Navigating the Sea of Research on Video Conferencing-Based Distance Education

A Platform for Understanding Research into the Technology's Effectiveness and Value

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Executive Summary

This white paper summarizes a representative subset of recent research on interactive video conferencing for distance education. The paper illustrates the fact that the past decade has witnessed a tremendous amount of distance education research, with a smaller but growing body of work specifically on video conferencing's use in education. This growth in research was brought about by the vast growth of statewide, national, and international video conferencing networks — and an increasing number of practitioners interested in understanding the value of the technology. As the use of video conferencing has expanded, educators, researchers, technology providers, analysts and others have increasingly sought to answer questions such as:

- Is interactive video conferencing as effective as the traditional classroom for delivering instruction?
- What are the unique capabilities this technology brings to the table—for student interaction, for wider participation, and for collaboration among dispersed groups of students and educators?
- Do the benefits of videoconferencing justify the up-front cost of adopting the technology?
- How might videoconferencing be best used to take full advantage of the technology's capabilities?

The body of research is highly complex, involving a wide range of practitioners and providers and exploring a hugely varied landscape of distance education approaches and educational strategies. While one might claim that research into the field is in its infancy — and that we still need analyses of the economic impact of widespread distance education — the research to date yields a number of important conclusions:

- For delivering instruction, video conferencing likely is neither more nor less effective than its counterpart, the "traditional" classroom.
- Interactivity is king — video conferencing supports far greater interaction than is otherwise possible from many asynchronous technologies, and effective video conferencing-based instruction must be designed to take advantage of this capability.
- A number of other, related instructional strategies have been identified to maximize the success of a video conferencing-based learning situation.
- When used appropriately, video conferencing is a cost-effective way for educational institutions to deliver successful educational experiences to an expanded student population.

It is important to note that some drift towards a bias seems to occur when the entire body of research into education-based video conferencing is viewed together. Most of the studies tend to be written by practitioners, who have an interest in seeing the technology's success and who might be accused of being somewhat close to the subject. This is not to question their methods or intellectual rigor; it is to suggest that the field would be well served for non-practitioners to also study its effectiveness.

This white paper is designed to arm future researchers with the foundation they need to continue the exploration. Specifically needed are rigorous, qualitative and quantitative studies that examine the economic implications — for individual students, for communities, and for an increasingly connected world. Also needed are studies that understand why – when the technology fails to deliver within certain programmatic environments– the underlying causes of those failures. This white paper is meant to provide future researchers with a platform for diving into the research waters, and for doing so with the confidence that a great deal of prior study has helped render those waters somewhat less murky than they might otherwise be.

This paper also is geared toward educators who might be considering the adoption of this technology. As some of the research we explore in this paper amply demonstrates, when utilized intelligently, video conferencing technology can have a measurable and profound impact on the availability and quality of the education experience.

Historical Overview

When distance education began in the 1800's, as a means for (mostly) women to take advantage of educational opportunities (and have access to learning that was otherwise denied to them), little could anyone have imagined the extent to which the concept — and tools — would evolve. From the correspondence course completed via mail, to the telephone, to audiographics, to reel-to-reel audio and/or videotapes, satellite TV, one-way video/two-way audio, two-way video conferencing, white boarding, interactive Web-based courses, asynchronous learning networks, e-learning and Web conferencing, and e-mail, the practice of distance education has grown into a multifaceted, multi-pronged field. Some of these media are asynchronous and useful for conveying very large amounts of information. They're flexible, allowing students to absorb new concepts at their own pace and in convenient locations. Others are synchronous, real-time media, more subject to conveying smaller amounts of information but achieving other types of learning goals.

Enter interactive video conferencing, the focus of this white paper, which marked a watershed in the evolution of synchronous distance education. For the first time, students in one or many locations could watch and listen to an instructor, a subject matter expert, or other students in real time — and maintain interactivity with those remote locations. The real-time, two-way visual and verbal interaction of the bricks-and-mortar classroom could be simulated by technology — creating a "virtual classroom" whose boundaries were limited only by the extent of the video conferencing network.

The possibilities for this technology have not been lost on educators — who first at the post secondary school level and then primary and secondary school levels have become adherents. State and national governments around the world — sometimes working with all levels of education, sometimes restricting themselves to specific "markets" such as universities, corporations, high schools, healthcare clinics, and others — helped to ensure delivery of bandwidth, equipment, and programs, often creating

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multi-purpose "town hall" networks for their countries, regions, or states. Colleges and universities quickly perceived the potential of video conferencing for reaching vastly expanded student populations, whether recruiting future full-time students or delivering education to remote groups. In North America today, virtually every state in the U.S. operates an extensive statewide video conferencing network, as do Canadian universities and provinces and Mexico (with what is widely considered the largest university in the world, UNAM, a practitioner of distance learning). In Europe, Asia, the Middle East, parts of Africa, and parts of Latin America, video conferencing has found its various educational practitioners and adherents. Video conferencing has become an indispensable part of education, at both the K-12 and higher education levels — despite the fact that society at large seems somewhat unaware of this pervasive technology.

This white paper describes a *small portion of* the research that has, over the past fifteen years or so, attempted to set forth the benefits of video conferencing-based distance education and to enhance its pedagogical effectiveness. As we turn our attention to this research, keep in mind that wave after wave of new technologies — asynchronous and synchronous alike — have created a complex, multifaceted distance education landscape. Each new wave of technology draws upon different media, different teaching styles, and different curricula, giving continuous rise to new applications and new instructional paradigms. Not surprisingly, the research reflects this complexity.

Types of Distance Education Research

Academics, corporations, governments, and others have conducted many types of studies into an extremely wide range of distance education technologies and methodologies. Research into video conferencing *per se* is, unfortunately, limited in quantity and approach. Many studies examine multiple distance education media, among them video conferencing, asynchronous learning networks (ALNs), online courses, and others, conflating these media under the "distance education" rubric. And, again, as we shall see, the topics cover an almost unlimited array of technologies, pedagogical approaches, and types of analyses. (Those studies which do hone in on video conferencing vary in scope and research methodology.)

For these reasons, it can be a challenge to tease out conclusions from the overall body of literature that apply specifically to video conferencing. As a start, let's examine the formal categories into which the research can be grouped:

Case studies. These studies look closely at one or more successful distance education projects. Depending on the aim of the research, a case study might concentrate on the technologies used, the course content, the teaching styles, the student population, or some combination of factors that produced a successful outcome. Video conferencing technology providers often compile case studies as evidence of the technology's effectiveness, generally with a view toward enhancing sales. Educators might also compile case studies as background information for teachers and students who are new to the media, or to justify technology investments. They also can be used to illustrate and inform others about best practices.

Delphi studies. Delphi studies typically draw on interviews with academic or technology experts. Researchers ask the experts such questions as these: "What technologies are most effective for distance learning? How might instructional methodologies best be matched to a particular media? What kinds of learning are best enhanced by this or that medium?"

The objective is to compile a "state of the art" compendium of technology know-how or best practices.

Outcome analyses. These studies typically compare educational outcomes (grades, test scores, and the like) produced by traditional, classroom-based instruction with those that result from distance education-based approaches. While some outcome analyses use rigorous scientific criteria to achieve quantitative measurements, many rely on more subjective criteria (for example, students' impressions of the quality of interaction in a videoconferencing-based learning session versus a traditional classroom session).

Subjective surveys. Did a group of teachers new to video conferencing experience the medium as a successful one? To what extent do rural school boards believe distance education benefits their remote students? Did the students who participated via video conferencing in a university lecture class feel included in the interactive discussions? Subjective surveys strive to answer questions such as these, and to draw conclusions accordingly.

Literature reviews. Finally, a substantial subset of the research into distance education as a whole — and into video conferencing-based systems specifically — simply provides overviews of previous research. Often zeroing in on a specific topic, such as pedagogical methods, technology configurations, or outcome analyses, these studies attempt to consolidate research findings into broad conclusions about overall distance education efficacy, cost benefits, approaches, and so on. Literature reviews can be very useful for obtaining a bird's-eye view into a research landscape that is complex and sometimes difficult to navigate.

Distance education research typically falls into the following formal categories:

- *Case studies* individually examine one or more successful projects.
- *Delphi studies* consolidate the perspectives and insights of academic or technology experts.
- *Outcome analyses* discuss how distance education measures up with respect to grades, test scores, and other measurement criteria.
- *Subjective surveys* describe how teachers, students, and others responded to distance education.
- *Literature reviews* provide overviews of some subset of the research to date.

General Research Findings

What does this research tell us? Unequivocally, that two-way, interactive video conferencing technology can be an extremely effective medium for delivering quality education to a broad, geographically dispersed student population. The research clearly shows that the technology has helped governments address mandates for economic and infrastructure development (not to mention internal agency training), helped universities follow mandates for educational outreach, and helped colleges, universities, and secondary schools reach out to vastly expanded student populations while also finding new sources of content and expertise. It also tells us when it is practiced well and when not. Like any technology, it can be abused, mis-used, inappropriately applied, or fall into neglect if not deployed with proper planning and training. A distance education program is only as good as the people who stand behind it, the planning and programs that go into it, and the ultimate content that results. There are plenty of cases of technology that sits idle because its acquisition was viewed as the hard part, when in fact the real work that needed to be done had nothing to do with buying, and everything to do with planning and training.

Video conferencing-based distance education has been in the early-adopter phase for 15 years or more (though it may not feel that way to some of the more established projects). The technology is now mature. And while the vast majority of educators, students, academics, and market analysts are now convinced that videoconferencing is an indispensable educational tool, we also have a better understanding of the technology's *limitations*. For example, one cannot effectively deliver a straight lecture to 50 locations via video conferencing. Rather, video conferencing is ideal for truly *interactive,* point-to-point instructional sessions, or for several dispersed classes collaborating together. It is better for shorter classes, and some types of content are more appropriate for videoconferencing than others. What's more, effective video conferencing requires that teachers adapt not only content but also technique to account for the distributed, highly interactive nature of the pedagogical situation.

Thomas L. Russell's *The No Significant Difference Phenomenon* draws on hundreds of studies to illustrate a key fact:

From the perspective of learning outcomes, distance education technology is no better — and no worse — than the traditional classroom for delivering instruction.

What is Now Needed

We do *not* need further research that attempts to prove the pedagogical worth of videoconferencing for education — that is, that video conferencing improves or degrades the educational experience. What we do need is research that achieves the following objectives:

- Gives us an understanding of the *economic* benefits of reaching students who might not otherwise have the educational opportunity — benefits to a community, a state, an educational organization, or the students themselves.
- Codifies the ways in which collaboration — that would otherwise not occur — fosters significant economic, personal, or professional growth and mutual understanding.
- Rigorously assesses the return on investment for states, school boards, or universities that invest in video conferencing systems.
- Brings to light why some programs and networks succeed where others do not.

In a moment, we will examine a small sampling of the current research. But first, a glimpse into one piece of research that has become a touchstone for most distance education researchers, as well as for this analyst: **Thomas L. Russell**'s *The No Significant Difference Phenomenon.* For more than ten years, *The No Significant Difference Phenomenon* has cited hundreds of research reports, summaries, and papers to illustrate an important (and perhaps, for some, counter-intuitive) point: From the perspective of learning outcomes, distance education technology is no better — and no worse — than the traditional classroom for delivering instruction.

No Significant Difference

From the dawn of technology-based distance education, there have been three vying camps of academics, researchers, and practitioners working in the field:

- Adherents, those who claim technology *improves* education.
- Opponents, who hold that technology *degrades* education.
- Those who hold that there is *no significant difference* — saying that technology per se neither enhances nor harms the business of learning.

Thomas L. Russell belongs, as does this analyst, to the third camp. When Russell began his research in 1992, he sought out comparative studies that showed technology promoted a measurable benefit to learning. Not only were there very few such studies, but the studies that showed a measurable benefit tended to be offset by those that showed the opposite — either no benefit or moderate negative impact.

What else did Russell discover? His most important determination is that the lion's share of research in the field demonstrates no significant difference with respect to learning outcomes. Russell collected these no-significant-difference findings into an annotated bibliography titled, appropriately enough, *The No Significant Difference Phenomenon,* and has since added published updates to the bibliography on the Web. His most recent available hard copy was published in 2001. For an idea of the impact of these publications, consider that in 1999, there were 25,000 hits on Russell's Web site in one six-month period alone. Russell's work is invoked by much of today's distance education research, with several studies using it as a launching point for research aimed at substantiating (or refuting) Russell's claims.

This brings us to one of Russell's ongoing frustrations, a frustration that this analyst shares. Despite overwhelming evidence to the contrary, he says, "one continues to hear of the goal of instructional improvement through technology, and that technology-based instruction is at a lower quality than the traditional classroom." These researchers, he suggests (and I agree) are asking the wrong questions and having the wrong expectations. A more fruitful approach might be simply to accept what Russell calls "the good news" — that

"technology does not denigrate instruction. This fact opens doors to employing technologies to increase efficiencies, circumvent obstacles, bridge distances, and the like."

In other words, when we accept that in the final analysis, technology *suitably and properly deployed* yields no significant difference for learning outcomes, we can stop expecting it to be the be-all, end-all to education. We can allow it to stand on its own. And we can begin to look more rigorously at the ways in which technology does provide an edge: not as an aid or a hindrance to student outcomes, but as a tool for reaching expanded populations of students, with the attendant economic, professional, and personal benefits that implies.

Now, let us turn to our examination of the research itself.

When we accept that in the final analysis, technology *suitably and properly deployed* yields no significant difference for learning outcomes, we can begin to look more rigorously at the ways in which technology *can* provide an edge: as a viable tool for reaching larger populations of students, with the attendant economic, professional, and personal benefits that implies.

Thumbs Up, Down, Sideways?

As stated earlier, the body of research into video conferencing-based distance education is highly complex. Researchers use a wide range of quantitative and qualitative yardsticks to assess the technology's effectiveness. Few zero in on a single topic; most range across multiple, broad content areas, exploring issues as diverse as pedagogical technique, cost-effectiveness, industry trends, and more. Many studies focus on K-12 education exclusively, while some discuss trends and projects in higher education; others do not separate the two. The types, approaches, and variety of distance education research are as multifaceted as the field itself.

Despite this complexity, a careful examination of the research does yield a number of broad conclusions. As we explore these results in depth in the sections that follow, keep in mind that a given study might (as most do) touch upon several of them. Similarly, there is some overlap among the results categories.

The conclusions are as follows:

Video conferencing stacks up well against the traditional classroom for delivering instruction. Studies that make this claim belong to what I call the "first wave" of research into video conferencing-based education — media comparison studies that attempt to demonstrate the technology's basic worth. Engaged perhaps (at least in Russell's view) in reinventing the wheel, this research nonetheless is valuable for demonstrating that video conferencing is a viable, valuable educational tool. What's more, it is useful for acquainting new audiences with basic issues in the field.

Interactivity is key. A large number of studies support the widely held belief that video conferencing is uniquely able to foster interactivity in a learning situation. In a similar vein, this research shows that practitioners are most successful when they design the instruction to be highly interactive. In other words, we see from this research that video conferencing both supports interactivity and demands it; as I have noted, straight lectures are not the best use of video conferencing for education.

Current research bears out the following conclusions about video conferencing-based distance education:

- Video conferencing compares favorably with traditional instructional methods.
- Interactivity is key to the success of the virtual classroom.
- Video conferencing expands the reach of education.
- Video conferencing can accommodate disparate learning styles.
- Instructional strategies must be matched to the technology.
- Video conferencing can be cost-effective.

Videoconferencing technology increases access to education. A not insignificant body of research explores the specific ways in which video conferencing expands the reach of a school or college to students who would otherwise not have access, and that it also supports collaboration and decision-making among remote work groups.

Video conferencing accommodates multiple learning styles in a single instructional session. As a portion of the research shows, this technology is an effective way to get away from a "one-size-fits-all" approach and effectively teach students who have very different learning styles. It also can work well with other technologies to provide a multifaceted approach to education.

Successful teachers match instructional strategies to the technology. Again, a lecture is not an effective use of video conferencing. What is required? Course content and pedagogical methods that are specifically geared to take advantage of the unique capabilities of video conferencing technology. Supplementary materials, coordination with remote locations, remote in-class instructors supporting overall pedagogical goals, creative design of virtual field trips, and gearing learning objectives to the medium are all components.

Video conferencing can be cost-effective. While additional research needs to be done on this topic, there is a solid body of current evidence showing that video conferencing technology produces a good return on investment for educational institutions — and for the communities and governmental entities that invest in it. Again, this is going to vary by community and organization; some achieve payback, some do not.

Media Comparisons: Video Conferencing as Equally Effective?

Owen and Aworuwa (2003) provide a fairly thorough analysis of how technology-based distance education (what they call "distributed" education) stacks up against the traditional classroom. The authors present a continuum of benefits and tradeoffs for traditional and distributed approaches, dividing the latter into several different categories from Web-assisted instruction to fully automated online learning. While they do not focus on videoconferencing per se, many of their general conclusions can be applied equally to video conferencing. These key findings include:

- The "remote delivery of a small-discipline course across several campuses certainly has value as a way to deliver courses that we otherwise might not be able to offer."
- When designed to promote interaction and provide instant feedback to students, technology-based instruction is as effective, with respect to student outcomes, as its classroom-based counterpart.

- Investments in technology can produce an enormous pay-off when adopters are aware of, and account for, the trade-offs and relative benefits.

Some of those benefits are articulated by Modupe Irele (1999, A), who in his brief overview of the relative effectiveness of distance learning systems cites the ability of video conferencing to quickly reinforce knowledge and correct misunderstandings. Video conferencing across groups, concludes Irele, "enables instructors to pace learning activities consistently, and … may improve motivation in some learners through the use of already-familiar teaching methods." Video conferencing enables remote learners "to be part of a social and socializing environment," he says, asserting that the technology is particularly well-suited for collaboration across distances.

Echoing Irele's point about collaboration, Sumner and Hostetler (2002) find that according to most of the current research, computer conferencing and face-to-face communication tend to produce decisions of equal quality. In addition to reviewing the research, the authors also cite the results of their own comparative study, which again reveals a more-or-less equal trade-off. "Broader participation, expression of a wider range of opinions, and greater analysis" enable distributed teams to evaluate issues more effectively than face-to-face teams, say the authors. At the same time, collaborating over distance requires time to exchange messages, makes it more difficult to clarify ideas, and increases overall decision-making time.

Cavanaugh (2001) analyzes 19 experimental studies and 929 student participants to find "a small positive effect in favor of distance education" in all academic content areas except foreign language study. Distance education programs are more successful, she says, when they "combine an individualized approach with traditional classroom instruction." Because distance education produces "achievement at least comparable to traditional instruction in most academic circumstances," the technology is useful for expanding educational options.

Perhaps the most interesting comparison of distance and classroom-based learning comes from Joy (2000). With respect to specific technologies, Joy focuses not on video conferencing but on asynchronous learning networks (ALNs) — but his findings and conclusions can, again, be instructively applied to video conferencing. Joy outlines the no significant difference findings and summarizes both sides of the NSD debate: that there is no significant difference, and that there is a significant difference. He then selects, at random, several media comparison studies and shows "the inadequacy of their methodologies and conclusions." According to Joy, most researchers in the field fail to control for critical factors, such as pedagogical method, prior student knowledge, and teacher and student ability.

"The outlook for improving the design of media comparison studies is bleak," Joy asserts. He is pessimistic that a "legitimate scientific model" can be designed to account for all the variables. For those who "choose to persist" in conducting this research anyway, he does provide a list of variables they should consider. More important, Joy suggests that rather than compare the effectiveness of various technologies and instructional media, researchers, instructional designers, and technology consumers should be asking this question: "'What combination of instructional strategies and delivery media will best produce the desired learning outcome for the intended audience?'"

This combination of strategies and media is, to some extent, precisely what the researchers discussed in the next section have attempted to identify.

What Makes Video Conferencing Successful?

In a very well-designed review of the literature, Amirian (2002) surveys print and electronic books and journals, research reports, dissertations, conference proceedings, and Web sites published in the two years preceding her review. Among her many cogent findings, one of the most emphatic is that interaction is critical to the video conferencing-based learning situation. Rather than "bringing experts into our classrooms like the six o'clock news" or presenting packaged documentaries in the style of yesteryear, educators should, she argues, use video conferencing in ways that make full use of its unique qualities. Specifically, she says, "interaction is the key component of this use of the technology to support a more social learning, negotiating meaning through interaction with peers over distance, and forming a sense of community using the technology." The literature, she finds, not only emphasizes interaction but frequently evokes the social nature of learning and video conferencing's ability to create community.[1]

What if a lesson simply does not lend itself to interaction? In that case, according to Amirian, the research is clear: educators should use the "15-minute rule," limiting presentations or talk-

> Researchers, instructional designers, and technology consumers should be asking this question: "What combination of instructional strategies and delivery media will best produce the desired learning outcome for the intended audience?" (Joy)

ing heads to no more than 15 minutes and following these sessions immediately with activity involving the students. It sounds like common sense, but anyone new to the field would be appalled to know how often this simple rule of thumb has been ignored. That's not to say that a talking head doesn't work for more than 15 minutes; it is to say that the talking head better have some "tricks up its sleeve" to maintain interactivity and retain attention spans.

Twigg (2001), in another comprehensive review — this time, a compilation of case studies illustrating innovative video conferencing-based projects in colleges and universities — is equally emphatic on the importance of interactivity. In her examination of what she calls "groundbreakers and pacesetters," institutions that are leading the way toward increasingly more

[1] This gives one pause to consider that video conferencing could be used to offset a possible one-sidedness, and add balance to web-based communities of learning, ultimately leading to "blended communities," a term emulating the concept of blended learning.

> Effective providers use video conferencing to provide "an environment in which students interact and wrestle with learning materials directly." The goal? For "students to become engaged in active 'doing' in the learning process." (Twigg)

effective use of video conferencing, Twigg notes that these providers, "rather than trying to replicate a teaching model online," instead create "an environment in which students interact and wrestle with learning materials directly (or in teams), under the tutorial guidance of a mentor."

The goal, she says, "is for students to become engaged in active 'doing' in the learning process — that is, move beyond merely reading text." Twigg also names "an array of high-quality, interactive learning materials and activities" as one of five key features that improve learning in video conferencing-based situations. The others include assessment of knowledge, skill level, and learning style; individualized study plans; continuous assessment; and varied human interaction.

In their extensive review of the literature on interactive video conferencing, Heath and Holznagel (2002) point out the unique ability of video conferencing to promote interaction in the classroom. In a video conferencing-based learning environment, they say, "synchronous connections via video conferencing 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." These authors go on to assert that student-to-student and student-to-teacher interaction must be designed into the instruction and continuously fostered by the teacher.

Yost (2001) describes a kindergarten project that used daily video conferencing with another kindergarten. Designed to demonstrate to preservice teachers the appropriate use of technology, the project engaged students in "dramatic play, Internet activities, and a field trip to a television station." Yost explains that this innovative interactive project was a tremendous success and an exciting experience for the children, who gained an expanded understanding of technology and the world.

Kunz (2002) also stresses the importance of interactivity in video conferencing. This author evaluated nearly 200 video conferencing-based classrooms to arrive at a set of recommendations for making video conferencing effective. Chiefly, he finds, "more active involvements of the participants" is critical.

It is interesting to note that the above studies, all of which emphasize the importance of interactivity, focus almost exclusively on video conferencing. Real-time *student*-to-teacher and *student*-to-student interaction, both visual and verbal, is a feature unique to this technology. The other widely used distance education technologies — online courses, e-mail, and other asynchronous learning systems — simply do not provide the degree of interactivity available with video conferencing. Therefore, I cannot stress too strongly the importance of this characteristic.

Increasing Access to Education

There is wide agreement in the literature that video conferencing does, indeed, vastly increase access to education. Cavanaugh calls upon educators to use video conferencing and other distance education technology to "provide students with authentic connections to a learning environment beyond the school boundaries." Not only can the technology include the family and community "in a learning conversation," she suggests, but it can also "extend the reach of student influence in the community."

In her compilation and analysis of higher education case studies, Twigg also stresses the ability of video conferencing to reach a broader student population. In fact, this is one of the chief benefits of the technology. She describes the work of colleges and universities as diverse as Rio Salado College, a Phoenix-area community college with one of the most extensive distance education programs in the country; British Open University; and Excelsior College. According to Twigg, these institutions use video conferencing and other distance learning technologies to achieve the following objectives:

- Increased access to academic resources, such as experimental lab equipment and other resources provided in a "virtual" online environment.
- Increased access to degree programs, with a significant recent expansion in the number of degree programs that are available online and through distance education projects.
- Increased access to learning through modularization, a feature that is heavily promoted by distance education technologies. Breaking education content into smaller chunks can, says Twigg, make the content more widely available.

In another significant study that supports the ability of videoconferencing to expand access, Kriger (2001) describes in detail a wide range of institutions that are using distance education technology to vastly expand access:

- Existing institutions, which supplement their bricks-and-mortar offerings with significant distance education networks reaching thousands of additional students.
- Corporate-university joint ventures, which are hybrid partnerships that either provide course management systems or package and distribute existing courses.
- Virtual universities, which are online institutions operating without bricks-and-mortar campuses.

Working under the rubric of the American Federation of Teachers, Kriger also provides a list of guidelines for making the most effective use of distance education technologies.

Accommodating Multiple Learning Styles

Researchers frequently make note of the ability of videoconferencing technology to accommodate multiple types of learners. Irele concludes in his comparative analysis that in a video conferencing-based learning situation, a combination of media — videotapes, live video instruction, computers, and telephones — "increases the chances of positive learning outcomes by increasing the range of learning styles that can be accommodated." The obvious conclusion from this is that there are times when video conferencing alone is not as effective as multiple technologies and techniques.

Twigg also cites evidence of this capability, describing a number of higher education institutions that are using the technology to create "learning activities that build on differences in students' learning styles so that students can be directed to the learning activities most suited to their preferred learning styles." Ohio State, for example, uses a "buffet" analogy to offer distance learners the most appropriate combination of courses — courses that use not only video conferencing technology but a wide range of other distance education methods as well.

Also weighing in on the importance of video conferencing's ability to accommodate different learning styles are Heath and Holznagel. These authors discovered in their literature review 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."

The Need to Match Technology with Instructional Strategies

Several researchers stress the need to match instructional strategies with the unique capabilities provided by video conferencing technology. In a Delphi study consolidating a wide range of expert opinion, Hayden (1999) suggests that the technology needs to be paired with "constructivist instructional strategies." (These are strategies that promote active learning and lead students to construct new concepts based on their current and past knowledge.) The experts, says Hayden, have identified a substantial set of video conferencing characteristics that support constructivist learning environments. They have also identified pedagogical methods and approaches that make good use of these characteristics.

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Amirian makes two related points along these lines. In her excellent review of recent literature, she stresses the fact that with video conferencing-based education, "learning goals are primary." In other words, educators should start with instructional goals and select technology that supports those goals — not vice versa. Wisely, she also asserts that "using technology for technology's sake may not be the best strategy supporting good teaching practices," emphasizing the fact that video conferencing-based teaching is intrinsically different from its classroom counterpart and may require "role changes, additional planning, and new skills." Good classroom teachers, says Amirian, "usually make good teachers using videoconferencing"— suggesting that it is the quality of the pedagogy, not the technology *per se,* that is the differentiator.

Amirian's points are echoed by an NEA (2000) document that stresses the relative importance of learning outcomes for distance education. These outcomes, says the author, "determine the technology being used to deliver course content" — not vice versa.

Cost-Benefit Analyses

While a great deal of additional research is needed in this area, several studies talk about the costs associated with video conferencing technology and discuss whether the educational outcome is worth the costs. Irele (B-1999) points out that distance education technology constitute a one-time expenditure that is amortized over time, with courses, materials, and the technology itself reused repeatedly over many years. Cost efficiency rises, he says, as more and more students use the technology and as travel costs are avoided. With respect to learning outcomes, Irele says video conferencing has been shown as highly appropriate for "demonstrating skills or processes" and also promotes collaboration, thereby raising the cost efficiency even more.

Twigg includes an entire section in her analysis on how distance education technology can reduce the costs of teaching and learning. The innovative providers described in Twigg's study carefully match instructors to the most appropriate instructional task, while also finding other creative ways to achieve cost-efficiency in developing and delivering courses. These providers:

- Develop courses in a technology-based, common or centralized way.
- Leverage information technology to modularize courses and course content for wide reuse.
- Enable faculty members to share content and materials while enhancing the quality of materials.

For the institutions Twigg describes, course-delivery costs are reduced by the use of technology to serve expanded student populations. Students can take advantage of courses according to their own needs, accessing the material when they need it. Finally, the providers assign different types of personnel to different tasks. These strategies, says Twigg, allow "for more cost-effective ways of learning — cost-effective both for the institution and for the student."

Conclusions — Swim in the Research without Drowning

This white paper is designed to be a lifeline for practitioners, researchers, and analysts and others who are just starting to look at video conferencing technology and understand its efficacy. So that this audience can avoid drowning in the sea of distance learning research, this paper provides one industry veteran's view of the most interesting and instructive research available at the current time. It modulates the din surrounding the field, exploring some of the key issues that occupy those who are committed to exploring how video conferencing can best be used.

If you are planning to look at the research yourself — or if you are aiming to conduct research of your own — you are now armed to understand the key issues. Consider this paper a jumping-off point for your own work. I have witnessed literally dozens of distance learning projects over the years, and have seen them succeed beyond anyone's expectations, or fail for a myriad number of reasons which could have been anticipated. In general, when it comes to video conferencing-based education, a few things are known for sure: that interactivity is king, that this technology is vital for expanding student access to a wealth of instruction, and that video conferencing can be seen as a remarkably useful tool when combined with robust, well-planned, student-centered instruction.

About the Author

Alan D. Greenberg is a Senior Analyst & Consultant at Wainhouse Research. As consultant, analyst, communicator, and strategist, Alan has worked in the telecommunications, video conferencing, software and services, and multimedia arenas for 20 years, holding positions with VTEL, Texas Instruments, and several Austin, Texas-based startups, and consulting to many organizations. At VTEL he conducted research into dozens of distance learning networks, was product marketing manager for a set of turnkey classroom packages, and led a number of educational and training initiatives. Most recently he was primary author on the segment report, *Video Communications Management Systems,* and author of the white papers *Best Practices in Live Content Acquisition for Distance Learning Networks* and *Renegades and Rogues: How to Tame the Unsanctioned Web Conferencing 'Buy'.* He also has authored reports on conferencing endpoints & bridges, streaming video, distance learning, and voice/fax services. He specializes in primary end user research and is a trained focus group moderator and interviewer. Alan holds an M.A. from the University of Texas at Austin and a B.A. from Hampshire College, Amherst MA. He can be reached at agreenberg@wainhouse.com.

About Wainhouse Research

Wainhouse Research (http://www.wainhouse.com) is an independent market research firm that focuses on critical issues in rich media communications, video conferencing, teleconferencing, and streaming media. The company conducts multi-client and custom research studies, consults with end users on key implementation issues, publishes white papers and market statistics, and delivers public and private seminars as well as speaker presentations at industry group meetings. Wainhouse Research publishes *Conferencing Markets & Strategies,* a three-volume study that details the current market trends and major vendor strategies in the multimedia networking infrastructure, endpoints, and services markets, as well as the segment report *Video Communications Management Systems* and the free newsletter, *The Wainhouse Research Bulletin.*

About Polycom, Inc.

Sponsor of this white paper, Polycom develops, manufactures and markets a full range of classroom, corporate training, and medical education solutions through its high-quality, affordable voice and video communication endpoints, video management software, Web conferencing software, multi-network gateways, and multipoint conferencing and network access solutions. For additional information, visit http://www.polycom.com/.

Appendix A – Bibliography

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