Comparing Student Satisfaction With Distance Education to Traditional Classrooms in Higher Education: A Meta-Analysis

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Meta-analysis provides a method of quantitatively summarizing and comparing empirical literature to reduce Type I and Type II error. The meta-analysis described here indicates a slight student preference for a traditional educational format over a distance education format (average $r = .031$, after the deletion of outliers), and little difference in satisfaction levels. A comparison of distance education methods that include direct interactive links with those that do not include interactive links demonstrates no difference in satisfaction levels. However, student satisfaction levels diminish as additional information is added to the available channel of instruction (e.g., written to audio to video). The findings support those of researchers arguing that distance education does not diminish the level of student satisfaction when compared to traditional face-to-face methods of instruction.
Early research dealing with user impressions of rudimentary audio and video teleconferencing technologies did not show particularly strong user satisfaction when compared with face-to-face communication (Fowler and Wackerbarth 1980; Ryan 1976; Williams 1978). Yet, there were clear differences between the three communication modalities. Williams (1978), for example, noted that nearly 50% of the face-to-face meetings could be substituted with audio or video conferences with little negative reactance from participants. Ryan (1976) found that both videoconferencing and face-to-face communication modes were perceived as more aesthetically positive than audio conferencing. However, both technical mediums, video and audio conferencing, were perceived as more "potent" communication channels than face-to-face communication. Mediated channels in Ryan’s (1976) study evoked a greater sense of social distance and formality (very common reactions to communication technology) even though they represented a somewhat narrower signal (stimulus) bandwidth than face-to-face communication. Finally, Hackman and Walker (1990) noted that the technology can influence learning outcomes. Students participating in interactive television classes indicated more satisfaction with the technological experience when it worked well and did not impede channel transferences. However, course and instructor satisfaction were only positively correlated with amount of information conveyed and contact with the instructor.

Besides perceptions of the technologies, various human factors (e.g., personality, attitudes, skill) emerge to influence user reactions to communication technologies used in distance education. Early research on computer-mediated communication conferencing systems showed that user attitudes toward the technology, prior use experience, and skill positively affected user satisfaction with participating in computer conferencing (Kerr and Hiltz 1982). Application of similar technologies to the university classroom (creating the so-called "virtual classroom") with more experienced and extensively oriented students produced strong correlations between positive evaluative attributes about the experience and learning outcomes (Hiltz 1986). User experience played a similar role in Althaus's (1997) study of students involved in online electronic mail discussion groups devised to support traditional classroom instruction. Students with more computer experience were more likely to use the online discussion groups and perceive them as beneficial. Similarly, Cody et al. (1999) reported a connection between the extent of mentoring experiences used in training and subsequent use of the Internet in a group of elderly adult learners. Scott and Rockwell (1997) noted the opposite trends for self-reported likelihood and use of new communication technologies and both computer
apprehension and communication-bound apprehension. Higher scores on the anxiety measures were negatively correlated with use preferences.

The move to distance learning should be accomplished more easily if people’s perceptions are that the media meet important class objectives. Generally, students are inexperienced with using technology, particularly educational technology (Merisotis and Phipps 1999). Students may resist the use of technology for several reasons: technology seems more likely to break down, students may be unused to working with machines, and students may feel that the mediated experience cannot fully replace the live classroom.

On the other hand, videotapes can be played at the convenience of the student and replayed to make images and explanations clear. The student can reflect on material and then review the portions of the relevant information as necessary. Further, the setting for viewing can be private, permit informality, and require less travel and the need for scheduling. Thus, some people may prefer the distance learning option because of certain advantages that a virtual or a distance classroom provides.

Meta-Analysis as a Method for Synthesizing Literature

Meta-analysis provides a method to combine statistical results across investigations (Hunter and Schmidt 1990). Meta-analysis provides a form of literature review that is potentially systematic and comprehensive. The advantage of a meta-analysis over traditional narrative reviews is that other scholars can replicate the analysis to verify the accuracy of the review (Cook and Leviton 1980; Cooper and Rosenthal 1980). The commitment to explicit rules for the analysis provides a form of literature review that offers a greater degree of agreement and/or some additional certainty about the outcomes of scientific research. The application of meta-analysis to distance education (Machtmes and Asher 2000) finds that two-way learning provides the most effective instruction (as measured by learner achievement).

The central goal of meta-analysis should be the reduction of Type II error (false negatives or concluding no association exists when, in fact, there is an association) and the identification of Type I error rates (false positives or concluding an association does exist when in fact no association does exist). The problem of Type II error consists of some combination of three factors: (a) level of Type I error, (b) size of the effect, and (c) sample size. Of these, the researcher affects only the size of the sample. Individual investigators when conducting research typically have about a 50% Type II
error rate (Hunter and Schmidt 1990). Meta-analysis, by averaging effects, generates an average effect across the body of research. This average effect has as its parameters an estimate based on the combined sample of the various studies.

Inconsistent bodies of literature may rely on significance tests and the associated level of Type II error or false negative rate. A meta-analysis can provide a sense of consistency, particularly after eliminating artifacts like attenuated measurement, restriction in range, regression to the mean, and sampling error. By reducing or eliminating these sources of differences between studies, the averaging and comparison of effects can generate a more accurate picture of the available research.

Methods

Literature Search Procedures

The Educational Resource Information Clearinghouse (ERIC) as well as SocioInfo (Index for the field of Sociology), Psychlit (Index for publications in Psychology), and ComIndex (publications in the field of communication) were searched using an electronic system with the key words "distance learning," "distance education," and "satisfaction" to find available sources on the topic. A manual search was conducted of the complete collection of two journals—Distance Education and The American Journal of Distance Education—to discover additional citations. Approximately 450 manuscripts were considered and obtained for possible use in this investigation (those used are marked in the references with an asterisk).

For inclusion in this review an investigation had to compare the student satisfaction with a distance education course to a course using traditional face-to-face methods of instruction. Many of the manuscripts obtained dealt with issues not related to student satisfaction or provided descriptions of programs and equipment. Investigations that did not include a control group or that reported a case study of the distance education were not included in this analysis (Biner, Dean, and Mellinger 1994; Biner et al. 1996; Biner et al. 1997; Birkenholz and Schumacher 1995; Boverie 1997; Franks 1996; Fulford and Zhang 1993; Gunawardena and Zittle 1997; Hackman and Walker 1990; Hansford and Baker 1990). Some investigations did not report sufficient statistical information to permit the calculation of an effect size and therefore could not be included in this summary (Boucher and Barron 1986; Souder 1993). Surveys about attitudes of administrators and teachers toward the use of distance education were not included since the
focus of this synthesis is the examination of the students’ reaction to inclusion in this pedagogy rather than the view of the instructional staff or administrators (Clark 1993). Studies examining persistence were not included, even though this may be an indication of satisfaction (Fjortoft 1995, 1996).

**Coding for Potential Sources of Moderation**

*Type of Media Used to Convey Information*

Distance education courses can take a variety of forms. The simplest form is that of a correspondence course that is conducted entirely through an exchange of written messages. There is no face-to-face, audio, or video communication. Some distance education is conducted using audio or video via some type of broadcast facility. The difference between those broadcasts that are taped versus those that are live should be considered.

The coding treats the use of writing, audio, and video represents a hierarchy of channels—that is, audio education would also include written information provided to and from the student. Similarly, the video information will, in addition, use audio and written materials. In this coding scheme, it is assumed that the more complex channel also utilizes the lower channels along with the more complex source of information.

Coding is conducted in this manner because the expectation is that students will demonstrate higher levels of satisfaction with channels that contain more information. If live instruction is rated highest in satisfaction, then as each channel is removed, the expectation would be that the level of satisfaction would decrease with the alternative technology, indicating that it is the amount of information that is connected to the level of satisfaction. Table 1 contains the relevant statistical and other information used in this meta-analysis.

*Presence and Type of Interactivity*

Some distance education is noninteractive during the learning. For example, in a correspondence course, there is some level of interaction, but the interaction is delayed and mediated. On the other hand, distance education could take the form of a live educational forum in which the participants are not physically present but with a simultaneous broadcast of both video and audio information to the learners. Similarly, there are educational forums where the instruction is conducted in video with interaction occurring once a month over the phone in satellite classrooms.
<table>
<thead>
<tr>
<th>Study</th>
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<th>Effect</th>
<th>Sample Size</th>
<th>Type of Situation</th>
<th>Presence of Interaction</th>
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<td>+0.129</td>
<td>239</td>
<td>Audio/writing</td>
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</table>

Note: The presence of interaction is considered NI—not possible; I—was used and includes both audio and video channels; or LI—limited interaction, usually the use of e-mail or audio feedback during class. The term average indicates the estimate for the study averaging across multiple situations.
Distance education can be synchronous but limited in terms of sensory inputs. For example, a class may be broadcast live, but the distance students are not physically present to participate, with communication limited to audio or written text (e-mail) with the instructor. The interaction is simultaneous; the instructor can interact using only a restricted channel of communication.

*Type and Assumptions of the Statistical Analysis*

The analysis was conducted using a variance-centered form of analysis (Hunter and Schmidt 1990). Meta-analysis involves three steps after acquiring the manuscripts. The first step is the transformation of the statistical information in the manuscript to a common metric (in this case the Pearson correlation coefficient), correcting for various artifacts (restriction in range, attenuated measurement, dichotomization of continuous variables, and regression to the mean as required), and removing outliers as necessary. The second step involves the process of averaging the effects using a weighting procedure that considers the sample size of the estimate. The final step is the consideration of the variability in the sample of findings. The test is for the homogeneity of the sample of effects averaged (the formula used in this investigation is $\chi^2 = \Sigma [r - \text{average } r]^2 \times [n - 3]$). The divergence in the estimates used to produce the average should differ on the basis of sampling error rather than any other characteristic. Homogeneity is indicated by a nonsignificant chi-square, which means that the differences between the correlations can be explained as a result of sampling error.

*Results*

The overall analysis indicates that students indicate a slightly higher level of satisfaction with live course setting than distance education formats (average $r = .031$, $k = 25$, $N = 4702$)\textsuperscript{1} based on a heterogeneous set of correlations $\chi^2 (24, N = 4702) = 138.29$, $p < .05$. The effect should be interpreted cautiously because the existence of moderating variables or outliers may be the basis for the excess variability found in the sample of correlations.

An examination for outlier studies found three (Köymen 1992; Hammond 1997; Treagust, Waldrip, and Horley 1993).\textsuperscript{2} A reanalysis of the data after removal of these three studies generates a higher average correlation (average $r = .090$, $k = 22$, $N = 3866$) and the sample of correlations is homogeneous $\chi^2 (21, N = 3866) = 27.21$, $p > .05$. The result indicates that
after removal of outliers there is homogeneity, so no evidence exists for the impact of a moderator variable.

**Effects of Channel of Communication**

The three primary channels of communication (video, audio, and written) were examined separately. The effect size indicates the degree to which there is a relative advantage for the use of traditional face-to-face communication in the setting.

There were not enough studies using only audio in distance education to treat that group as a separate unit. Therefore, the analysis considers only the use of video versus written channels of communication. The effect size comparison for the video channel indicates a very small correlation favoring the distance education group \( (average \ r = -.006, \ k = 23, \ N = 4277) \) based on a heterogeneous set of findings, \( \chi^2 (22, N = 4277) = 89.81, p < .05 \). When the analysis is conducted excluding the relevant outliers (Köymen 1992; Hammond 1997) the analysis is changed to favor slightly the traditional education group \( (average \ r = +.047, \ k = 20, \ N = 3483) \) using a homogeneous set of studies \( \chi^2 (19, N = 3483) = 26.85, p > .05 \).

The use of written communication or correspondence (this included faxes and e-mail) demonstrates a much larger effect \( (average \ r = +.247, \ k = 4, N = 255) \) based on a homogeneous set of effects. No outliers were found in this sample; therefore, no studies were removed for a subsequent analysis. The comparison of written communication to the videotaped instruction indicates that as the information in the channel is reduced, students indicate a preference for video over the written instruction. This is consistent with a hypothesis that the ability to get more information, including visualization of the instructor, is a preferred method of instruction over more restricted channels.

**Effects of the Presence or Absence of Interaction in Setting**

The presence or absence of the ability of students to interact with instructors during the sessions was analyzed. Although some distance education uses a videotape method where the student cannot directly interact with the instructor, other methods offer some type of interaction that may include a two-way audio/visual signal or a telephone or other audio feedback method. Some forms of feedback exist that are limited; for example, a feedback method may be used only once a month, or the feedback may be
using e-mail during conferences just after the video session. The issue is whether the level of student satisfaction is effected by the presence or absence of such direct methods of feedback to the instructor.

Examining a Combination of Channel and Availability of Interaction

The previous analysis runs contrary to the expectation that the level of interaction constitutes a fundamental factor in the evaluation of the distance education technology. One would reasonably expect that the more interactive the media, the more desirable the person would find the experience. This analysis attempts to examine the interactivity of the experience and the issue of the particular channel of communication used. There are only enough studies that used a video channel of communication to examine the impact of various levels of interaction. Both the Köymen (1992) and Hammond (1997) studies were not included in this analysis since both studies consistently tested as outliers.

Full interactive audio/visual demonstrates the largest difference in effect (average $r = +.078, k = 12, N = 2476$). This is followed by the limited interaction group (average $r = +.049, k = 3, N = 421$) and then the no-interaction group (average $r = +.029, k = 5, N = 674$). All three groups demonstrate homogeneity in the samples of correlations (full interaction, $\chi^2 [11, N = 2476] = 16.72, p > .05$; limited interaction, $\chi^2 [3, N = 421] = 2.00, p > .05$; and no interaction, $\chi^2 [4, N = 674] = 7.41, p > .05$). This finding, while consistent with the earlier outcomes dealing with the impact of interaction, is inconsistent with what most scholars would normally expect.

Discussion

In general, the replacement of traditional face-to-face education with distance education technology should demonstrate little decline in student satisfaction with the quality of the educational process. The arguments in favor of the use of distance education should be cognizant of the outcome that suggests little difference in student satisfaction as a probable outcome of the procedure. One of the studies that found students favoring distance education over traditional methods admitted that the move to distance education was made because the conditions of traditional education were so poor that to provide access to what was a limited facility may have improved the quality of access and that may have resonated with the students (Köymen 1992).
Several unanswered questions remain when interpreting and applying these findings. First, is there a difference in performance when comparing students on the basis of distance education? It is entirely possible that the students, while equally satisfied with participation in distance education, do not learn as much as those methods involving traditional face-to-face communication in a traditional classroom. Satisfaction with the educational process provides only one possible source of evaluation and must be compared to other evaluations of the effectiveness of any pedagogical device or procedure. In the case of distance education, the technological requirements and other alternatives require consideration of the various outcomes that the technique may produce. A meta-analysis by Machtimes and Asher (2000) indicates little difference between the two methods across nineteen studies. This summary provides evidence that distance learning offers as much academic improvement as traditional learning environments.

Second, learning style may impact as a form of individual difference on the issues of distance education. One student may prefer distance education while another has a strong negative reaction to it. The link to student style of learning may indicate the need for diagnosis or providing a course in multiple formats. The issue then becomes a matter of identifying those students who work better in a noninteractive or other environment and tailoring the educational procedures to the style that would best serve the student in maximizing the amount of learning. The administrative issues are serious since there would exist a need to consider the "match" between the student and the particular instructional format. The current diagnostic tools and the implementation of this as a general procedure and the subsequent effects are currently unknown. The effectiveness of simply providing students the option to self-diagnose a learning style and indicate a format preference is unknown. A student may choose a format because it appears to provide an "easier" or more convenient set of options rather than selecting a format that would maximize the potential success of that student. The focus on learning styles requires an additional commitment by the educational institution to define what is meant by a success.

Third, the cost-effectiveness of existing programs should be examined. One issue pertinent to higher education is comparing the cost of providing distance education to students to more traditional classroom methods. Cost must be considered in a variety of issues and not simply the cost to the institution of instruction but also the cost of transportation and relocation, as a school might not be proximal to a student population.
The data summarized in this report conclude that students show little preference for a live classroom to distance education. To the degree that student satisfaction plays a major role in the assessment or evaluation of instructional effectiveness, distance learning represents a format that students evaluate comparably to other potential formats for a course. The objections to distance education should not be based on the issues related to student satisfaction; students find distance learning as satisfactory as traditional classroom learning formats.

Note

1. $k$ indicates the number of samples used to estimate the average effect. $N$ refers to the combined sample size.
2. Deletion of the Köymen (1992) study should not be surprising. Köymen notes that the move to distance education was motivated by a desire to expand the educational system "forced to work beyond its capacity and it thus became inefficient and of lower quality" (108). Basically, the traditional educational system is overcrowded and losing quality; distance education offers students a potential alternative. Viewed in that context, it is not surprising that distance education students view the system as more desirable than traditional methods of education.

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Asterisk indicates a manuscript contributing data used in the analysis.


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