported the use of asynchronous video and audio streaming such as recorded lectures.

Table 4. Communication Technology

	Number of Papers
Asynchronous Conferencing	28
Email	25
Synchronous, same room	5
Synchronous Chat	4
Interactive TV	1
Audio Streaming	0
Conference	0
Asynchronous A/V Streaming	1

5. Outcomes

As stated earlier, eleven of the studies did not state a research question or hypothesis to be tested. However these could be inferred from the author's discussion of the context and methods of study. In the six cases of explicit hypothesis statements the outcomes were also clearly stated in such a manner to support the author's conclusions.

We recorded the hypotheses and results verbatim in the case of explicit sources. We generated a short hypothesis for those lacking a concise statement of such and then paraphrased the authors' conclusions as results. For explicitly reported results the detail was such that the reader could easily follow the author's conclusion and implications for theory building. To analyze the aggregate of the hypotheses/results the research questions are grouped in six general categories (Table 5). Some papers report in more than one category.

Table 5. Research Question/Area

	No. of Papers	Face-to-face > ALN	No Significant Difference	Face-to-face < ALN
Technology Effectiveness	15	-	5	10
Administration	2	-	-	2
Cost Efficiency	3	-	2	1
Student Attributes	2	-	2	-
Collaboration	14	1	5	8
Teaching Methods	9	-	1	8

Technology and its effectiveness when used in ALN was the theme when researchers were looking for the addition of CMC per se to alter the outcome of the class. Interestingly, no studies comparing the many commercial CMC applications were seen. This is the category where the theory of adaptive structuration [5] and media synchronicity [1] would have been tested if the researchers were studying CMC. It was a well-represented research question and as Russell [6] has documented still generates some results of 'no significant difference' compared to the non-technology face-to-face tradition. However, in two thirds of the studies for which this data exists (10/15), the ALN condition was judged as more effective, and in no case was it less effective.

Administration of the course or university program was the subject of two studies. This is of interest to the developer of the course and the teacher as facilitator. This was explored from the point of view of the student as a customer and the university management as producer. The theories of strategic management were being tested [3]. Automating the course, as is the trend in online delivery, is a desirable outcome in contrast to traditional delivery in a classroom, from the administrative point of view, since it allows more quality control.

Cost and efficiency are powerful driving forces for any distance-learning program. The issue of teacher-student ratio and the need for capital investment [7] is always behind the scene. In some of these studies, it is the research question. These studies found that the effort to develop the course and to attend to the 24/7 aspects of the conference would likely bring the cost in time and dollars to equal that of the traditional class. With time and experience this may not be the case. Course developers become more expert and the cost of computing is expected to fall.

Gender and student age/maturity are of interest to researchers to alleviate the common belief that they are confounding factors. ALN is most commonly used in higher education and adult education where these factors

may not be as powerful. The two studies for which data on effects of student characteristics are reported, did not find significant differences, so there is no empirical evidence thus far to suspect that they are a confounding factor in other studies.

Collaboration is the subject of many studies that were also investigating other teaching methods. The ability of asynchronous conferencing to support group work has stimulated interest in collaborative learning processes [4]. Interestingly the present studies have not been conclusive on the benefits; though eight find the collaborative methods more effective, five found no statistically significant differences. This may have been due to the newness of the constructivist teaching technique or the newness of the student to working with peers online. In these studies only one found collaboration to be unsuccessful.

The impetus for many reports on ALN is to describe the different teaching methods used when developing a new course for online students. The ALN context allows teaching methods that are difficult in the face-to-face tradition and these studies can show if they will make a difference. All studies investigating teaching methods through ALN found progress being made in student achievement and satisfaction. There is some danger of recreating the Hawthorne Effect by studying this new thing, but results do show the students in the online courses excelling, which is the goal of trying new things.

6. Summary

While noting caveats due to the flawed research procedures used in some studies, the answer to our first research question is: Yes, the results of the various studies can be aggregated into a significant summary. The ALN methods have been judged as more successful than traditional methods in the majority of cases.

It may come as no surprise that nearly all studies report positive results, indicating either no significant difference or some significant advantages of computer mediated distance learning over traditional face-to-face classroom teaching. That may be because there is an advantage to the use of computer mediation or it may be that papers don't get written about studies showing less advantages to ALN. So the answer to our second research question (how many studies?) is likely not answerable except in the sense that those studies reported do report positive results with enough detail to answer what works better.

The answer to the third research question (Have various modes of delivering ALN been compared?) is most definitely, no. The various means of ALN delivery, alone or in combination, have not been compared. This ongoing study may be able to do that in the future by locating and including more papers in the database. We

will continue to search for papers reporting results and to formalize the analysis of the aggregation of those papers.

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8. Appendix: ALN and Related Empirical Studies

These are studies that asked research questions, collected data (qualitative or quantitative), reported results, and were published in a refereed conference proceedings or journal, in the English language. If you have additions to suggest, please let us know.

Study

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9. Appendix: Descriptions of Studies of ALN (partial list)

Author(s), Date, and Title of Teaching Studies Paper				Study Method		Class Size	
				Subject		Age of Students	
				Class Type		M/F Ratio	
Sync Same Room	Async Email	Async Conf	Sync Chat	ITV	Audio Stream	Async A/V	Campus Based
Alavi, 1994, "Computer-Mediated Collaborative Learning: An Empirical Evaluation"				Experimental		127	
				MIS		MBA	
				Multiple Cross-sectional		1.54	
Yes	No	Yes	No	No	No	No	Yes
Alavi, et al., 1997, "Using Information Technology to Add Value to Management Education"				Case		46	
				MIS		MBA	
				Single		-	
Yes	Yes	Yes	No	Yes	No	No	Yes
Andriole, 1997, "Requirement-Driven ALN Course Design, Development, Delivery & Evaluation"				Case		207	
				SA & Design		Masters	
				Multiple Longitudinal		-	
No	Yes	Yes	No	No	No	No	Yes
Arbaugh, 2000, "Virtual classroom versus physical classroom: An exploratory study of class discussion patterns and student learning in an asynchronous internet-based MBA course"				Comparative		60	
				Intro to Management		MBA	
				Multiple Longitudinal		-	
No	Yes	Yes	No	No	No	No	No
Arvan, et al., 1998, "The SCALE Efficiency Projects"				Case		100	
				Various		Undergrad	
				Multiple Cross-sectional		-	
No	Yes	Yes	No	No	No	No	Yes
Benbunan-Fich, et al., 1999, "Impacts of Asynchronous Learning Networks on Individual and Group Problem Solving: A Field Experiment"				Experimental		140	
				Computers and Society		Undergraduate 23-27average	
				Multiple Cross-sectional		-	
No	Yes	Yes	No	No	No	No	No
Blum, 1999, "Gender Differences in Asynchronous Learning in Higher Education: Learning Styles, Participation Barriers and Communication Patterns"				Case		149	
				Various		Over the age of 25	
				Multiple Cross-sectional		1	
No	No	Yes	No	No	No	No	Yes
Bourne, et al., 1997, "Paradigms for On-Line Learning: A Case Study in the Design and Implementation of an Asynchronous Learning Networks (ALN) Course"				Case		83	
				Information Technology		Jun/sen/grad	
				Single		0	
Yes	Yes	Yes	No	No	No	No	No

10. Appendix: Hypotheses and Results (partial list)

Author(s), Date, and Title of ALN Teaching Studies Paper	Hypotheses
Results and Comments	
<p>Alavi, 1994, “Computer-Mediated Collaborative Learning: An Empirical Evaluation”</p>	<p>H1-Student affective reactions to CMC will be more positive than the manual collaborative leaning process. H2-Student self-reported learning will be more positive in the Computer Mediated environment. H3- Student learning interest will be increased by the use of Computer Mediated collaboration.</p>
<p>Data supported the Hypotheses with $p < .05$ in all areas except Perceived Skill where support was at the $p < .001$ level. GDSS contributes to collaborative learning effectiveness by enhancing cooperation and teamwork. Final course grades of the students who were exposed to the computer-mediated collaborative learning were significantly higher than students that did not use computers. The implication of this finding is that the impact of the computer-supported group learning process on student achievement may be cumulative and realized over time.</p>	
<p>Alavi, et al., 1997, “Using Information Technology to Add Value to Management Education”</p>	<p>(1) Value is added by course delivered through two universities sharing faculty and technical resources. (2) Outcomes for in-class student achievement, learning, and satisfaction will be enhanced. (3) Outcomes for out of class will be enhanced. (4) Outcomes for faculty will be enhanced. (5) The cross university course will be more efficient than two individual courses.</p>
<p>Remote and local students in-class activities showed no significant differences in test scores or satisfaction. Means of out of class student satisfaction showed no significant difference from the logical mean suggesting no difference by comparison to face to face meeting. Significant differences were found for students' satisfaction with out of class learning experiences and for participation in out of class learning activities. There were both cognitive and professional impacts on both instructors. Various capital cost and one time setup costs are balanced with savings of achieving more student/instructor contact and use of outside experts via video conferencing.</p>	
<p>Andriole, 1997, “Requirement-Driven ALN Course Design, Development, Delivery & Evaluation”</p>	<p>Requirements driven course design is the best path to an effective ALN.</p>
<p>28% of students preferred interaction times in the daytime. 97% of students felt that they had more access to the instructor in ALN. 80% of students felt that conventional courses were more boring than ALN courses. 67% of students felt that they had more communication with fellow students in ALN courses. 66% of students felt they learned more on the OLN course. 99% of students felt that seeing the ideas and assignments of others was useful.</p>	
<p>Arbaugh, 2000, “Virtual classroom versus physical classrom: An exploratory study of class discussion patterns and student learning in an asynchronous internet-based MBA course”</p>	<p>Compare student participation and interaction. Compare student exam performance.</p>
<p>Participation patterns are significantly different between the two class sections with 70% coming from the internet class. Results show that the internet class scored significantly higher in interaction difficulty, and higher in quality and dynamics. Although the classroom pretest group significantly outperformed the internet pretest scores, there were no significant differences between these groups in the posttest scores.</p>	

<p>Arvan, et al., 1998, “The SCALE Efficiency Projects”</p>	<p>Productivity increases with ALN. Efficiency in student teacher ratios can be achieved with ALN without sacrificing course quality.</p>
<p>The project included ten courses involving 8000 students. Productivity increases were accomplished by using more TA grading and automatic quiz taking. Students indicated that they liked the increased opportunity to interact with the professor who was now relieved from grading. Efficiency gains were achieved in all ALN courses by increasing the enrollment with subjective assessment of no loss of quality. Student outcomes and satisfaction was either increased or not significantly different from the non-ALN sections.</p>	
<p>Benbunan-Fich, et al., 1999, “Impacts of Asynchronous Learning Networks on Individual and Group Problem Solving: A Field Experiment”</p> <p>NOTE: similar results of this study were reported in: Benbunan-Fich, Raquel and Starr Roxanne Hiltz (1998), Learning Effects of Asynchronous Learning Networks: A comparison of Groups and Individuals Solving Ethical Case Scenarios, HICSS, 31st, pp.340-347. and Benbunan-Fich, Raquel and Starr Roxanne Hiltz (1999), Educational Applications of CMC's: Solving Case Studies Through Asynchronous Learning Networks, JCMC, Vol 4, No 3 March, 18p. http://www.ascusc.org/jcmc/vol4/issue3/benbunan-fich.html</p>	<p>H1b: Participants working through an ALN will produce higher quality solutions to the ethical scenarios than will their manual counterparts. H2b: Participants working through an ALN will submit longer reports than their manual counterparts. H2c: ALN-supported groups will produce the longest reports, while individuals working manually will submit the shortest reports. H3b: ALN-supported participants will perceive higher levels of learning than will non-supported participants. H3c: ALN-supported groups will perceive the highest levels of self-reported learning. H3d: ALN- supported and face-to-face groups will report about the same levels of perception of collaborative learning. H4b: Solution satisfaction will be lower for ALN-supported participants than for their manual counterparts. H4c: Individuals working through an ALN will be the least satisfied with their solutions.</p>
<p>This was a 2x2 factorial experiment pitting individual/group factors against manual/online interaction. Since distance learning students were part of the subject pool, assignment randomly was not completely possible as they were only online. Online subjects were significantly older and had more work experience, factors that were used as covariates. H1b: Supported, p<.05 H3c: Supported, p<.05 H2b: Supported, p<.001 H3d: Supported H2c: Supported, p<.01 H4b: Not Supported H3b: Not supported H4c: Not Supported</p>	
<p>Blum, 1999, “Gender Differences in Asynchronous Learning in Higher Education: Learning Styles, Participation Barriers and Communication Patterns”</p>	<p>An equitable learning environment should produce equal amounts of male and female type messages.</p>
<p>Messages in the ALN were male dominate as in FTF interactions. This was an unmoderated general ALN used by all students in the school.</p>	
<p>Bourne, et al., 1997, “Paradigms for On-Line Learning: A Case Study in the Design and Implementation of an Asynchronous Learning Networks (ALN) Course”</p>	<p>ALN is more effective than traditional lecture or laboratory. Peer to peer learning is enhanced through ALN. ALN provides a cost benefit.</p>
<p>Students stopped attending the face to face lectures when they discovered that they could get answers on the conference. Students used the conference at all hours of the day. ALN courses are harder to construct but are scaleable to more students.</p>	