Interactive Videoconferencing: A Literature Review

Marilyn J. Heath
Donald Holznagel

Interactive Videoconferencing: A Literature Review

Introduction

As we move into the new century, advances in technology communication systems provide more sophisticated and varied educational opportunities for content delivery across distances to reach wider audiences. At the same time, advances in technology challenge our traditional paradigms of teaching and learning. The use of the internet, one-way and two-way videoconferencing, computer telecommunication tools such as electronic mail, electronic bulletin boards, chats, computer conferences, and listservs, are just some of the powerful alternatives that educators can now use to deliver instruction either face-to-face or across distances.

Historically speaking, the use of technology for instruction across any distance has been regarded as "distance education." In fact, the evolution of distance education in the United States has generally paralleled the evolution of technology. It has been one of the few areas in education where technology has been central to the teaching task (Bates, 1995). However, with increased integration of technology into classrooms, technology is no longer reserved just for teaching students across distances.

One of the more interesting current technologies, from both a technical and social viewpoint, is interactive videoconferencing (IVC). Institutions that are looking to adopt an innovation such as IVC in a technology-based distance education program need to be able to demonstrate in several ways the relative advantage of the innovation (Moskal, Martin, & Foshee, 1997).

Three of the Regional Technology in Education Consortia funded by the US Education Department are collaborating in a national effort to provide the necessary information. It is our intention that a combination of resources including this Review of the Literature, a Policy Report summarizing the policies needed for effective IVC implementation, and Case Studies of K-12 programs using IVC, will create a useful body of knowledge to support decision-making in such an adoption process. All three of those components will be used in developing an IVC Symposium involving personnel from many IVC projects in the K-12 environment including those from the case study projects. The symposium will be conducted in October in Dallas, Texas, and will focus on obtaining and synthesizing the knowledge of educators experienced in the use of the medium in a wide variety of settings.

What is IVC?

Interactive videoconferencing is generally regarded as live, two-way audio and full-motion video communication. IVC can network rural schools, colleges, and/or service centers, giving them the

capability to transmit and receive live programming. With improved technology capacity, images and sound can be equal in quality to professional commercial television.

While some educators are exploring the use of IVC to supplement traditional, face-to-face coursework, many educational institutions use IVC to deliver extensive coursework at a distance. Complete university degrees, high school equivalency programs, and K-12 school enrichment programs are some of the common uses for IVC. Its use in school districts also includes providing staff development opportunities, conducting district-wide meetings for planning and other purposes, and conducting community communication events.

The Status of Research

This literature review is intended to support planning for the use of IVC in K-12 educational settings by identifying and presenting findings from relevant research studies. However, our search yielded only a limited number of such studies conducted at the K-12 level.

Most of the available published research studies were conducted primarily with university, professional, and some high school students. There are some problems in using this research to support decisions about investing in videoconferencing technology for K-12 instruction. If most of the existing research has been conducted with audiences of college students and other adults, its validity for high school age or younger students can be questioned. In order to apply the results to the younger age students, we need to build a rationale that shows that the teaching and learning activities of younger students are comparable to those of the older students. Cursory consideration of teaching strategies employed by successful teachers at different K-12 levels indicates that this is possibly true, at most, in grades 10-12 where the curriculum is presented through courses, in a fashion similar to college lectures.

Since relatively few studies have been conducted about IVC in the elementary and middle school settings and in delivery strategies other than courses, we have approached our task by first presenting what we have found in the K-12 environment, and thereafter combining a synthesis of the available literature with broader sources and presenting the results in a meaningful narrative.

K-12 research and evaluation studies

An important question for K-12 planners is "Why use IVC?" Sullivan, Jolly, Foster & Tompkins (1994) report that IVC has several characteristics that make it appropriate for a variety of populations in a variety of geographic locations.

- *Continuous interactivity* - overcomes the limited availability of satellite telecast, which typically is broadcast on a fixed schedule from an outside vendor. Flexible scheduling promotes more interaction between participants.

- *Relevance* - IVC generally involves the clustering of several small student populations with a teacher positioned at one of those locations. This allows teaching to be specially designed to the meet the needs of the students involved. An example of such an arrangement is a course taught by a remotely located certified teacher who is then connected to several other classrooms and perhaps linked to a university professor in his or her classroom.
- *Stimulating learning environments* - The use of multiple cameras from different angles and the use of various sources such as video display, computer display, and viewing of objects and images can stimulate visual learning opportunities. Multiple visual and audio elements have the potential to engage students in ways that go beyond typical classroom methodologies.
- *Flexibility* - The flexibility to link with other schools or entities is one of the major features of IVC. Links to higher education, regional service centers, schools, libraries, and community resources are just some of the ways IVC can be linked.
- *Affordable cost* - Technology has greatly improved and at the same time has become more affordable. Seeking out cooperative arrangements and partnerships can also help reduce the cost of classroom equipment and charges for airtime use.
- *Cooperative arrangements and partnerships* - The creation of consortia or partnerships with businesses, other schools or educational institutions is a common way that IVC can reduce costs and increase collaboration; especially with small school districts in rural areas.
- *Access to information* - Once linked with two-way video and audio, other technologies such as the Internet, laser disc, digital audio, movies and still images can be used to access information.
- *School/community production center* - The electronic classroom has the potential to exceed its original expectations. Recording of classroom sessions for future distribution, shared community meetings, guest lecturers for the school or community, adult education, live school news production, dramatic presentations are just some the possible uses for classrooms that have two way video equipment.

Addressing other questions, we found one study that deals specifically with elementary age students and two-way interactive video. In January 1991, the Region 5 Rural Technical Assistance Center of Denver, Colorado undertook a three-month study (Lawyer-Brook, 1991) to explore the feasibility of using video technology for providing Chapter 1 [Title I] remedial courses to eligible children. Interactive television was used to provide mathematics instruction to third and fourth grade students with one teacher at the sending site and facilitators at the three remote sites. Four schools in the Oklahoma Panhandle Shar-Ed Network were selected for the study as well as four sites in southeastern Kansas. Lawyer-Brook made the following observations:

- Chapter I [Title I] instruction could be effectively delivered using two-way interactive video.
- Video classes were at least as effective as traditional instructional delivery systems in producing student achievement.
- Interactive television was successful in actively engaging the students for the entire program.
- Since the technology was already in place (in these sites), Chapter I [Title I} delivery was no more expensive than the cost of a traditional Chapter I [Title I] program.

- Advantages of using two-way interactive video included sharing of human and material resources, increased teacher support through networking, visual clarity of object, and staff development through modeling.
- Teleteachers, facilitators, superintendents, and parents responded positively to the distance education project in surveys and interviews.

Lawyer-Brook also identified problem issues such as: the commitment of time and money; the need for specific teleteaching training; the difficulty of establishing schedules; the possible limitations of the classroom environment; and the differences in classroom management among schools.

Other studies carried out in IVC environments provided additional insights into success factors of IVC activities:

- The role of the facilitator is critical to the success of interactive video. (Joiner, Silverstein, and Clay (1981) . Students at remote sites are less independent than first thought. Therefore, facilitators need to be available at remote sites to offer support and guidance, especially in large classes.

- Kober (1990) cites a study conducted by Robert Threlkeld at California State Polytechnic showing that "high interactors," students who interacted with the instructor two or more times a week, did better academically, had more affinity for classes, and had more sense of involvement than "low interactors."

- Monk (1991) advises that cooperative arrangements for IVC should be managed through formal organizations because of the complexity of the programs and the resource requirements.

- Barker (1991) recommends that the following issues be addressed: type and extent of course offering, preparation and planning time, selection and qualifications of teachers who will deliver instruction, teacher training, local control, classroom management, levels and types of interactions, remote site visits, technical breakdowns, scheduling, class size, and materials dissemination.

- Sullivan, Jolly et al (1991) carried out a study of six two-way full-motion video and audio projects in New Mexico, Oklahoma, and Texas and found that the following areas of concern should be addressed by the collaborating partners or members. (1) Is there a context conducive to change through the use of a technology innovation? (2) Is there an articulation of specific needs and concerns? (3) Is there a shared vision and/or commitment and open communication among the participants? (4) Is there adequate community and administrative support, planning and resource allocation, monitoring and problem-solving, and ongoing assistance and support?

- Bates (1995) finds that the nature of IVC presents some instructional limitations. For students with little experience in a particular subject area, or for students struggling with the content of

a particular subject, or subject areas where deep or critical thinking is the educational objective, IVC may not be a cost-effective technology**.**

- A major difference between successful and unsuccessful programs is prior planning. The practice of "just in time" delivery - deciding the hour prior to class to show a film or engage in a group activity - will not likely work if attempted under the conditions of a distance education technology such as IVC. (Willis, 1994)

A Bigger Picture of IVC

While the use of IVC technology has grown to support the demand to deliver content, it is helpful to also look at IVC in a broader context. Understanding theoretical issues, teaching and learning issues, practical issues, and educational studies and research are useful to practitioners for making informed decisions regarding the use of this technology.

Theoretical issues

Using a technology such as IVC to deliver educational content and to create educational environments across distance challenges traditional teaching paradigms and brings up theoretical issues such as:

- What is meant by the term “educational transaction” in a learning experience created or supported by technology?
- What is the process of educational interaction among the learner, the teacher, and the institution when they are physically separated by distance?
- What is the role of different forms of communication?
- How does distance affect the outcome of learning?
- What should the role of the instructor be?
- What degree of student autonomy and independence can be granted and still assert that an educational process is in place? Is it education if a student does not participate in classroom meetings or does not have face-to-face discussions with an instructor? (Keegan, 1990)

The first attempt in the US to articulate a theory of distance education appeared in 1972 by Michael Moore who later concluded that education across distance is not only a geographic separation of learners and teachers but also a pedagogical concept (Moore, 1991). Education across distance forces us to rethink the traditional meaning of education and learning and the roles of the student and the instructor. Moore articulated the *theory of transactional distance*, which attempted to describe the universe of teacher-learner relationships that exist when space and/or time separate learners and teachers. Moore’s theory is shaped around elementary constructs of the educational field: the *structure* of instructional programs, the *interaction* and dialog between learners and teachers, the nature and degree of *autonomy* and *self-directedness* of the learner, and

the concept of *transaction*. Broadly speaking, a transaction is regarded as the interplay of individuals, the environment, and the patterns of behavior in a situation.

Moore goes on to explain that transactional distances are not fixed but relative, and will vary from person to person, never being exactly the same in every situation.

> "The transaction that we call distance education occurs between teachers and learners in an environment having the special characteristic of separation of teachers from learners. This separation leads to special patterns of learner and teacher behaviors. It is the separation of learners and teachers that profoundly affects both teaching and learning. With separation there is a psychological and communication space to be crossed, a space of potential misunderstanding between the inputs of instructor and those of the learner. It is this psychological and communications space that is the transactional distance." (Moore, 1993. P. 22)

The importance of this distinction is that the separation of teacher and learner is sufficiently significant so as to necessitate special teaching-learning strategies and techniques. The nature of each communication medium also influences the transactional distance of a teaching-learning situation. For example, one-way communication media allow no dialog between teacher and learner and therefore cannot successfully bridge transactional distances. To overcome the problem of transactional distance, the design of instruction and appropriate choice and use of media are important.

Teaching and learning issues

Instructional design basics

While evidence shows that technology can both improve the quality of instruction and reach students in multiple ways, the design of good instruction cannot be overlooked. Furthermore, the design of good instruction does not happen by accident. Clear objectives, appropriate structuring of learning materials, and activities relevant to learners' needs are necessities, regardless of the choice of technology. If these principles are ignored, then the teaching will fail even if the unique characteristics of the technology are appropriately exploited. Technology is not the central issue. "The central issue is 'How and what do I want students to learn? And where?' Good teaching may overcome a poor choice in technology, but technology will never save bad teaching; usually it makes it worse. Good teaching matters." (Bates, 1995, p. 12). In addition, the needs of the learners, program goals, and the context of the learning should drive the choice of technology, not the novelty of the technology.

Instructional design is a process that serves to improve learning by the design of instruction with effective learning experiences. It focuses on ways of interactivity, relevance, transfer, achievement, and understanding. Instructional designers who specialize in this complicated process might be a content teacher, an outside resource, or other equally qualified professional. In any case, instructional designers must have a solid foundation in learning theory, understanding of

cognitive styles, human learning, motivation, and creativity as well as understanding the instructional design process in order to design effective IVC instruction (Heath, 1997). In a distance learning environment that utilizes a technology such as IVC, well-conceived instruction and appropriate choice and use of media to overcome the problem of transactional distance are important.

Instructional and communication media differ in the way they represent the world, and the way they handle concrete or abstract knowledge. The nature of each medium influences the teaching-learning situation and at the same time offers different learning and teaching opportunities. For example, print can precisely present facts, television can use drama and documentaries, and computer conferencing can allow people to build their own interpretations. Basically, every medium has its strengths and weaknesses in terms of its presentation and instructional qualities and has a direct relationship to teaching tasks (Bates, 1995). Instructional designers should analyze the effectiveness and impact of the different technology media and design strategies that combine the strengths of each medium.

Emerging technologies, such as IVC, can be described as those that go beyond single-use applications of video, audio, and computers to include more sophisticated combinations and complex applications such as expert systems, hypermedia, and advanced computer technology and telecommunications. They provide a rich set of resources that progressively broaden, rather than narrow, learning themes. Hannafin (1992) expresses concern regarding the ability of the traditional instructional design models to accommodate design of learning that takes place within these technologies. He feels that traditional design methods support "low road" approaches to learning. "While instruction as operationalized in traditional instructional design models may be effective for defined outcomes, it may be completely ineffective for broader learning which is substantially more complex, individual, and internally centered." (p. 52)

Until the past few years, instructional design models and all of their related activities have been heavily influenced by the "systems" paradigm that emphasizes hierarchical and linear processes. This approach grew out of the early computer programming efforts and the influence of early Artificial Intelligence theorists (Mandler, 1985; Massaro, 1986). Newell and Simon (1972) and others asserted that human thinking and processing could be understood as analogous to computer processing. That is, a human operates as an information-processing system with a goal, a problem, a task, a task environment, and a processing system with input/output buffers. This behavioral-empirical point of view with its explicit representations of knowledge and language and corresponding formal structures and logical rules strongly influenced ideas about human learning, problem-solving, instruction**,** and instructional design**.**

The systems concept was one foundation for systematic instructional design models, the most well known model being the Instructional Systems Design (ISD) model of Dick and Carey (1978). Using the ISD model, the procedure for designing, developing, and validating instruction progresses through predetermined steps in a systematic fashion. The goal is to begin with well-defined needs, goals, and learning objectives so that the "correct" knowledge can be transferred to learners effectively and efficiently (Dick, 1995). Experts play a critical role in ISD. A major activity for the instructional designer is to correctly classify learners, skills, hierarchies, and tasks

with the underlying assumption that design can take place outside the learning environment and limited input from targeted learners.

The systematic instructional design model was introduced into educational settings with the intention of improving instruction by focusing on cognitive activities. For example: active learning, not passive learning, should take place. Performance objectives, not teacher objectives, should determine the content of instruction. Measurable outcomes, which meet performance objectives, should improve instruction and guide future instructional design. Among the earliest authors who bridged the gap between psychological research and educational practice were Glaser (1962) who coined the term *instructional system*, Mager (1962) who created a system for writing instructional objectives, and Gagne (1965) who elaborated on the analysis of instructional objectives and related classes of objectives.

While this approach did bring about improvements in the focus of instruction, the systems approach generated a set of its own problems and accompanying critics. Jonassen (1991) criticized these models as a "top-down" behaviorist and subject-matter-expert approach to education. Furthermore, (Carroll, 1992) points out that from the designer's point of view, instructional design cannot always be based on careful and logical decomposition of the knowledge and skills to be learned. "One size fits all" does not work successfully for instructional purposes.

New concepts and approaches to cognitive processes have emerged from another paradigm - called Constructivism - where learning is regarded as a constructive process and the learner is building an internal representation of knowledge. Constructivism has its roots in 20th century psychology and philosophy and the developmental perspectives of Piaget (1954), Bruner (1966), and Vygotsky (1978). Consequently, the cognitive models are being challenged by the Constructivism and Social Constructivism theories which recognize that social context, roles and relationships are central to learning (Jones, Kirkup, & Kirkwood, 1993).

Generally speaking, the approach to distance education course design should recognize that learning is dynamic and unpredictable and learners can and do make their own decisions about a learning task (Thorpe, 1995). Instructional design for IVC can support construction of learning through problem-based learning, project-based learning, team-based learning, simulations, and use of technology resources. To do this, learning activities must shift from passive to active, and from de-contextualized tasks to authentic learning tasks.

In a survey of 32 experts in the K-12 videoconferencing field, Hayden (1999) was able to identify several desirable characteristics of videoconferencing that support such learning environments:

- Connections - synchronous connections and links to remote people in remote locations;
- Questioning - students develop and ask questions to investigate topics, clarify meanings, receive feedback;
- Learning - students use audio and video to listen, tell, observe, present, interview;
- Interaction - students work in collaborative groups using remote connections, sharing resources and tools, participating in authentic activities. Videoconferencing is used to support activities.

Design of IVC

Designing new educational programs is a time-intensive effort and requires release time for those instructors who are involved in the process. Moore and Kearsley (1996) argue that without quality course design, distance education programs are unlikely to reach a maximum level of effectiveness, yet many administrators fail to plan and support this importance phase of program development. Furthermore, the design of IVC programs and courses should be regarded as part of an institution's whole curriculum planning, not just as isolated area or alternative delivery mechanism. Miller (1990) describes the operation of the curriculum on at least four levels: the institutional level where a mission and social goals are set; the academic level at which content and standards are set; course level at which specific learning goals are set; and the delivery level where instructional and technology support are critical. All of these levels interact with each other and should be recognized in the design in order reach educational goals.

In a study of the Faculty Development Group of the Central Florida Consortium of Higher Education (CFCHE) higher education faculty, Moskal et al (1997) found that most of the instructors who were developing distance education courses had no formal training in instructional design. Several recommendations for preparing and supporting teachers in the instructional design process came out of this study:

- Teachers must be given opportunities to learn the basics of instructional design either through workshops, texts, mentoring or some other arrangements.
- Teachers should have the opportunity to work with instructional designers in the design of courses and programs.
- A team approach to course design is the best approach for designing quality instruction. This team would include curriculum designers, faculty members, content experts, and evaluators.
- Administrators should be involved in some way so that they understand the effort involved in course design and development.
- If teachers have had no experience in course design, they should first start redesigning small pieces of existing courses.

While this study was carried out with higher education faculty, these same recommendations apply as well to the design of programs for K-12 settings, because they apply to the teacher and planner, and are not based on issues of student outcomes as noted in our discussion on page 12.

Interaction

As in all instructional settings, it is important for learners to have appropriate and sufficient interactions with the teacher, other students, and with the material to be learned (Moore & Kearsley, 1996). In an IVC environment, synchronous connections via videoconferencing between students, experts, and peers, and among locations offers opportunities for students to develop a high level of interaction. Students can develop questions, work in teams on authentic tasks, interact synchronously to gain understandings and interpretations, access primary sources of information, combine other online communication tools, and discuss, compare, and present to remote partners.

Bates (1995) makes an important distinction regarding interaction in the learning process. He states that there are two different contexts for interaction: the first is the individual, isolated, interaction with the learning material, be it text, television or a computer program. The second interaction is social, which is an interaction between two or more people about the learning material. Social interaction can take place between students or between teacher and student. Both kinds of interaction are important to learning and require good instructional design and teaching and the appropriate technology to maximize the effects of both (p. 52).

In an IVC environment, with synchronous video and audio features, there are assumptions that high levels of interactions will take place. However, such interactions do not automatically occur. Interactions between students as well as between teachers and students must be designed into the lesson and fostered constantly by the instructor.
Therefore, when designing instruction for an IVC environment, the form of interactivity should be considered. Also, to what extent will teachers employ these interactions during class time? And lastly, what is the impact of the interactivity in enhancing the quality and form of the instruction?

Successful interactions among participants at all IVC sites will be dependent upon the skills of the teacher and support from remote site facilitators. The nature and extent of such interactions and activities will vary according to the subject matter, the age and maturity of the students, their location, and the media used in the course. Common activities are those that involve interaction among the members of the group and interactions with groups at other sites. The most **c**ommon flaw in IVC activities is that it is used solely for information transmission rather than providing opportunities for hands-on practice.

While there is considerable research conducted in higher education settings regarding teacher-student and student-student interactions, there seems to be very little research published about the role of interactions in K-12 settings. For the adult learner, the research does not necessarily support the concept that interactions are necessary for improved learning in a distance learning experience (Threlkeld & Brzoska, 1994; Stone, 1990). However, live synchronous learning appears to make students more connected, a member of a class (Willis, 1994). Oliver and McLoughlin (1997) found that interactive technologies played a critical role in lesson delivery and that the resulting learning environments were engaging and generally motivating for students. (p. 51). However the learning environments that they observed were typically teacher-centered. The results of this research study suggest that current practices and teaching models don't appear to exploit the full potential of the power of technology tools to promote successful interactions.

Effectiveness

The question of the effectiveness of distance education has been a subject of concern over many years, beginning with correspondence education methods and continuing through e-mail, one-way video and now two-way interactive video. It has been the focus of a great deal of research, mostly by making the comparison between student outcomes from a distance-delivered course and those from a similar course delivered by a teacher in a classroom. These research efforts show that distance education methods are at least as effective in terms of student performance as in-person classroom instruction (Berge & Mrozowski, 2001).

As pointed out in an earlier section however, the validity of those findings for high school age or younger students can be questioned. A second concern is that applying research conducted on the course delivery instructional model to the broader range of instructional uses in earlier grade levels is also likely invalid. At elementary and some middle school ages, the use of distance education methods is not likely to be dominated by the course delivery model. It is more likely to include learning activities that supplement regular instruction, and involve more group work, team work, and project-oriented instruction. In this arena, the existing research is quite limited. The term “effectiveness” requires a set of interpretations beyond student learning of course material; and, the research methods chosen to investigate effectiveness will need to recognize other teaching and learning structures, methods, and objectives.

Instructional design principles suggest that using several technologies to meet different instructional needs and learning styles results in a richer, more "effective" instructional experience. Therefore, using a two-way interactive video system is necessarily more effective than using one-way video or any other technology alone; and, it also will benefit from the additional use of phone, electronic mail and the Internet to enrich the learning environment.

Another issue raised about distance education methods involves an assumption that more intelligent students are more suited to learning through distance education than others, and that therefore courses chosen for distance delivery should be the higher level courses. We find no evidence that average students are less able to progress in distance delivered courses than are more intelligent students. Student ability to handle distance education courses appears to depend more on motivation, self-direction, or the ability to take responsibility for their learning.

Elements of support also contribute to effectiveness. For example, student focus is greater if there is adult assistance and supervision at each student site, and even better if that remote site assistant is knowledgeable in the subject of presentation and can act as a resource. Providingthis level of professional support applies to situations other than the course delivery model, such as collaborative projects between groups of students in different geographic locations. A fully qualified teacher at both (all) locations is very difficult to implement unless there is financial and other support from the sponsoring educational agency..

It is possible that instructional effectiveness is dependent less on issues related to the medium of videoconferencing and more on observance of good instructional practice in general. Cotton (1999) developed an extensive summary of research in effective schooling, which addresses many such practices, especially in chapters on instruction and assessment.

Student Needs

A high level of interactivity between learners and between learners and the teacher has been shown to be important in improving learning. Distance learning systems designed to provide for increased interaction appear to result in greater student satisfaction. In this case, student satisfaction is considered to be a factor in effectiveness. Two-way video provides more real-time interactive capability for all students and teachers than other distance methods, allowing all participants to see and hear each other, resulting in more effective instruction.

Teacher Requirements

Delivery over IVC is substantially different from conventional classroom teaching; however, good classroom teachers generally make good teachers over IVC (Sullivan, Jolly, Foster & Tompkins, 1994). While there are many instructional skills that are common to both teaching environments, there are some skills that apply primarily to interactive videoconferencing. It must be clearly noted that teachers cannot transport one of their traditional courses directly to interactive videoconferencing without significant modifications.

Cyrs (2001) has created an online resource that contains a list of what he considers to be123 of the most important components of teaching at a distance that he has learned through several years of first-hand experience. One of the most important that he notes is: "Students never learn from the technology. They learn from the way instructors communicate or show how to communicate through the technology."

The following is just a sample of important teacher skills and activities from Cyrs' list.

- Using visualization techniques to take advantage of the visual opportunities that IVC provides.
- Planning and managing remote site activities.
- Creating and using questioning strategies with remote sites.
- Correlating handouts to what is seen on the screen.
- Planning and managing materials at the remote sites.
- Using good presentation skills such as appropriate style and color of dress, voice, movement, facial expressions, gestures, and eye contact.
- Using different types of camera shots and using props.
- Knowing and following copyright laws.
- Planning how evaluation will be carried out.

In some IVC projects, the teacher will have the responsibility for both instructional design and instruction of the course. Instructional design and instruction require different and specialized sets of skills. As a result, if teachers are expected to do one or the other, or both, they need to have adequate preparation and planning time. If they are to serve as instructional designers, they must possess a solid foundation in learning theory, an understanding of cognitive styles and instructional strategies, an understanding of the strengths and limitations of IVC, and knowledge of designing appropriate interactions and learning materials.

The major challenges for teaching via IVC relate to planning, delivery, and logistics. Planning is extremely important in the process. As Cyrs says, "You can't wing it on live interactive television or you will get wung out." Sullivan (1994) finds that the technology tends to make teachers more organized and more conscious of the teaching process. The use of IVC necessitates strong communication skills as well as strong organization and management skills. Whatever technology or media are used for instruction, teachers need to adapt their teaching to the medium (Bates, 1995).

Practical Issues

As with all educational and technological innovations, there are many practical issues to consider which arise from experience and are not necessarily identified from research. Ideally, these issues and subsequent decisions should be driven by the instructional needs of the educational entity. A discussion of the administration, management, and policy of IVC programs is beyond the intended purpose of this paper. However, we recognize the importance of addressing management issues, such as identifying stake-holders and resources, visioning, planning, budgeting, establishing policy and procedure, hiring staff, and conducting training.Educational issues such as quality, instruction, and assessment must also be considered. These issues will be addressed at the Fall IVC Symposium and more information about it is available at **http://neirtec.terc.edu/k12vc/**

Where do we go from here?

We propose two activities in the context of the Regional Technology in Education Consortium Program. First, synthesize the experience of school district projects around major issue areas identified in this paper. This will serve both to provide answers to questions in those areas and help refine researchable questions for which answers are desired. Second, conduct some discussions during the Symposium that will identify critical questions and lead to the formation of a group of IVC project staff willing to participate in research activities. These efforts will be organized to provide data to R-TEC staff who will employ action research strategies to shed light on some of the questions.

Here are several potential challenges and questions that could be addressed in the upcoming IVC Symposium, along with others posed during the discussions:

1. Does IVC offer clear advantages over traditional delivery, increase student motivation, and increase student learning?

2. What are the strengths and weaknesses of IVC and how do these impact the goals of instruction?

3. Are there characteristics of a teacher which indicate the likely success of the person in teaching through, or with the aid of, IVC?

4. How can teachers be helped in learning how to use this technology effectively?
   - How much time and what types of training are needed to learn how to use it?
   - How much time and what training are needed to design effective instruction?
   - Can the technology be compatible with an instructor's discipline?

5. What are some topics and opportunities for future research studies?

Through the Fall Symposium, we plan to create a dialogue to expand the knowledge of successful practices in IVC for instructional and administrative purposes, as well as help shape the R&D agenda for IVC in response to the issues in K-12 education. We need to link the quickly emerging capabilities of the technology, including Internet2 and middleware, to the realities of schools through a carefully considered research agenda that looks carefully at student and teacher learning.

References

Barker, B. (1991). Technological delivery systems and applications for K-12 instruction in rural schools. In DeYoung (Ed.), *Rural education: Issues and practice* (pp.203-237). NY: Garland.

Bates, A.W.(1995). Technology: Open learning and distance education. New York: Routledge.

Berge, Z.L. & Mrozowski, S. (2001). Review of Research in Distance Education 1990 to 1999. *American Journal of Distance Education, 15*(3).

Bloom, B. S. (1956). *Taxonomy of educational objectives: Handbook I: The cognitive domain*. New York: David McKay.

Braden, R. (March -April, 1996). The case for linear instructional design and development: A commentary on models, challenges and myths. *Educational Technology, 36*(2), 5-22.

Bruner, J.S. (1966). *Toward a theory of instruction*. New York:W.W. Norton.

Carroll, J.M. (1992). *The Nurnberg funnel: Designing minimalist instruction for practical computer skill*. Cambridge, MA: MIT Press.

Cotton, Kathleen (1999). *Research You Can Use To Improve Results.* Alexandria, VA: Association for Supervision and Curriculum Development.

Cyrs, T.E. (June 2001). Instructional Skills Specific to Instructional Television. *Educational Development Associates.* Online [wwww.zianet.com/edacyrs/itvspec.htm]

Dick, W., & Carey, L.M. (1990). *The systematic design of instruction* (*3rd Ed.).* Glenview, IL: Harper Collins.

Dick, W. (1995, July-August). Instructional design and creativity: A response to the critics. *Educational Technology,(35)*4, 5-11.

Gagne, R.M. (1965). *The conditions of learning* (1st ed.). New York: Holt, Rinehart, and Winston.

Hannafin, M.J. (1992) Emerging technologies, ISD, and learning environments: Critical perspectives. *Educational Technology Research and Development, 40*(1), 49-63.

Hayden, K.L. (1999). Videoconferencing in K-12 Education: A Delphi study of characteristics and critical strategies to support constructivist learning experiences. Online [http://hale.pepperdine.edu/~kahayden/dissertation.html]

Heath, M.J. (1997). The Design, development, and implementation of a virtual online classroom. Unpublished doctoral dissertation. University of Houston, Texas.

Joiner, L.M., Silverstein, B.J., & Clay, M.B. (1981). Independent study: Route to academic equity for rural high schools. *Educational Leadership, 387(7),* 578-580.

Jonassen, D.H. (1991).Objectivism vs constructivism: Do we need a new philosophical paradigm? *Educational Technology Research and Development* 39(3). 5-14.

Jonassen,D.H. (1994, April). Thinking technology: Toward a constructivist design model. *Educational Technology*. 34-37.

Jones, A., Kirkup, G., & Kirkwood, A. (1993). *Personal computers for distance education: The study of an educational innovation*. New York: St.Martin's Press.

Keegan, D. (Ed.) (1993). *Theoretical principles of distance education*. London: Routledge.

Kober, N. (1990). Think rural means isolated? Not when distance learning reaches into school. *The School Administrator, 47(10),* 16-24.

Lawyer-Brook, D. (1991). *The use of distance education to deliver Chapter I services*. Denver: Region 5 R-TAC.

Mager, R. F. (1962). *Preparing education objectives for programmed instruction*. Belmont,CA: Lake.

Mandler, G. (1985). *Cognitive psychology: An essay in cognitive science*. Hillsdale, NJ: Lawrence Erlbaum.

Massaro, D.W. (1986). The computer as a metaphor for psychological inquiry: Considerations and recommendations. *Behavioral Research Methods, Instruments, and Computers, 18,* 73-92.

Miller, G. Distance Education and the curriculum: dredging a new mainstream. In Moore, M. (Ed.). *Contemporary Issues in American Distance Education.* (pp. 211-219). New York: Pergamon Press.

Monk, D.H. (1991). The organization and reorganization of small rural schools. In A. DeYoung (Ed.), *Rural education: Issues and practice (*pp. 177-201) NY: Garland.

Moore, M. G. (May, 1991). *Theory of Distance Education.* Distance Education Symposium: Selected Papers, Research Monograph Number 9, American Center for the Study of Distance Education, College of Education, Pennsylvania State University.

Moore, M. G. (1993). Theory of transactional distance. In D. Keegan (Ed.), *Theoretical principles of distance education* (pp. 22-38). London: Routledge.

Moore, M. G., & Kearsley, G. (1996). *Distance education: A systems view.* Boston: Wadsworth.

Moskal, P., Martin, B., & Foshee, N. (1997). Educational technology and distance education in Central Florida: An assessment of capabilities. *American Journal of Distance Education.* 11(1) 6-22.

Newell, A., & Simon, H.A. (1972). *Human problem-solving*. Englewood Cliffs, NJ: Prentice-Hall.

Oliver, R., McLoughlin, C. (1997). Interaction in audiographics teaching and learning environments. *American Journal of Distance Education.* 11(1) 6-22.

Piaget, J. (1954). *The construction of reality in the child*. New York: Basic Books.

Reigeluth, C. M. (1996, May-June). A new paradigm of ISD? *Educational Technology*.36(8) 13-20.

Sullivan, M., Jolly, D., Foster, D., and Tompkins,R. (1994). *Local Heroes: Bringing telecommunications to rural, small schools.* Austin, TX: Southwest Educational Development Laboratory.

Thorpe, M. (1995). The challenge facing course design. In F. Lockwood (Ed.), *Open and distance learning today* (pp. 175-184). New York: Routledge.

Tyler, R. (1949). *Basic principles of curriculum and instruction: Syllabus for education 360*. Chicago: University of Chicago Press.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA:Harvard University Press.

Willis, B. (Ed.) (1994), Distance education strategies and tools. NJ: Educational Technology.

Willis, J. (1995, November-December). A recursive, reflective instructional design model based on constructivist-interpretivist theory. *Educational Technology, 35*(6), 5-23.

Winn, W.D. (1990). Some implications of cognitive theory for instructional design. *Instructional Science, 19,* 53-69.