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ABSTRACT

The purpose of this study was to determine whether asynchrony between audio and visual presentation in distance education classes had an impact on student perceptions of distance learning and student achievement. Six distance education courses, all in different disciplines, were taught from six different locations to a minimum of one satellite location. Over 115 students from these classes filled out a 42-item post-course questionnaire. In addition to demographic data, two constructs emerged from the questionnaire. One construct was labeled "metacognition." The second construct, "technology," is the focus of this paper. This construct was found to have predictive value in: (1) determining whether students would enroll in future distance education courses; (2) determining whether they would recommend such courses to other students; and (3) predicting their final grade. Questions dealing specifically with asynchronous audio/video presentation of distance education classes revealed that there was no measurable impact of the asynchrony on student perception of performance, nor their willingness to register for future distance education courses. Further quantitative statistical analyses were conducted to explore other areas which might prove helpful in formulating future distance education classes. The Factor Loadings pattern matrix is appended. Contains 11 references. (Author/AEF)

Running Head: USING ASYNCHRONOUS VIDEO IN DISTANCE LEARNING

Implications of Using Asynchronous Video in Distance Learning

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Abstract

The purpose of this study was to determine whether asynchrony between audio and visual presentation in distance education classes had an impact on student perceptions of distance learning and student achievement. Six distance education courses, all in different disciplines, were taught from six different locations to a minimum of one satellite location. Over 115 students from these classes filled out a 42 item post-course questionnaire. In addition to demographic data, two constructs emerged from the questionnaire. One construct was labeled "metacognition". This construct, though critical to learning, is not the focus of this paper. Central to this study is the other construct. This construct, labeled "technology", was found to have predictive value in: a) determining whether students would enroll in future distance education courses; b) whether they would recommend such courses to other students, and, c) in predicting their final grade. Questions dealing specifically with asynchronous audio/video presentation of distance education classes revealed that there was no measurable impact of the asynchrony on student perception of performance, nor their willingness to register for future distance education courses. Further quantitative statistical analyses were conducted to explore other areas which might prove helpful in formulating future distance education classes.

Implications of Using Asynchronous Video in Distance Learning

Introduction

Distance education could be said to have existed since before recorded time began. If the only requirement for learning to be distance education is that learners are time and/or location removed from the instructor, then distance education has been a form of learning since the written word was first transcribed. Modern distance education, however, is credited with a 150 year history, being identified with mail correspondence in nineteenth century Europe (Klesius, Homan, & Thompson, 1997). These days modern technologies offer educational possibilities for distance education that were undreamed of 150 years ago. Educational technology has stretched educational boundaries and created new ones on a daily basis. If, as numerous researchers and educators contend (Barker & Dickson, 1996; Miller, 1997; Yellen, 1998), distance education is a new, student centered paradigm for future learning that is growing exponentially, then this method of instruction should be as easy to use and understand as educators can make it.

Moore and Kearsley (1996) report that "In the past it was not unusual for noncompletion (also referred to as "dropout") rates for distance learning courses to be in the range of 30 to 50 percent; nowadays the figure should be near the lower end of that range" (p.159). The goal, it would seem, would be to raise the completion rate for distance education courses. User-friendly technology is one method of accomplishing that goal.

Though technology is not the message, it is a tool that carries the message. As in most everything else, the better the tool and the better the tool fits the task, the better the final product. "The technical design of course delivery seems at least as important as curriculum design, because technical problems can doom even the best designed curriculum" (Roblyer, 1998, p. 34).

Extrapolating then, technology, if properly chosen and matched to the task, can enhance pedagogy and affect learning (Ahern, 1996; Tennyson, 1994).

Does the old adage "One picture is worth a thousand words" apply to distance education? Reeves and Nass (1996) believe that it does and have developed an equation that states "media = real life" (p. 5). In other words, we equate mediated and real life. They state that the media equation applies to everyone and is highly consequential. Further in their book they dissect various aspects of media, in particular the audio and video. Reeves and Nass (1996) postulate that the most important component of any media, with regard to getting the message across, is the audio portion. Accordingly, the fidelity of the audio is the most critical component of media. Though other aspects of media may not need to be "true to life", audio must be. Next in criticality is video. The closer the video is to the real thing and the more natural the movement of the subject, the more the audience can "get into" the presentation. They would then suspend their belief that it is, indeed, a video display and treat it more as an experience in which they are participating.

A critical component of media is synchrony. Synchrony in media equals real life. Asynchrony, between audio and video, does not equal real life, it is unnatural. "Certain alterations to reality can be accomplished only in media, and this manufactured reality is, like poor audio fidelity, something for recipients of media presentations to reckon with. The new reality, rather than being attributed to technology, is instead taken as something natural but wrong. And in media, as in real life, strange occurrences are evaluated negatively" (Reeves & Nass, 1996, p.215).

Actually, there are two schools of thought as to how asynchronous video will affect the audience. The first holds that viewers will concentrate on the content and be able to ignore the imperfections due to asynchrony and that there will be no negative affect on the viewers. The

second says that though people can discount the technological problems of asynchrony, the unusual psychological experience of asynchronous video cannot be ignored and will negatively impact the viewer (Reeves & Nass, 1996).

This research set out to determine the effects on students of audio/video asynchrony. There were three aspects/questions to this study:

1) Did students perceive asynchronous audio/video to have an effect on their performance?

2) Did the technology used in the distance education courses affect students' willingness to enroll in another distance education course?

3) More importantly, after completing these distance education courses, would students recommend that other students enroll in distance education courses?

Methods

Sample

The sample for this study encompassed 159 undergraduate and graduate students enrolled in six different courses taught at a distance from six geographically separate University of Connecticut campuses. Very important in this study was the fact that the courses were spread across several academic specialties encompassing science and social science content areas; Public Health, Computer Science, Mathematics, Marine Science, Psychology, and Social Work. Though not a random sample, the breadth of courses encompassed by this study would have reduced error that might have been found if only sampling from one academic discipline, such as Computer Science. Additionally, the fact that each course was taught by a different instructor was seen to reduce instructor influence on the results of the study. Each course lasted 13 weeks. Some courses were transmitted to only one site while others were transmitted to as many as three sites. A pre-course questionnaire was completed by 97 students and a post-course questionnaire by 120

students. Only the post-course questionnaire was used for this study. No minority data was gathered.

The sample was 60% female/40% male; ranging in age from 17-20 to 50+. There was almost a perfect split at age 29 with 51% being 29 years of age or younger. When asked if they had ever taken another distance education course, 75% of the students responded that this was their first one. Because the professors traveled and transmitted from each site, all students in this sample experienced distance education through the use of *PictureTel*®.

Equipment

During the time period of this study the *PictureTel*® "switched 56 system" was used at the University of Connecticut. "Switched 56 system" employs two T-1 phone lines and delivers audio and video signals at 256 kbps (kilo bites per second). The system delivered real time, constant audio. Normal video, such as television, is transmitted at 30 frames per second, however, the *PictureTel*® equipment could only deliver video at half that speed (15 frames per second). The result was video that was broken, choppy, and jerky. This was most evident in lectures where the professors' physical actions and lip movements were asynchronous to the audio.

Instrumentation

The post course questionnaire was the third iteration of an instrument developed by one of the researchers for use in evaluating technology effects and student affective traits in distance education courses (King, Harnar, & Brown, in press). The current instrument was formulated by modifying an instrument previously used for another distance education class, adapting question used by another questionnaire that measured self-regulation in study habits (Travers, 1998), and by developing new questions in the areas of technology, self-regulation and self-efficacy. Again,

for the purposes of this study we will only address the results from the technology and demographic portions of the questionnaire.

Content validity for each of the questionnaire iterations was determined using professors and graduate students experienced in the areas of technology and metacognitive processes. Based on their ratings and recommendations the final instrument consisted of a total of 42 items; six were demographic, five were yes/no, 30 were Likert scale items, and one was a grade prediction question.

Results

Data Analysis

The data were first analyzed using SPSS 8.0/9.0 descriptive procedures (e.g., frequencies, percentages, means, and standard deviations). Common factor analysis followed by an oblique rotation (oblimin) was used to extract constructs from the data set. Two constructs emerged. Cronbach's alpha internal reliability was then used to check the reliability of the two factors and to aid in reducing items while optimizing reliability. To determine if the asynchronous video had an effect on students' perception of performance correlation and regression analysis were used. Discriminant function analysis was run to determine if students' willingness to enroll in future distance education classes could be predicted. Independent samples t-tests were conducted to determine if students would recommend distance education courses to others. Chi-square analyses were used to determine if those students presently enrolled in distance education courses would enroll in future distance education courses. Independent samples t-tests were constructed to see if gender was significant in either of the two constructs. List-wise deletion was used in each statistical procedure.

Construct Validity

First, principle axis factoring was used to determine construct validity scores on the distance education questionnaire. Two underlying factors eventually emerged and were labeled "metacognition" and "technology." (The technology factor was student perception of the use and perceived impact of various technological components.) The questionnaire items and loadings on each of the two factors are found in the Appendix. The correlation between the two factors was low (Table 1) and the factors were, therefore, determined to be statistically independent of each other and did not need to be collapsed into a single factor.

Table 1.

Factor Correlation Matrix

Factor	1	2
1	1.000	.137
2	.137	1.000

Reliability analysis was then performed for the technology factor to determine if the instrument's scores proved a reliable assessment of the characteristic. Original analysis was conducted using 10 items and resulted in an internal reliability of α =.72. This reliability did not meet the researchers' desired minimum reliability of α = .80 (Gable,1993). Dropping one item (#32), based on a predicted increase in alpha if the item was deleted, resulted in Cronbach's alpha internal consistency for the 9 remaining items meeting the minimum (α =.82). No further item deletions were predicted to improve alpha reliability. Table 2 lists the items which comprised the technology construct and their associated means, standard deviations, and loading values.

Table 2.

Technology Construct

Items	Mean	SD	Loading
(Q12) In-class interaction between professor and students was sufficient using distance education.	3.32	1.20	.650
(Q14) The audio was clear and understandable.	3.37	1.11	.573
(Q17) I am pleased that this was a distance education class.	2.84	1.19	.548
(Q19) Video motion was distracting. (reverse scored)	3.82	1.03	.506
(Q21) The video of computer software, such as PowerPoint slides, was clear and readable.	3.29	1.24	.538
(Q23) I felt comfortable asking questions in class using the technology of distance education.	3.86	1.11	.564
(Q24) I enjoyed this class.	4.29	0.90	.643
(Q26) Considering the technology, the instructor did a good job in managing the class.	3.27	1.23	.703
(Q29) I found this class more difficult because it was a distance education class	3.25	1.26	.565

Two questions directly addressed the question of asynchronous video and audio. The first item "Video motion was distracting" was reverse scored and loaded on the technology factor when factor analysis was conducted (see Table 2). The second item, "Video motion became less distracting as the semester progressed," did not load on either factor. Though the two questions were significantly correlated with each other (r = .253 p<.05), regression analysis highlighted the fact that neither question predicted student success, or lack thereof, in the distance education courses (p=.54 and p=.40 respectively).

Factor score variables were computed for each student using the arithmetic mean of items comprising that factor. As stated earlier, 120 students participated in the post-course survey. Using the factor score variables, a total of 117 cases were used in a discriminate function analysis (DFA) to determine if the two underlying factors could correctly classify those students that would enroll in future distance education courses. The metacognition factor contributed little to this prediction. However, the technology factor was found to be 78% accurate (Table 3) in predicting those respondents who indicated that they would take another distance education course in the future. This finding was significant at $p<.001$ with an effect size of .26. (Predictive accuracy did not increase when both factors were used in the DFA.)

Table 3.

Classification Results [a]

Would you take another distance education course if it were offered?		Predicted Group Membership Yes	No	TOTAL
Count	Yes	63	18	81
	No	11	25	36
	Ungrouped cases	1	2	3
%	Yes	77.8	22.2	
	No	30.6	69.4	
	Ungrouped Cases	33.6	66.7	

a. 75.2% of original grouped cases correctly classified.

To further validate this statistic, beyond the automatically run jackknife procedure, a cross validation DFA was accomplished using 50% random selection of the sample. These results (Table 4) were significant at $p<.001$ with an effect size of .25.

Table 4.

Cross Validation Classification Results [a,b]

Would you take another distance education course if it were offered?			Predicted Group Membership Yes	No	TOTAL
Cases Not Selected	Count	Yes	28	10	38
		No	3	11	14
		Ungrouped Cases	0	1	1
	%	Yes	73.7	26.3	
		No	21.4	78.6	
		Ungrouped Cases	0.0	100.0	

76.9% of selected original grouped cases correctly classified.

a. 75.0% of unselected original grouped cases correctly classified.

As can be seen by comparing the two tables, the DFA remains stable and prediction rates remain good for determining who will take future distance education courses based on the technology construct.

Further statistical analysis of the data was conducted to attempt to obtain findings that would benefit and improve distance education classes. Using the technology factor, demographic data, and final course grades some interesting data were revealed.

Independent samples t-tests were run to determine if gender was significant for either factor. Gender was found to be significant for the metacognition factor (t_{119}=-2.08, p=.04). However, gender was not found to be statistically significant for the technology construct (t_{119}=1.05, p=.30).

Independent samples t-tests were run to determine which participants might recommend a distance education course to their friends. Gender was not significant (t_{114}=.37, p=.72)in this case. Additionally, having taken a previous distance education course was not significant (t_{114}=1.31, p=.19). However, if the participant indicated that they would take another distance education

course themselves, then were more likely to recommend a distance education course to their friends (t_{113}=4.26, p<.001).

Chi-square analysis of categorical data was accomplished to determine who might take future distance education courses. These tests revealed that:

a. Gender was not significant in determining if a participant would take another distance education course (X^2=.78, p=.38)

b. Moore and Kearsley (1996) state that successful completion of other distance education courses is a good predictor of students who are likely to complete subsequent courses. Their thesis was supported in this study. Those participants that had previously taken a distance education course were more likely to enroll in another distance education course in the future (X^2=7.55, p=.006).

Lastly, regression analysis was conducted to determine if the two factors predicted success in the courses offered, as measured by final grade. Due to listwise deletion only 66 cases were used in the computation. Overall the results were statistically significant ($F_{2,66}$=4.28, p,<.05). The major contribution to the regression was made by the technology factor as shown in table 5.

Table 5.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Significance
Technology	.342	.117	.346	2.925	.005
Metacognition	2.44E-04	.139	.000	.002	.999

Discussion

Using the three questions posited at the beginning of this paper, what can we determine? Did the asynchrony between the audio and video affect the participants' perception of their performance in the distance education courses? What effects did technology have with regards to enrolling in more distance education courses and/or recommending distance education courses to others?

First, the findings suggest the asynchrony between the audio and video had no affect on student achievement as measured by final grades. The participants self-reported attitude toward the asynchronous audio/video connection illustrated that the students did not regard this problem as serious or distracting.

Once the technology factor was extracted it proved to be the major predictor in:

1. Whether students would enroll in future distance education courses;
2. Whether a student would recommend a distance education course to others;
3. Student achievement as measured by final grade.

Gender did not affect how a student rated the technology used in the distance education courses. Likewise, gender was not a contributing factor in whether students would take another distance education course or recommend one to another student. Finally, gender played no part in student success in coursework as measured by final grade.

As anticipated (Moore & Kearsley, 1996) having taken a distance education course previously was a significant predictor of those who said that they would take another distance education course. The fact that students indicated that they would take another distance education course was also significant in predicting whether a student would recommend distance education courses to other people.

Asynchrony between the audio and video did not turn out to be a factor in the distance education equation, as had been anticipated. Students' perception of their course achievement was not affected by the asynchrony.

The technology construct, though pretty strong, can be improved. Future questionnaires used for distance education will modify and add questions to this instrument until the alpha reliability approaches .90.

Lastly, the overall technology construct was a predictor of student achievement even if the two asynchrony questions, by themselves, were not.

Future Research

Much has been written about distance education, most of it deals with synchronous distance education courses. Numerous studies have shown that synchronous distance education parallels classroom education in almost every respect. The intense interest in synchronous distance education has also led to an increased interest in asynchronous distance education. In asynchronous distance education the student and the instructor are separated by time and distance, or as Barker and Dickson (1996) write "Asynchronous programs are both *time* and *distance* insensitive" (p. 20). One need only "surf" the World Wide Web to find out how popular and numerous asynchronous distance education courses have become.

Research in asynchronous distance education is sparse, especially the interaction of pedagogy, instructional design, technology, and learner characteristics. What makes a good, asynchronous, distance education course? How do you measure it? Given the popularity of this type of distance education and its probable benefits to students, this is where future distance education research should concentrate.

Appendix

Pattern Matrix – Factor Loadings

Item	Factor	
	1 (Metacognition)	2 (Technology)
Q12		.650
Q13	.485	
Q14		.573
Q15	.234	
Q16	.574	
Q17		.548
Q18	.358	
Q19*		.506
Q20	.235	
Q20A	.715	
Q21		.538
Q22	.538	
Q23		.564
Q24		.643
Q25		.368
Q26		.703
Q27	.432	
Q28	.305	
Q29		.565
Q30	.466	
Q31	.559	
Q32		.475
Q33	.464	
Q34	.541	
Q35	.689	
Q36	.576	
Q37	.517	
Q38	-.355	

Extraction Method: Principal Axis Factoring
Rotation Method: Oblimin with Kaiser Normalization
a. Rotation Converged in 6 iterations.
*Q19 Reflected

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