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A QUANTITATIVE ANALYSIS OF INSTRUCTOR-STUDENT VERBAL INTERACTION IN A TWO-WAY AUDIO TWO-WAY VIDEO DISTANCE EDUCATION SETTING

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Abstract

The purpose of this study was to establish a quantitative baseline analysis and description of the verbal interaction between instructors and students in simultaneous two-way audio and video distance education settings. Additionally, the nature of the interactions of students and instructors based upon their physical location in this distance learning environment was investigated The design was causal-comparative with data collected using observational methods, distinguished by a lack of random assignment of subjects and nonequivalent groups. The sample was purposefully drawn from classes taught over a videoconferencing network during the spring semester of 1995. The classroom observation instrument used was an expanded version of Johnson's (I986) Cognitive Interaction Analysis System. Descriptive statistics are reportedfor all IO categories in the CIAS. The levels of classroom interaction found in these settings were not fundamentally different than those found in traditional classroom settings described in the literature. Significantly different levels of both total and cognitive student talk were found The interaction between the instructor and the location of the student was significant in determining the total amount of student talk and the amount of cognitive student talk. Diff erences among instructors contributed to both amount and type of student talk at local and remote sites. Students at remote sites contributed significantly higher levels of non-cognitive student talk.

Introduction

In a recent national survey, researchers found that the public increasingly expects educational opportunities to be available off-campus (Christenson, Dillman, Warner, & Salant, 1995). In this same study, the researchers noted that,

> Land-grant universities have an enormous advantage when compared to other higher education institutions; they have a long tradition of providing outreach, as well as offering the kind of continuous, lifelong learning that is becoming essential to success in the information age. (p. 39)

Many land grant institutions have been moving to meet this new public expectation.

Shale and Garrison (1990) reported that "the growth of university level distance education in recent times has been striking with regard to both the number of students undertaking study at a distance and the numbers of institutions providing distance education" (p. 1). The Iowa Communications Network connected sites in each of Iowa's 99 counties via fiber optics, creating a network for distance education (Simonson, Schlosser, & Anderson, 1994). Iowa's efforts, while impressive, were not unique. Many states were building such networks. In Texas, a total of 74 telecourses were carried over the Trans-Texas Videoconference Network (TTVN) during the 1993-94 academic year (Annual Report, 1994).

The move by institutions to adopt these technologies and to develop a distance education system has been rapid. These systems constitute new teaching and learning environments. The analysis of educational efficacy in these environments has been limited in scope.

Recognizing this situation, the Boyer Commission (1998) reported that technology "can be expected to alter the manner of teaching at every educational level and in every conceivable setting [and] it is the role of universities to make technology positive" (p. 1). They further noted that, "the best teachers and researchers should be thinking about how to design courses in which technology enriches teaching rather than substitutes for it" (p. 2).

Theoretical Framework

In Bloom's (1976) Theory of School Learning, he posited that 25% of the variability in achievement found among learners might be explained by what he called the quality of instruction. In Bloom's model, the quality of instruction incorporated four factors. Three of these factors were instructor behaviors. Cues, properly used to guide learners to appropriate conclusions, the reinforcement of correct responses and behaviors, and timely and effective feedback or correctives provided to inform learners of their progress were all believed to contribute to learning. The fourth factor was described as the overt and covert participation of the students. Of the four factors this fourth one, the participation of the students, was described as the most important.

> We believe that a crude but effective method of estimating the quality of instruction for a group or individual is to note the extent of overt or covert participation of students in the learning process. Where the overall quality of instruction is poor, only a few students will be actively participating in the learning. (Bloom, 1976, p. 123)

The positive effects of classroom interaction enjoys wide support in the literature. The social learning theory of Bandura (1977) emphasized the importance of observing and modeling the behaviors, attitudes, and emotional reactions of others. Although addressing primarily children, the major theme of Vygotsky's (1978) social development theory was that social interaction plays a fundamental role in the development of cognition. Vygotsky (1978) stated, "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological)" (p. 57).

In Alexander Astin's (1993) study of more than 11,000 students, he found that "retention (completing the degree) is facilitated by both student-student and faculty-student interaction" (p. 196). Further, he noted that GPA is positively correlated with "tutoring other students" and "hours per week spent talking with faculty outside of class" (p. 190). Astin stated that "student-faculty interaction has significant positive correlations with every [sic] academic attainment outcome" (p. 3 83). Clearly, student-student and faculty-student interaction is a crucial element in effective instruction. Describing faculty-student interaction in distance learning environments is a necessary and prerequisite step in assessing their effectiveness.

Purpose

The purpose of this study was to establish a quantitative baseline analysis and description of the verbal interaction between instructors and students in a simultaneous two-way audio and video distance education setting. Additionally, the nature of the interactions of students and instructors based upon their physical location in this distance learning environment was investigated.

Methods

To accomplish this purpose, three primary objectives, broadly stated as research questions, were established. These were:

1. What is the amount of verbal interaction in each of the categories described by the Distance Interaction Analysis System (DIAS), in selected two-way-audio two-way-video teleconference classes?

2. What interaction patterns and ratios are present in this setting?

3. Are the verbal interaction patterns and ratios between students and instructors consistent when they are separated by distance? This third primary objective was accomplished by testing three null hypotheses. These are enumerated in the findings as Ho,, Ho,, and Ho_3.

The design for this study was causal-comparative with data collected using observational methods distinguished by a lack of random assignment of subjects and nonequivalent groups. The sample was purposefully drawn from classes taught over the videoconference network during the spring semester of 1995. Of the 59 courses offered, five met the four sampling criteria. These criteria were: 1) they were delivered using the videoconference network, 2) they were official credit-granting graduate level courses, 3) the amount of experience the instructors possessed in utilizing the interactive videoconferencing system was similar, and 4) the content and type of courses were similar--these were scientific and technical courses in agriculture. Three complete classes were selected from each of these five courses and recorded. Recordings were made of class sessions during the third, eighth, and fifteenth week of the semester. These weeks were selected as representative of the beginning, middle, and end of a typical semester. These tape-recorded verbal interactions were then assigned by the researcher to numerical categories on three-second intervals.

The classroom observation instrument used was an expanded version of Johnson's (1976) 1 0-category Cognitive Interaction Analysis System (CIAS) called the Distance Interaction Analysis System (DIAS). Descriptive statistics were reported for all 12 categories in the DIAS. These categories are described in Table 1. The three research hypotheses were tested using analysis of covariance (ANCOVA) with backward elimination.

Borg & Gall's (1989) recommendations for controlling observer "effects and errors" (p. 496) were followed. Inter-rater reliability was established and maintained. The results of both the pre- and post-coding measures of inter-rater reliability can be found in Table 2.

Findings

The 15 class sessions ranged from just less than 55 minutes (1,093 events) to just less than 1 hour 53 minutes (2,246 events). The mean class session was 1 hour, 19 minutes and 31 seconds long. It contained 1,590.66 events; the standard deviation was 347.84. These 23,860 events were further analyzed by category. In addition to the frequencies, proportions, means, and standard deviations, a weighted mean was calculated for each category to control for length of class. This weighted mean is reported to provide a more accurate description of the "average" class. These data are reported in Table 3.

Using the adjusted mean, an average class session was 1 hour 19 minutes and 3 1 seconds long (1,590 events). During this average class, 3 minutes 32 seconds were spent in silence. Instructors demonstrated acceptance for students=s attitudes for 2 seconds, praised students for 5 seconds, and provided students with feedback for 1 minute 4 seconds. Instructors were asking questions during 3 minutes 21 seconds, lecturing during 54 minutes 10 seconds, and providing students with cues and directions during 9 minutes 54 seconds. Students at the local site were talking about the course material during 3 minutes 10

Table 1. Distance Interaction Analysis System (DIAS)

Numerical Category	Name of Category	Description
0	Silence	3 full seconds of silence.
1	Accepting Student Feelings	Instructor comments that communicate nonthreatening acceptance of student attitudes.
2	Positive Reinforcement	Praising students; Communicating a definite value judgment indicating that the instructor really likes what the student said or did
3	Corrective/Feedback	Includes negative statements which are non-punitive and non-threatening, and positive statements without a value judgment.
4	Questions	All questions raised by the teacher, rhetorical questions, even calling a student's name to respond to a previous or implied question.
5	Lecture	Communication of facts, expressing ideas, providing examples.
6	Providing Cues/Directions	Words that signal importance/ emphasis of particular material, and directions the instructor expects the students to follow.
7	Criticism	Negative, punitive comments.
8	Cognitive Student Talk-Local	Talk by students which are subject matter oriented.
9	Non-Cognitive Student Talk-Local	Talk by students not related to subject matter, management and organizational comments
10	Cognitive Student Talk-Remote	Same as "8" by Remote students.
11	Non-Cognitive Student Talk-Remote	Same as "9" by Remote students.

seconds, and talking about material not directly related to the course content for 54 seconds. Students at remote sites were talking about the course content during 1 minute 39 seconds, and talking about issues not directly related to the course content for 1 minute 39 seconds.

These instructors were talking 85.97% of the time they were in class. This may or may not be surprising to the reader; it's more than the literature would support as normal. Flanders (1970) said, "After several years of observing we anticipate an average of 68 percent teacher talk, about 20 percent pupil talk, and 11 or 12 percent silence" (p. 101). Flanders thought that 68% was too much. He concluded that, "at least one-half of all the pupils . . . experience chains of events that are inconsistent with our educational aspirations and contrary to what we would like to believe. This is a tragedy in terms of social science knowledge" (p. 14).

Table 2. Inter-rater Correlations

Date	Pre Coding Correlation	Number of Sessions Coded	Post Coding Correlation
2/09/95	Pearson .84, Scott .88	5	Pearson .94, Scott .96
2/27/95	Pearson .89, Scott .91	4	Pearson .94, Scott .97
3/28/95	Pearson .96, Scott .89	5	Pearson .93, Scott .90
5/05/95	Pearson .94, Scott .82	7	Pearson .97, Scott .84

Table 3. Frequencies, Proportions, and Means of DIAS Categories

Category	0	1	2	3	4	5	6	8	9	10	11
Frequency	1049	11	24	310	983	16106	3079	948	281	524	545
Proportion	0.0440	0.0005	0.0010	0.0129	0.0412	0.6750	0.1290	0.0397	0.0118	0.0220	0.0228
Mean	69.93	.73	1.60	20.66	65.53	1073.73	205.27	63.20	18.73	34.93	36.33
Adj. Mean	70.83	.72	1.71	21.41	67.09	1083.51	197.85	63.48	17.91	33.08	33.07

Sequences of Interest

Frequencies were established for the sequences of interest. Sequences were event pairs, or consecutive three-second intervals (Flanders, 1970; Johnson, 1981). In the literature the primary sequences of interest were matching event pairs, when an event repeated or lasted for longer than three seconds. The frequencies of sequences discovered are summarized in Table 4. As expected, lecture (category 05) was followed lecture 15,026 times.

Ratios of Sequences

Ratios of interest were calculated from these sequences. The Teacher Steady State Ratio (TSSR) was calculated. The TSSR represented the amount of total teacher talk to the amount of teacher talk that was offered within a given teacher-talk category *without pause or interruption.* If carried to the extreme, this could be considered as *droning on* within a given teacher talk category. The TSSR was found to be 1:0.87. Flanders (1970) does not report a TSSR; however, he reported a normative Steady State Ratio (SSR) of 1:0.53 with a range of 1:o.32 to 1:0.61 (p.107.) The teachers in this study clearly remained within a given teacher-talk category, in this case category 5 (lecture), longer than the norm. In this study the Pupil Steady State Ratio (PSSR) was also calculated. The PSSR represented the amount of total pupil talk to the amount of pupil talk that was offered within a given student talk category without pause or interruption. The PSSR was 1:0.54. Flanders (1970) reported a normative PSSR of 1:0.53 with a range of 1:0.26 to 1:0.72 (p.107). The PSSR reported in this study amounted to a mean of the PSSR of local and remote students. This researcher was interested in comparing the PSSR for the Local site students and the PSSR for the Remote site students. The PSSR (Local) was found to be 1:0.56; the PSSR (Remote) was found to be 1:.53. These ratios were not significantly different. Students in this study, regardless of location, remained within a given student-talk category just as did those referenced in the literature. These ratios are summarized in Table 5.

Table 4. Matrix of Events in Sequenmce

First Event	Second Event in Sequence											
	00	01	02	03	04	0.5	06	07	08	09	10	11
00	560	1	0	2	45	317	68	0	28	9	11	10
01	0	4	0	0	1	2	4	0	0	0	0	0
02	0	0	4	4	2	10	4	0	1	0	0	0
03	10	0	2	45	25	134	28	0	35	2	19	9
04	72	1	1	9	355	169	30	0	115	18	127	86
05	301	1	4	8	321	15026	228	0	165	2	45	5
06	58	1	2	2	105	239	2445	0	20	74	19	113
07	0	0	0	0	0	0	0	0	0	0	0	0
08	16	1	9	140	43	138	21	0	558	3	18	1
09	8	1	0	3	12	4	87	0	1	125	0	40
10	8	0	2	73	35	60	32	0	25	2	285	2
11	13	1	0	24	39	8	132	0	2	47	0	278

Table 5. Ratios of Sequences

Sequence Ratio	TSSR	PSSR	PSSR (Local)	PSSR (Remote)
1:	0.87	0.54	0.56	0.53

Tests of Hvpotheses

An analysis of covariance (ANCOVA) was used to test the three hypotheses proposed in this study. ANCOVA was chosen so that the effects of the variability in class time within the semester, length of class, and number of students at each site could be statistically controlled.

The Type III sums of squares were used in comparisons and calculations of the partial F statistics. Significant statistical interaction was discovered in the regression model during the testing of the first two hypotheses. In other words, the total amount of student interaction as a function of student location could not be considered independently of instructor. Neither could the amount of student interaction as a function of instructor be considered independently of location. The amount of verbal student interaction increased for some instructors due to location, and deceased for others. Therefore no discussion of the main effects of any of the independent variables in these two models is appropriate. A discussion of the interaction between the variables was appropriate and follows.

Findings Ho,: The hypothesis Ho,: There is no difference between the levels of local student talk (categories 8 and 9), and remote student talk (categories 10 and 11) due to the location of the student when the effects of instructor, class time within the semester, length of class, and number of students in attendance are controlled, was tested.

Upon fitting the reduced model to the data, the interaction between instructor and the location of the students (Inst X Trt) was found to be significant (p = .O 123). Due to the interaction found in the model, Ho, could not be rejected and the main effects cannot be reliably determined. For instance, Class Length as a predictor of total amount of student talk would appear to be significant (p = .0132), but in the presence of statistical interaction, this finding is unreliable. The findings of the analysis of covariance are reported in Table 6.

Table 6. ANCOVA of Total Student Talk

Source	DF	Type III SS	Mean Square	F	p
Class Length	1	33.7235	33.7235	7.55	.0132
Attendance	1	02.6545	02.6545	0.59	.4506
Instructor	4	28.9681	28.9681	1.62	.2120
Treatment	1	00.0871	00.0871	0.02	.8904
Inst X Trt.	4	77.7210	19.4302	4.35	.0123

Findings Ho,: The second research hypothesis was tested. Ho,: There is no difference between the levels of cognitive student talk, due to the location of the student (category 8 for local students, 10 for remote) when the effects of the instructor, class time within the semester, length of class, and number of students in attendance are controlled. In this test, Instructor by Treatment interaction was again found to be significant (p = .0214). Due to the interaction found in the model, Ho, could not be rejected. The Type III sums of squares and their associated probabilities are reported in Table 7.

Table 7. ANCOVA of Cognitive Student Talk

Source	DF	Type III SS	Mean Square	F	p
Class Length	1	9.775 1	9.7751	2.33	.1431
Instructor	4	24.5332	6.1333	1.46	.2522
Treatment	1	32.5099	32.5099	7.76	.0118
Inst X Trt.	4	62.2114	15.5528	3.71	.0214

Findings Ho,: The third research hypothesis (Ho_3:) was tested. Ho,: There is no difference between the levels of non-cognitive student talk, due to the location of the student (category 9 for local students, 11 for remote) when the effects of instructor, class time within the semester, length of class, and number of students in attendance are controlled.

The reduced model was fitted to the data; the hypothesis was tested at a .05. Because statistical interaction was not found to be significant (p = .2263), the hypothesis was rejected in favor of the alternative. There is a difference between the levels of non-cognitive student talk (category 9 for local students, 11 for remote) due to the location of the student when the effects of instructor, class time within the semester, length of class, and number of students in attendance are controlled. Students at local sites had an adjusted mean for category 9 of 4.03 1 while remote site students category 11 mean was 5.424. In this study, students at remote sites contribute 34.55% more non-cognitive talk than students at local sites. These findings were summarized in Table 8.

Table 8. ANCOVA of Non-cognitive Student Talk

Source	df	Type III SS	Mean Square	F	p
Class Length	1	23.7797	23.7797	9.36	.0065
Instructor	4	24.3240	06.0810	2.39	.0867
Treatment	1	14.5611	14.5611	5.73	.0272
Inst X Trt.	4	15.8266	03.9566	1.56	.2263

Conclusions

Simultaneous two-way (full duplex) audio and video telecourses were not significantly different than traditional face-to-face courses in most respects. Instructors in both educational settings talked a great deal of the time (85.97%). They talked without pause or interruption for 43% of the time they were talking. Students spoke very little. Their talk filled 9.6% of the available class time. Of this, only 27% lasted for more than three seconds before being terminated. With the exception of the amount and continuity of teacher talk, these findings closely align with those of researchers in traditional classrooms (Amidon & Flanders, 1967; Flanders, 1967; Johnson, 1970, 1986, 1987; Pankratz, 1967).

In their theory of social constructivism, Prawat & Floden (1994) contend that knowledge is a social product. One of their related assumptions is that knowledge evolves through negotiation in discourse communities (p. 37). Little evidence of discourse was evident in these settings.

The primary difference between full duplex audio and video classes, and traditional classes, is the placement of technology between the instructor and the students at the remote sites. The placement of this technology into the educational environment significantly increased the amount of non-cognitive student talk from the students required to use it. This non-cognitive talk was, in a large part, devoted to understanding and utilizing the required electronic interface. Moore (1989) describes three types of interactions present in distance education settings. While all learners benefit equally from Moore's learner-instructor and learner-learner interactions, the remote students must disproportionately contend with learner-interface interaction. While some would argue that the remote site students spent, on average, only an additional 45 seconds per class talking about subjects not related to the course, this amounted to 50% of their total verbal interaction in the class. Local students devoted only 22% of their talk to these unrelated subjects.

More importantly, it was found in this study that the placement of technology into these settings explains the total amount of student verbal interaction and the amount of cognitive student interaction only within the context of an instructor and his or her instructional design. The location of the student, or the presence of the technology, did not by itself explain the amount of total student interaction or the amount of cognitive student interaction in these settings.

In this group of five instructors, some increased the amount of student interaction through the use of technology while others decreased it. Through their use of the electronic communications technologies associated with distance education settings, instructors generated equal, or even greater than equal, amounts of student interaction at remote sites. The key element was found to be the instructor's interaction with the technology, that is, his or her ability to effectively utilize these technologies to interact with students. Moore (1993) concluded that dialog is critical to effective distance education, and stated that, "As the distance education field matures it is to be hoped that greater attention will be paid to variables besides the communications media, especially the design of courses and the selection and training of instructors" (p. 24).

Recommendations for Practice

The following recommendations are based upon the findings and conclusions of this study.

Bloom (1976) held that quality instruction incorporated four factors: 1) use of cues, 2) use of positive reinforcement, 3) use of correctives/feedback, and 4) student participation in learning. These factors were minimally present in the sample analyzed. Consequently the researcher recommends that faculty development activities and programs be created to assist instructors in increasing the levels of Bloom's four factors.

Prawat & Floden (1994) indicate that learning is fostered through dialog. This constructivist dialog will require much greater levels of student talk and consequently a reduction in the amount of instructor talk. The researcher recommends that faculty development activities and programs be created to assist instructors in increasing the levels student talk and incorporating opportunities for constructivist dialog.

Students at remote sites contributed more non-cognitive talk than did those at local sites. Much of this difference in talk was apparently due to inequalities in Moore's (1989) learner-interface interaction. In order to provide equal opportunities for students regardless of geographical location, the researcher recommends that prior to attending classes in these settings, faculty and students be provided instruction in the utilization of the electronic equipment employed at these sites.

Recommendations

It is recommended this study be replicated using two groups of instructors, those well trained in the use of videoconference equipment and an untrained group of instructors. This would both validate the methodology used in this study and help to evaluate the effectiveness of the recommended training program.

The amount and effectiveness of non-verbal communications and alternative forms of instructor-student and student-student interaction in full duplex audio and video distance education settings should be investigated. The amount of instructor-student interaction taking place on the telephone, e-mail, and computer conferencing systems that are an integral part of these new learning environments remains unknown.

Instructional designs that radically reduce the amount of lecture while increasing the amount of cognitive student talk, the reinforcing categories of instructor talk (Johnson, 1987), and opportunities for social constructivism through dialog (Prawat & Floden, 1994), should be initiated, and their effect on student achievement should be evaluated. Instructional designs incorporating techniques and methods that encourage student interaction and student-centered responsibility for mastering content should be investigated in these settings.

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