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Instruction Via Satellite Television: An Exploratory Analysis of Teacher Effectiveness

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Growing interest in the concept of interactive satellite instruction is being expressed by state and national education leaders and education policy makers in the United States. Congressional passage of $19 million funding for the Star Schools program is one recent example [1]. Legislative approval to establish statewide satellite instructional systems in North Carolina, Kentucky, and Missouri are other examples [4].

Four producers of high school credit course work, delivered via satellite, are presently offering classes on a regular basis to subscribing high schools in the United States. These include: (1) Oklahoma State University's Arts and Sciences Teleconferencing Service; (2) the SCI-STAR satellite program from Avon, Connecticut; (3) Satellite Telecommunications Educational Programming (STEP) from Education Service District 101 in Spokane, Washington; and (4) the TI-IN Network which broadcasts from San Antonio, Texas [3].

The largest and fastest growing producer of satellite teaching to schools is the TI-IN Network. In the Fall of 1988, TI-IN was offering 100 hours of live programming each week from its Texas studios to 524 sites in over 26 states [2]. Offerings include over 20 different high school courses, over 400 hours of inservice training and staff development, selected college credit courses, student enrichment programming, student remediation courses, test reviews for both teachers and students, and community interest programs.

A Description of Satellite Telecommunications

Satellite communication systems employ microwave terminals on the satellite transponder (a combination of receiver, converter, and transmitter) as well as on ground or earth stations commonly referred to as down-link or up-link dishes. The result is a highly reliable and high capacity communications circuit. The satellite itself is positioned in geosynchronous orbit over the equator about 22,000 miles above the earth. The rotation of the satellite thereby matches the rotation of the earth causing it to appear motionless above earth stations. Three equally spaced satellites could send and receive signals over the entire world. The satellite's transponder acts as both a receiver for up-link transmissions and a transmitter for down-link transmissions. Earth stations can be fixed or mobile. A positive characteristic of satellite communications is that the cost of transmission is insensitive to distance. This is not true in the case of telephone or other land line communications systems. In other words, the cost of satellite transmission between Los Angeles and New York is no higher than that between Los Angeles and San Diego.

Televised classes are nothing new in education. What is new, however, is live, two-way communication made possible by linking satellite technology with regular telephone service. Live TV broadcasts are beamed from the host site classroom or studio via an up-link dish to the satellite transponder. The signal is then beamed back to down-link dishes at the various receiver site locations. In this configuration, satellite technology permits one-way transmission of voice, data, and full-motion video. Audio talk-back by participants at the receiver site locations is over regular telephone lines. On the basis of one-way video, two-way audio communication, the instruction is deemed to be interactive. By picking up a telephone, students at subscribing schools can call in questions, usually on a toll-free telephone line, and hear their instructors' answers on the air. Students can both see and hear their instructor over the classroom television, but are unable to either see or talk directly to students located at different sites. The teacher cannot see students, but is able to respond to questions or comments whenever students call in on the telephone line. The technology is also capable of electronic copy distribution to create hard copy handouts, exams, and course administration materials sent via satellite directly to the receiver sites. In each of the systems now in operation, a classroom facilitator who may be either an aid, volunteer, or another teacher usually sits in with the students to operate the equipment, distribute materials, and provide assistance as appropriate. In most cases, student homework assignments are sent via the postal service to their TV teacher(s) for evaluation.

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PURPOSE OF STUDY AND PROCEDURES

As interest in teaching remote and/or geographically isolated students via satellite technology continues, questions related to the quality of instruction delivered will naturally be posed. Does satellite delivery of high school instruction which provides one-way video, two-way audio interaction with all of its advanced technological delivery resources effectively provide participating students with a quality learning experience. The purpose of this article is to present research findings which are intended to help answer this question. Inasmuch as interactive satellite teaching seems to perpetuate the existing and familiar teacher-present/student recite pattern of traditional classroom instruction, it was deemed appropriate to compare instruction via satellite with the traditional model.

Over the past 20 years there have been hundreds of studies conducted on effective schools and effective classrooms. In the decade between 1969 and 1979 alone, more than 2700 findings were reported in the literature [14]. Due to the newness and novelty of satellite instruction, however, current research on this approach is limited. Inasmuch as the role of the teacher is viewed to be so important in the educational process, whether in a traditional setting or in a distance education setting, we felt that one way to help determine the effectiveness of satellite delivered instruction was to document selected characteristics of instructors teaching via a satellite system. The following effective teaching practices were identified from the literature: (1) giving effective praise, (2) allowing students "wait time" during questioning, (3) posing suitable questions at the student's cognitive level, (4) use of advanced organizers, (5) clearly explaining student performance expectations, and (6) frequent content reviews [5, 7, 8, 11]. A content analysis design was used to determine the frequency or extent that satellite TV teachers exhibited these behaviors.

The TI-IN Network was chosen as the interactive satellite system to study because it is the largest and fast growing interactive satellite instruction network in the United States. TI-IN high school classes are broadcast five days each week, 175 broadcasts per school year. Each daily class broadcast is 55 minutes. Fifteen hours of selected TI-IN instruction were observed at a receiver site location and videotaped during late February and early March 1988. High school classes observed were Computer Science I, Art History I, and Sociology I. Five periods of instruction were observed for each of these three classes. These courses were selected because they were either in the teaching fields in which one of the researchers was certified to teach or in which he had received significant college training. The satellite TV teachers were not aware that their instruction was being evaluated.

All teacher and student dialogue observed during the study period was transcribed from videotape into a written narrative (transcript) and to a machine readable format using the Microsoft Word word processing program. The transcripts composed five hours of actual classroom instruction conducted by teachers in each of the three observed classes. Computer programs were developed and written by the researchers to (1) separate the teacher dialogue from the student dialogue, and (2) to count the number of words in assorted word groupings.

FINDINGS

The use of advanced organizers and frequent reviews are well documented in the literature on effective teaching [8, 9]. In this study, "advanced organizer" was defined as any part of the teacher dialogue that indicated to the students what the instructor intended to do during the immediate class period or upcoming class period. Most of the advance organizer statements contained key phrases such as, "Today we will . . . ", or, "Tomorrow we are going to . . . ", or, "The important concept to understand is . . . ", etc. These may or may not have been accompanied by a visual aid. "Review" was defined as any part of the teacher dialogue that directed the students' attention to previous class work or discussions. Most of the review statements contained key phrases such as, "Remember back . . . ", or, "Yesterday we . . . ", etc. To measure the extent of use of advanced organizers and reviews, transcripts for each of the three classes were inspected and relevant passages flagged. The flagged passages were then processed by the computer and the total number of words in each passage calculated.

Replay of video tapes and analysis of transcripts showed that all three instructors devoted class time to advance organizers and reviews. During the five day observation period, 7.3 percent of the Art History teacher's instructional time was devoted to the use of advanced organizer statements and 9.2 percent was devoted to content review. In Computer Science, the percentages were 5.0 and 6.2 respectively, and in Sociology 11.3 and 23.7 (see Table 1).

In addition to the use of advance organizer statements and reviews, research from the literature indicates that communicating student expectations positively affects student performance [6]. Review of the transcripts and videotapes revealed that all three teachers informed their students about what was expected on a daily basis. Teacher statements of student expectations included comments such as "Your assignment today is . . . ", or, "Today, I want you . . . ", or "I want you to call in now and discuss . . . ", etc. Over the five day observation period, 35 statements of student expectations were noted from the Art History teacher. In Computer Science the total was 52 statements and in Sociology the total was 62.

An area of interest in the study was to measure the extent of dialogue carried out by the instructor and the extent of dialogue carried out by the students. The computer was used to separate the transcripts into two groups—teacher dialogue and student dialogue, then tally the word totals in each group. This method revealed that overall about 90 percent of the dialogue in the three classes was carried out by the teachers. Specific breakdowns on teacher verbalization versus student verbalizations

TABLE 1
Summary of Effective Teacher Behaviors/Activities Observed of Three TI-IN Satellite TV Teachers During a Five Day Observation Period. Spring 1988.

Variable	*Teacher* Art History	Computer Science	Sociology
Frequency of teacher initiated interactions	38	57	65
Frequency of student initiated interactions	27	34	11
Number of teacher statements of corrective feedback	12	19	14
Number of teacher statements of student expectations	35	52	62
Frequency of expressions of teacher praise	40	16	29
Percent of class time spent in teacher dialogue	92.9	89.3	91.7
Percent of teacher time spent on "advanced organizers"	7.3	5.0	11.3
Percent of teacher time spent on content review	9.2	6.2	23.7
Frequency of "low" Bloom questions asked	19	70	124
Frequency of "high" Bloom questions asked	15	31	143
Average student "think" time before responding to a question (seconds)	1.5	1.6	2.6
Average teacher "wait" time when asking a question (seconds)	3.8	5.3	4.8

were as follows: Art history, 92.9 percent teacher talk versus 7.1 percent student talk; Computer Science, 89.3 percent and 10.7 percent; and Sociology, 91.7 percent and 8.3 percent.

Our interest in teacher/student interaction focused on the nature of these teacher/student exchanges, specifically how often did the instructors initiate interaction with the students and how often did the students initiate interaction with the instructors. For purposes of the study, an "interaction" was defined as any verbal exchange, however lengthy, between the instructor and the student. The exchange might involve only one statement for each of the participants, or a series of statements. A new interaction was determined to occur whenever another student was either addressed by the instructor, or was responsible for addressing the instructor. Based on this criteria, both instructors and students were likely to initiate interactions. In Art History, the total number of direct teacher initiated interactions in the five days was 38 with a mean of 7.6. Student initiated interactions totaled 20 with a mean of 5.8. In Computer Science the total teacher initiated interactions was 57 and student initiated was 34. The means were 11.4 and 6.8. In Sociology, teacher initiated interactions totaled 65 while student initiated interactions were only 11. The means were 13 and 2.2.

As in traditional classrooms, much of the teacher/student interaction involved question and answer episodes. While the literature suggested that student attention was enhanced when teacher questioning represented a variety of cognitive levels [13], it also supported the view that students who were asked more high-order questions had higher levels of achievement [10]. To quantify the level of cognitive questions posed by the teachers, Bloom's Taxonomy of Thinking Processes was utilized. Each question in the transcripts was analyzed and assigned to one of two categories—"high Bloom" or "low Bloom". The former category included levels three through six of the well-known taxonomy (application, analysis, synthesis and evaluation). The latter category included levels one and two (knowledge and comprehension). Rhetorical questions and questions such as "Are you with me?", "Do you see what I'm saying?", and, "Right?" were not included in either group. The two categories (high Bloom and low Bloom) were tallied. In Art History, the teacher asked a total of 19 low Bloom questions in the five days and 15 high Bloom questions. The means were, respectively, 3.8 and 3.0. In Computer Science there were 70 low Bloom questions and 31 high Bloom questions. The means were 14 and 6.2. In Sociology the totals were 124 low Bloom and 143 high Bloom. The means were 24.8 and 28.6.

Directly related to the questioning episodes was the concept of "wait-time." When students did not immediately answer a teacher initiated question, our interest was in how long the instructors would wait for a response before either answering their own question, restating the question, or providing cues to students. Tobin and Capie [13] concluded that a three second pause was optimal on the part of the teacher. Rowe [12] determined that student performance was enhanced when teachers extended a mean wait-time from three seconds to five seconds. Measurement of teacher wait-time and student-process or think time was conducted only during the class times that a student or group of students were on-line via the telephone with their instructor. To quantify the length of the wait-time/process-time periods, we had to deal with two conditions: (1) either students responded to the question or (2) students did not respond to the question and the teacher intervened. In the first situation, the number of seconds between the completion of the

teacher's question and the beginning of a student's answer was noted. This was labeled as the "average think time" before student response. Between the three classes, the average think time before student response was just under two seconds (1.9). The longest think time was in Computer Science, 2.6 seconds on the average. Art History and Computer Science were almost the same, 1.5 and 1.6 seconds on the average, respectively. In the second situation, the number of seconds between the completion of the question and the instructor's subsequent intervention was noted. This became the "average teacher wait-time." Each of the three teachers fell within proper norms for wait-time. The Art History teacher waited on the average 3.8 seconds; Computer Science, 5.3 seconds, and Sociology, 4.8 seconds.

Once a question had been answered, teachers had the option to either praise correct answers or to provide corrective feedback to incorrect or marginal answers. Because students respond positively to praise [5], and errors should not go uncorrected [11], we tallied the occurrences of teacher initiated praise and corrective feedback in the transcripts. "Praise" was defined as the teacher's positive response to a student's answer provided the response went beyond simple affirmation. For example, merely repeating a student answer, saying "right", "yes", or "OK" did not count as praise. Remarks such as "Good!", "Very good!", "Fine!", or "I like your answer!", etc. did count as praise [5]. "Corrective feedback" was defined as any statement or series of statements that directed the student toward a more proper response. During the observation period, 40 instances of praise were noted for the Art History teacher with a mean of eight. In Computer Science the total was 16 instances of praise and a mean of only 3.2. In Sociology the total was 29 with a mean of 5.8. Instances of corrective feedback by teachers were noted as follows: Art History, 12, mean of 2.4; Computer Science, 19, mean of 3.8; and Sociology, 14, mean of 2.8.

COMMENTS AND OBSERVATIONS

The purpose of this study was to collect and analyze data that could be used to help answer the question, "Does satellite delivery of high school instruction which promotes one-way video, two-way audio interaction effectively provide students with a quality learning experience?" This study was limited to observation of three satellite TV teachers on the TI-IN Network over a five day period. Additional studies observing instruction of other teachers over TI-IN and of instructors on the Oklahoma State University network, the STEP program in Washington, and the SCI-STAR network would provide useful comparative data.

Based on frequency counts and in consideration of the parameters of this study, we conclude that quality instruction can and does occur via interactive satellite TV teaching. Specifically, we would like to note:

1. Each of the TI-IN teachers observed appeared to be cognizant of the effective teaching characteristics under investigation and to varying degrees were practicing them. Whether or not this was a conscious effort or intuitive on the part of the teachers is unknown. The important thing is that the instruction was indeed interactive—students and teachers were in fact talking back and forth to each other via the medium. In essence, the major aspects of a traditional classroom were being employed albeit via long distance. A sufficient number of low and higher level questions were being asked with appropriate teacher wait-time to permit students an opportunity to process information, student needs and interests were being attended, student praise was being extended, corrective feedback was being given, and student initiated interaction was occurring.

2. The three teachers appeared to have good rapport with their students. Each of them displayed a genuine interest in their students' affairs—not only with classroom matters, but with other matters as well, such as sports activities between schools, recreational activities in the local community, etc. Two of the teachers were usually able to recognize their students' voices and frequently called them by name. This projected a personalizing touch.

3. In general, the teachers seemed to make good use of their delivery medium. Rather than being just a "talking face" on a TV screen, they made use of numerous visual aids, such as art works, props, written materials, and purposely tried to "reach out" to students. During the period of observation, several guest speakers were present for varying lengths of time. On the other hand, the nature of the medium makes it easy for students to "hide" from the teacher. Two of the teachers were good at calling on specific students by name to call in on the telephone and contribute to the class. For example, after calling on a specific student at a specific site and exchanging questions and answers, one teacher consistently called on another student at the same site while the phone connection was still made. Later, the same teacher would specify and encourage other sites to call in. This type of "forced interaction" made it more difficult for the students to avoid taking part in the class. The third teacher, however, did not call on specific students. She made several requests for students to call in, but it was always in the general sense. For instance "Ya'll be sure and call in now. I need your help."

4. The medium makes it difficult for the teacher to determine whether or not the students are able to follow the teacher's verbal pace or are fully responding to the teacher. Although students can see the TV teacher, the teacher is not able to see the students. This severely limits teacher sensitivity to student non-verbal cues or behavior. Two of the instructors used a consistent, moderate pace while talking that was easy to follow. The third instructor, however, talked at a considerably faster pace and was often difficult to follow.

5. Although the medium is interactive in the sense that it permits live, teacher/student exchanges, two significant differences between satellite TV instruction and a traditional classroom need to be noted: (1) There is danger that this approach can promote a large class enrollment size thereby potentially limiting the extent that each student is able to interact individually with the teacher; and (2) the technology does not permit student-to-student interaction at different sites. It is true that students can telephone their teacher to ask questions or make comments, but if they want to talk to a student at a different site, they cannot call directly. All communication must be routed through the teacher.

RECOMMENDATIONS

Interest in satellite delivery of instruction is expected to grow. As it does, producers of interactive satellite programs can anticipate close scrutiny from educational researchers, administrators, and policy makers as to program quality and effectiveness. The novelty of course delivery via satellite has grown so rapidly in the last three years that few questions relative to program quality or student performance have been asked. That position is changing, and rightly so. It is both inappropriate and dangerous to fully embrace or accept a new approach without ongoing evaluation.

Not only is continued research needed to study the effectiveness of satellite delivery as a viable medium, we also need well designed studies that compare one program producer with another. For example the TI-IN Network broadcasts their high school courses five days each week and the STEP program, emanating from Washington state, broadcasts high school courses four days each week. By comparison, the Arts and Science Teleconferencing Service (ASTS) at Oklahoma State University broadcasts high school courses only two or three days weekly (depending on the class) and the SCI-STAR series in Connecticut only one day each week. Class size between producers also varies. Whereas TI-IN and S.T.E.P. limit high school class size to around 200 students, after which a new section would be created, ASTS in Oklahoma has no apparent limit. ASTS, for example, offers one German language class which has over 1000 students. In one fashion or another, many educators might ask, "How interactive can a teacher be with 1000 students, especially when broadcasts are only two days per week?" Extent of course offerings also varies. At the close of the 1987-88 school year, TI-IN offered over 20 high school classes, ASTS offered five, S.T.E.P. offered four, and SCI-STAR offered less than five.

Satellite technology is capable of reaching a large number of students spread over an extensive geographical area. Educators and other school officials who are interested in purchasing satellite reception equipment for their school and subscribing to an instructional network need to be aware of differences between vendors. Factors to consider include cost, maintenance, upgrading of equipment, extent of course offerings, limitations on class size, frequency of instructional broadcasts, quality of instruction provided by the teaching staff, skill of the instructional staff to "force interaction" with students, etc. It is also important to know whether or not students at all receiver site locations are able to telephone their instructor during the broadcast or just designated classes which are "on-line." Programs which permit only selected on-line classes to call in can hardly pretend to be interactive when a majority of their students are passively watching a one-way TV program that does not allow them to call-in to ask questions or make comments. A related factor is whether or not students at one receiver site location would be able to be on-line with students at other receiver site locations at the same time, thereby enabling not only teacher/student interaction but also student/student interaction. School administrators thinking of subscribing to a satellite network would be advised to contact program producers and seriously consider these factors prior to deciding which network to join. Furthermore, educational researchers might consider some of these factors as research topics worthy of consideration.

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