Mapping the Latest Research into Video-Based Distance Education

The 2009 Updated, Expanded Analysis Navigating the Sea of Research
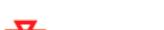
Alan D. Greenberg
Wainhouse Research

September 2009

Study sponsored by:

WAINHOUSE
Research

POLYCOM®

Table of Contents

Executive Summary

This white paper summarizes a representative subset of recent research on video-based technologies 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 the use in education of videoconferencing, on demand video, and lecture capture systems. This growth in research was brought about by the vast growth of statewide, national, and international videoconferencing networks — and an increasing number of practitioners interested in understanding the value of the technology. As the use of videoconferencing has expanded, educators, researchers, technology providers, analysts and others have increasingly sought to answer questions such as:

➢ Is interactive videoconferencing 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?
➢ What are the success factors and what are the obstacles to successful deployment?
➢ How are the newer, on demand solutions measurable and what is the impact of the additional points of contact between educator and learner?

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, videoconferencing likely can be more effective than its counterpart, the "traditional" classroom, as a result of educators compensating for the distance side of the equation by working to keep learners engaged.
➢ Academics interested in "visual literacy" have embraced Albert Mehrabian's 1981 research into emotional responses to video, vocal, and verbal sources as a marker in the understanding of the value of video – as it points to the relatively high degree of impact visual communications can have in comparison to verbal and vocal contact.
➢ Interactivity is king — videoconferencing supports far greater interaction than is otherwise possible from many synchronous and asynchronous technologies, and effective videoconferencing-based instruction must be designed to take advantage of this capability. In that vein, the technology appears to be particularly useful for Socratic and constructivist educators.
➢ A number of other, related instructional strategies have been identified to maximize the success of a videoconferencing-based learning situation.
➢ When used appropriately, videoconferencing is a cost-effective way for educational institutions to deliver successful educational experiences to an expanded student population.
➢ On demand video and lecture capture solutions appear to increase learner retention and have other measurable benefits.

Wainhouse Research believes that seeking reduced costs can be a useful method for cost justifying videoconferencing, on demand video, and other online meeting tools for administrative purposes, but that reduced costs alone are simply a side benefit to a much larger picture. Put simply, the ROI from video-based technologies arises out of the immediacy, the learner outcomes, the classroom enrichment, and

the ability for remote and local learners to have a richer set of interactions with their educators and one another.

It is important to note that some drift towards a bias seems to occur when the entire body of research into video-based technologies 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 – when the technology fails to deliver within certain programmatic environments – what are 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-based technologies can have a measurable and profound impact on the availability and quality of the educational experience.

Overview

When distance education began in the 1800's, mainly as a means for 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 videoconferencing, white boarding, interactive web-based courses, wikis, asynchronous learning networks, e-learning and web conferencing, lecture capture systems, social networking, 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, which are more appropriate for achieving other types of learning goals and fitting Socratic or constructivist[1] pedagogical styles.

Enter video-based technologies, including interactive videoconferencing, on demand video, and lecture capture – the foci of this white paper – each of which have marked a watershed in the evolution of distance education. With videoconferencing, 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 videoconferencing network. On demand streaming video and lecture capture enable that same content to be saved, manipulated (edited), and made available to learners and others at any time, creating the opportunity for more accurate learner review and increased educator-learner contact. Some important new studies are now finding that blended learning – combining elements of online or video-based and face-to-face instruction – can actually be superior to traditional brick-and-mortar classroom instruction.

The possibilities for these technologies have not been lost on educators -- who, first at the post secondary school level and later at the 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 multi-purpose "town hall" networks for their countries, regions, or states. Colleges and universities quickly perceived the potential of videoconferencing for reaching vastly expanded student populations, whether recruiting future students or delivering education to remote groups. In North America today, virtually every state in the U.S. operates an extensive statewide videoconferencing network as do Canadian universities and provinces and Mexico (with what is widely considered one of the largest universities in the world, UNAM, a practitioner of distance learning). In Europe, Asia, the Middle East, parts of Africa, and parts of Latin America, videoconferencing has found its various educational practitioners and adherents. Videoconferencing has become an indispensable part of education, at both the primary and secondary and higher education levels — despite the fact that society at large seems somewhat unaware of this pervasive technology.

---

[1] Strategies that promote active learning and lead students to construct new concepts based on their current and past knowledge.

The newer technology, video-based lecture capture, has been introduced in two forms. One is by videoconferencing vendors like Polycom, sponsor of this white paper, in the form of archival/streaming servers that take standards-based videoconferencing input and make it available on demand to learners via streaming technologies. The second approach, more formally called lecture capture, consists of multimedia management systems, which combine simple webcam or H.323-standards-based videoconferencing input with various data sources and index/mix them, making them searchable and accessible on demand.

This paper is geared toward educators seeking to embark upon their own research projects as well as those who might be considering the adoption of this technology. As some of the research we explore in this paper amply demonstrates, when utilized intelligently and appropriately, videoconferencing technology can have a measurable and profound impact on the availability and quality of the education experience. The paper describes a *portion* of the research that has, over the past twenty years or so, attempted to set forth the benefits of video-based distance education and to enhance its pedagogical effectiveness.[2] 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 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.

Methodology

This paper updates the *Navigating the Sea of Research into Videoconferencing-Based Distance Education,* published by Wainhouse Research in 2004. In addition to conducting online searches of websites created by leading distance learning providers (typically universities), sites of major organizations such as the U.S. Distance Learning Association (USDLA), and conference proceedings, we consulted with several other experts in the field to discuss the state of research. Wainhouse Research would like to note the blog maintained by Janine Lim, which was of particular value and to express our appreciation to her as a resource as well as to Polycom, sponsor of this project.

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 the impact of online, on demand learning – as delivered by computer-based training, simulation software, online gaming, and Course Management Systems (CMS's) – has exploded in recent years. Simultaneously, research into video-based technologies, namely videoconferencing, streaming video, and lecture capture, has increased significantly since 2004, for two reasons. First, many videoconferencing and lecture capture vendors have funded research into pedagogical effectiveness and best practices. Second, many more active practitioners have been conducting (often independently) their own research or acquiring advanced degrees by investigating the very technologies they utilize to teach or learn.

---

[2] Highlighted in this report are the research studies of which we are aware that further the goal of improving understanding of benefits and best practices; omissions of any particular research studies is not an indicator of any lack of validity; we may simply be unaware of some studies.

The formal categories into which the research can be grouped are as follows:

> *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. Videoconferencing technology providers often compile case studies as evidence of the technology's effectiveness, generally with a view towards enhancing utilization. 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. The Horizon Report – an attempt to assess directions for emerging technologies in education – is an example of a Delphi study.

> *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).

> *Surveys.* Did a group of teachers new to videoconferencing experience the medium as a successful one? To what extent do rural schools believe distance education benefits their remote students? Are learners appreciative of the benefits of the on demand nature of lecture capture solutions, and do these support increased retention? Did the students who participated via videoconferencing in a university lecture class feel included in the interactive discussions? Surveys strive to answer questions such as these, and to draw conclusions accordingly.

> *Literature reviews.* Finally, a subset of the research into distance education as a whole — and into video-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 benefit relationships, 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.

One particularly useful recent literature review was conducted by **Anderson** and **Rourke** (2005) for the Alberta Learning project. Designed to help the Alberta, Canada Education Ministry strategize for future videoconferencing initiatives in primary and secondary schools, this review notes the "meager empirical research in this domain" as it describes articles from 1991-2004. It, along with most of the other reviews, points to the need for far more work to be conducted on the impact of video-based technologies at all levels of education.

While not a formal method of research, one newer form of "reporting" on video-based technologies since our first publication of this white paper in 2004 has appeared, namely, the online blog. Dozens of blogs

exist related to video-based technologies; many of them describe specific learning events, share best practices, and in some instances contain their own literature reviews. One blog with a fairly comprehensive list of related blogs can be found at the [Videoconferencing Out on a Lim](#) blog.

Research Findings

What does this research tell us? Unequivocally, it tells us that two-way, interactive videoconferencing and on demand, video streaming technologies can be extremely effective media for delivering quality education to a broad, geographically dispersed student population. The research clearly shows that the technologies have 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, these can be abused, mis-used, inappropriately applied, or fall into neglect if not deployed with proper planning, funding, policy, 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.

Videoconferencing-based distance education was in the early-adopter phase through the 80's and 90's, but is reaching mainstream status in higher education and beginning to move more deeply into primary and secondary education. The technology is now mature and is used heavily for many different applications, from classroom enrichment, full course delivery, research collaboration, professional development, student services, and finally, to general meetings. 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 videoconferencing. Rather, videoconferencing is ideal for truly *interactive*, point-to-point and small numbers of multi-site 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 videoconferencing requires that teachers adapt not only content but also technique to account for the distributed, highly interactive nature of the pedagogical situation.

> Videoconferencing-based distance education was in the early-adopter phase through the 80's and 90's, but is reaching mainstream status in higher education and beginning to move more deeply into primary and secondary education. -- Wainhouse Research

On demand video and lecture capture will remain in early adoption mode for several more years. As of 2009, adoption has tended to be by department where particular needs (engineering, math, medicine, pharmacology as examples) have driven adoption. Because it is relatively new on the scene, much work remains to be done in understanding the best practices surrounding deployment and use, but research already conducted on its impact is beginning to appear, as discussed later in this paper..

In a moment, we will examine a sampling of the most important current research. But first, a glimpse into one piece of research that has become a touchstone for most distance education researchers: **Thomas**

L. Russell's *The No Significant Difference Phenomenon.* For more than 15 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 distance education technology *improves* education.
> ➢ Opponents, who hold that distance education 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 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. 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. 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 we agree) are asking the wrong questions and have 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 distance education 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.

At the same time, it is becoming apparent that one side benefit of distance education exists: instructors in many instances work at engaging their learners, because of the barriers of time and space that may exist

with their learners. As a result, some learners anecdotally are beginning to report that they actually do better in online or video-based distance education courses than they did in traditional classrooms.

Before examining video-based studies, we should examine several studies that relate to the "big picture" of research into distance education overall. Some important new studies are now finding that blended learning – combining elements of online or video-based and face-to-face instruction – can actually be superior to traditional brick-and-mortar classroom instruction. Wainhouse Research believes that the entire notion of blended learning will continue to gain currency in coming years as distance education gains further traction.

Studies of Online Learning

The US Department of Education announced in June 2009 that it had conducted its own meta-study and reached some far-reaching conclusions regarding online learning. "A systematic search of the research literature from 1996 through July 2008 identified over 1,000 empirical studies of online learning. Of these, 46 met the high bar for quality that was required for the studies to be included in the analysis. The meta analysis showed that "blended" instruction had a larger advantage relative to purely face to face instruction or instruction conducted wholly online. The analysis also showed that the instruction conducted wholly online was more effective in improving student achievement than the purely face to face instruction. In addition, the report noted that the blended conditions often included additional learning time and instructional elements not received by students in control conditions."

This analysis points to one of the side effects of distance education technologies: because educators must overcome the challenges of time and space, and compensate for the fact that learners are not face-to-face with them, they may find ways of engaging with learners that exceed traditional pedagogical methods.

The Sloan Consortium (2009) also has conducted research into online courses among primary and secondary learners, with a series of massive surveys of U.S. public school districts. Three quarters of responding districts are offering online or blended courses and as of the end of 2008, 75% had one or more students enrolled in a fully online or blended course. The overall number of primary and secondary school students engaged in online courses 2007-2008 was estimated at 1.03M, up 47% from 2005-2006; and respondents report that online learning is meeting the specific needs of a range of learners, from those who need extra help and credit recovery to those who want to take Advanced Placement and college-level courses. Worth noting is that concerns about course quality were less of a factor 2007-2008 than in a previous survey of 2005-2006, whereas issues regarding course development and/or purchasing costs, and limited technological infrastructure to support distance education were moderately or significantly increased in the latest survey. Put simply, concerns about the ability of online courses to meet quality standards seem to be receding while concerns about the ability to actually deliver online classes (development and infrastructure) are growing. This may be a good thing, as it shows that schools are grappling with the issues more than ever before.

The Megatrends Project 2007 is one more important resource for those interested in the broad topic of online educators. This four-volume research project exhaustively examines the European experience with online learning over the past 20 years and identifies factors that drive success, sustainability, and scalability, as well as reasons why some programs fail to achieve their goals.

Meanwhile, Course Management System (CMS) vendors have introduced a plethora of assessment capabilities in their platforms in recent years. Most of these are used for instructor assessment of outcomes. While they offer some degree of ability to measure outcomes of blended learning courses, they are limited in their applicability for studies of real-time and on demand video-based technologies.

Studies of Video-Based Distance Education

The body of research into video-based distance education is highly complex, in part because the ability to assess the value of video itself as an additive pedagogical tool is challenging as well. Researchers use a wide range of quantitative and qualitative yardsticks to assess the technology's effectiveness. Many range across multiple, broad content areas, exploring issues as diverse as pedagogical technique (best practices), cost-effectiveness, or impact upon learners. Often these types of research rely on surveys of learners more than on actual learning outcomes. Many studies focus on primary and secondary education exclusively, while some discuss trends and projects in higher education; others do not separate the two. A new group of studies has emerged since 2004, primarily focused on the benefits and value of streaming and lecture capture platforms. The types, approaches, and variety of video-based 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-based distance education stacks up well against the traditional classroom for delivering instruction.* Studies that make this claim initially belonged to what Wainhouse Research called the "first wave" of research into videoconferencing-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 videoconferencing is a viable, valuable educational tool. What's more, it is useful for acquainting new audiences with basic issues in the field. More recent studies are moving beyond this first wave and finding, as described later, that video-based distance education has many benefits not originally assessed in earlier studies. Some of the newer studies are finding – like the U.S. Department of Education study did for online learning – that video-based distance education can be superior to traditional classroom instruction. Others are simply finding new benefits in learner retention and engagement.

> *Interactivity is key.* A large number of studies support the widely held belief that videoconferencing in particular 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 videoconferencing both *supports* interactivity and *demands* it; as we have noted, straight lectures are not the best use of videoconferencing for education.

Research is beginning to show that grades truly can be affected positively. Academics are especially beginning to track the impact of lecture capture/on demand systems by comparing the grades/retention rates of classes with access to on demand content and classes that do not have access.
---- Wainhouse Research

- *Video-based technologies increase access to education.* A not insignificant body of research explores the specific ways in which videoconferencing, streaming, and lecture capture systems expand the reach of a school or college to students who would otherwise not have access, that it also supports collaboration and decision-making among remote work groups, and that it provides an enhanced context for local learners as well.
- *Video-based education 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 an effective platform for blended learning.. This is true for both two-way videoconferencing and lecture capture systems.
- *Successful teachers match instructional strategies to the technology.* Again, a lecture is not an effective use of videoconferencing. What is required? Course content and pedagogical methods that are specifically geared to take advantage of the unique capabilities of videoconferencing 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. Similarly, on demand video and lecture capture systems are beginning to offer a very robust set of tools for both instructors and learners to customize the experience of delivering – and later accessing – captured content.
- *Video-based technologies 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-based 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.
- *Learners like it.* Whether surveying remote learners who are receiving access to courses otherwise not available to them, or local learners who simply wish to supplement classroom activities with on demand access, learners appear to appreciate the opportunities afforded by video-based educational technologies. Not all instructors like it, as they must adapt their content to alternative delivery mechanisms, but rarely do learners resist it.
- *Research is beginning to show that grades truly can be affected positively.* Academics are especially beginning to track the impact of lecture capture/on demand systems by comparing the grades/retention rates of classes with access to on demand content and classes that do not have access.

Media Comparisons: Video 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 videoconferencing. 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 videoconferencing to quickly reinforce knowledge and correct misunderstandings. Videoconferencing 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." Videoconferencing 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. Wainhouse Research believes this assessment helps explain the rapid adoption of virtual field trips and learner-to-learner videoconferencing in primary and secondary education in recent years, where educators are seeking to broaden the opportunities for socialization, and greater amounts of group collaboration in higher education.

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 tradeoff. "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, they believe that using asynchronous online technologies adds to the time its takes to exchange messages, makes it more difficult to clarify ideas, and increases overall decision-making time. This makes the case for the value of video as a component of a blended learning environment.

Albert Mehrabian (1981) identified the relative importance of verbal, vocal, and facial messages when dealing with communications of "emotive" matters. This psychologist published the book *Silent Messages*, which has found new currency recently in academic circles based on his finding that total *liking* consists of 7% verbal liking + 38% vocal liking + 55% facial liking. He cautions that this equation regarding the relative importance of verbal and nonverbal messages was derived from experiments dealing with communications of feelings and attitudes (i.e., like-dislike), not general comprehension or retention of fact. Nonetheless, academics interested in "visual literacy" have embraced Mehrabian's research as yet another "No Significant Distance" sort of marker in the understanding of the value of video – as it points to the relatively high degree of impact visual communications can have in comparison to verbal and vocal contact.

> Academics interested in "visual literacy" have embraced Mehrabian's research as yet another "No Significant Distance" sort of marker in the understanding of the value of video – as it points to the relatively high degree of impact visual communications can have in comparison to verbal and vocal contact. – Wainhouse Research

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 videoconferencing but on asynchronous learning networks (ALNs) — but his findings and conclusions can, again, be instructively applied to videoconferencing. 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?'"

Shaer and **Fuchs** (2008) describe a videoconferencing-based engineering program that has been in existence for five years, and point out that while the synchronous model was preferable to an asynchronous model, challenges existed for both faculty and learners. These academics describe a pedagogical setting that offers insufficient interactions between faculty and learners in both real-time classroom situations and after-hour (office hour or email) interactions. Put simply, this program's remote learners have a less positive experience than do local learners. But this points out the importance of educator preparation and the treatment of all locations with equivalency. Greater interactivity, and the need for educators to compensate for distance with additional after-hour contact, are clearly important in virtually all distance education programs – and described in the next section.

What Makes Video-Based Technologies 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 videoconferencing-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 videoconferencing 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 videoconferencing's ability to create community.[3]

> "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."   ---- Amirian

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 talking 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.

A strong recent study comes from **Newman, Du, Bose,** and **Bidjerano** (2006). This group has conducted a content analysis of 46 lesson plans by teachers in New York State developed around content provider programs. Structured discussion/Socratic methods were the top approach employed by teachers (65%), followed by lecture/direct instruction (46%), demonstrations (44%), and constructivist activities (43%). Newman and others have also analyzed the impact and value-add of museums delivering content via videoconferencing (2005).

Twigg (2001), in another comprehensive review — this time, a compilation of case studies illustrating innovative videoconferencing-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 effective use of videoconferencing, 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 videoconferencing-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 videoconferencing, **Heath and Holznagel** (2002) point out the unique ability of videoconferencing to promote interaction in the classroom. In a videoconferencing-based learning environment, they say, "synchronous connections via

---

[3] This gives one pause to consider that videoconferencing 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.

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." 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 videoconferencing with another kindergarten. Designed to demonstrate to pre-service 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 videoconferencing. This author evaluated nearly 200 videoconferencing-based classrooms to arrive at a set of recommendations for making videoconferencing 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 videoconferencing. Real-time *student*-to-teacher and *student*-to-student interaction, both visual and verbal, is a feature unique to this technology. Most 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 videoconferencing. Therefore, we cannot stress too strongly the importance of this characteristic.

What are the Obstacles to Success for Video-based Technologies?

Lundgren (2007) assesses the barriers to success in a literature review and analysis that summarizes four major obstacles: 1) equipment and technical support issues; 2) professional development and training issues; 3) concerns with time; and 4) fear of technology use. Lundgren explores why some educators resist adoption of videoconferencing, finding that at times it is as simple a matter as lack of technical support (or training) or poor infrastructure, e.g., lack of bandwidth or firewall issues. Time concerns relate to educator resistance to taking the time to learn new technologies, and unwillingness to integrate videoconferencing and other technologies into their practice of education. He describes the Berrien County Intermediate School District (BCISD) in Berrien Springs, Michigan, and a project designed to assess barriers (instructor resistance) and ways to overcome those barriers. His recommendations are: 1) provision of adequate access to equipment and support; 2) addressing the issue of time and scheduling; and 3) most important, providing "sustained, meaningful professional development and training."

Wainhouse Research (this author -- 2009) has published on this topic as well, finding that the major obstacles to adoption in primary and secondary schools are (in rank order): 1) lack of bandwidth and technology infrastructure, or old equipment; 2) inability to afford support personnel; 3) lack of interest at the educator or administrator level; 4) funding challenges; and 5) no statewide or district-wide policy/standards/champions. Yet almost 80% of administrators, policymakers, and educators interviewed in 44 U.S. states indicated that interactive videoconferencing is helping their schools, districts, and states address and achieve their academic goals.

Currie (2007) compares the success factors in play in three regional service centers and at the school district level within those service center coverage areas, and describes obstacles that made a difference between successful and unsuccessful implementation: lack of facilitators, lack of promotion by administration, access limitations, lack of awareness of how to integrate into lesson plans; lack of professional development; low picture quality; lack of clear purpose for technology use; teacher lack of time; and fear of the unknown.

Outcomes and Benefits

Research is showing outcomes through tracking studies – as well as advising on new ways to evaluate distance education. **Lockee, Moore,** and **Burton** (2002) discuss the importance of creating effective evaluation models. They create their own taxonomy for the best ways organizations can address *formative* evaluation – data collected during the design and development process that can help improve distance education prototyping – and *summative* evaluation – data that summarizes after-the-fact and in the aggregate if products, programs and learning activities have led to the desired outcomes.

Assessments of the impact of content providers e.g., museums, zoos, and research labs began mid-decade. **Ba** and **Keisch** (2004) examined the SeaTrek Distance Learning Project, located at the Mote Marine Laboratory, based on a set of survey, focus groups, observations, and interviews. They found that teachers felt that SeaTrek videoconferences motivated students to learn more about how scientists work in teams and solve problems, and increased their interest in science. Teachers in schools with fewer technology resources faced greater challenges in implementing both the videoconference and the instructional materials than those in schools with greater technological literacy.

> They found that teachers felt that SeaTrek videoconferences motivated students to learn more about how scientists work in teams and solve problems, and increased their interest in science. -- Ba and Keisch

Though content providers have been the most visible and available source of ad hoc content for primary and secondary schools, university science and math academics have joined the bandwagon by reaching out to their future audiences. **McCombs, Ufnar, and Shepherd (2007)** suggest that videoconferencing can be a useful tool for introducing the mechanics and practicalities of professional science into the classroom. Their study describes a National Institutes of Health (NIH) grant-funded program for science education, and discusses the value of increasing interactions between learners interested in science and professional scientists, program evaluations, and approaches to mentoring.

The University of Massachusetts – Lowell (2008) conducted a study of the impact of lecture capture on learner outcomes. The Department of Mathematics sought ways to improve the success rates of pre-calculus and calculus students. UMASS Lowell conducted a survey that found that 72% of students said that a newly deployed lecture capture platform had contributed to their understanding of the subject matter. Later studies showed an impact on grades, as students in classes utilizing lecture capture platform had a success rate (a grade of C or better) 11 percent higher than their peers, and received 10 percent fewer Ds, Fs, or withdrawals. The school observed a similar spike in comprehension when captured lectures were added to its Green Chemistry classes. The school reported that lecture capture increased student understanding of concepts and as a result, students achieved better grades.

Creighton University (2008) also reports improvement of grades in courses that have no other changes except for the addition of lecture capture capabilities.

Central Wyoming College (2008) conducted an assessment of the impact of podcasting on its nursing program and found that students increased performance on final exams by 6.5% compared to scores of students from the years before podcasting was introduced. This study also showed that students improved comprehension by listening to material during long commutes and throughout their day, and that 50% review podcasts for every lecture, and 70% listen to the entire lecture when they access a podcast. More than 90% of students feel that podcasts are beneficial to their learning experiences.

Sweeney (2007) finds a connection between primary and secondary educator preference for constructivist learning theory and their use of videoconferencing. This dissertation is based on a survey of educators who use videoconferencing. While the sample size is small, it points to ways of identifying educators who are more likely to be successful with video-based technologies: they prefer constructivist teaching strategies. Four out of five (81%) give students the opportunity to ask their own questions of remote learners. (On the other hand, the Newman study analyzing teacher instruction methods described earlier suggests that discussion/Socratic methods are an even more utilized approach for classroom enrichment from content providers.)

There is wide agreement in the literature that videoconferencing does, indeed, vastly increase access to education. **Cavanaugh** calls upon educators to use videoconferencing 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 videoconferencing 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 videoconferencing 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.

Szente (2003), in a meta-study examining multiculturalism and technology, describes the use of videoconferencing across borders as a means of successfully promoting literacy, language training, cross-cultural comprehension, and team building. She promotes the ways in which videoconferencing can assist in developing learner ability to work cooperatively.

Keefe (2003) assesses the integration of a video learning center into an elementary school (K-6), finding positive effects on teaching and learning. This qualitative study suggests that videoconferencing classroom enrichment "compacts curriculum," in essence getting material covered as or more quickly than otherwise possible, without reportedly creating additional work for the instructors. This goes counter to some other studies that claim instructors *may* require extra preparation time. It also suggests that teachers are able to assess student interactions in new and different ways, observing classroom behavior differently (and reportedly noticing learner behavior not previously observed).

Accommodating Multiple Learning or Teaching 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 videoconferencing-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 videoconferencing 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 videoconferencing technology but a wide range of other distance education methods as well.

Also weighing in on the importance of videoconferencing's ability to accommodate different learning styles are **Heath and Holznagel**. These authors describe 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; it also will benefit from the additional use of phone, electronic mail and the Internet to enrich the learning environment."

Bradshaw, Berson, Carano, Carlson, et al (2006) describe a collaboration between teacher education programs at the University of South Florida and University of North Carolina-Chapel Hill using videoconferencing over the high-speed Internet2 network. The course mixed one class of primarily graduate students who were already teaching with another class consisting primarily of graduate students

who had not yet taught. The mix of perspectives and advantage of two professors reportedly added to the quality of the discussions and learning on both sides.

Similarly, the Medical College of Georgia has conducted research into the reasons its students access on demand presentations via its lecture capture service. Of 344 responses, 32% do so for test review; 28% replay portions for clarification; 22% are first time viewing from remote locations; and 18% do so for class makeup. A similar study of 258 students conducted spring 2007 by the University of Alabama indicates that 84% believed the use of a lecture capture service increased their satisfaction with the course, and 82% believed the service improved their classroom performance. **Brittan-Powell** (2007) claims that lecture capture affected learner performance. In one controlled study, his face to face classes with no recorded lectures offered after the fact averaged a 71 percent retention rate; when he offered lectures in class and online via a lecture capture service, the retention rate was boosted to 83 percent. Finally, the IMS Global Learning Consortium conducted a survey of 500 students at three campuses and found that 95% of those surveyed cited a positive impact on learning; 90% cited increase in studying effectiveness, and 97% said that it contributed to teaching effectiveness.

The relatively newer field of lecture capture and on demand systems has led to significant research at the higher education level, as described above. One additional concept comes from the Alberta Education research report that followed the literature review described earlier. In this case, three sets of researchers (Athabasca University, University of Lethbridge, and Galileo Educational Network Association) assessed early use of videoconferencing within five Alberta school jurisdictions, and attempted to identify issues and promising practices that could inform future use of videoconferencing technology within primary and secondary educational contexts. Besides finding that videoconferencing enhances and expands administration services and professional development activities, enhances student learning in regular classrooms, and helps courses be delivered to small and remote schools where full programming options are limited, the study goes on to place videoconferencing within a pantheon of connected technologies, all of which serve a purpose.

> "While video-conferencing technology can play an important role in adding immediacy to distance education delivery, when used alone it does not appear to provide as rich an environment as one in which various tools and techniques are blended to create more engaging and effective learning experiences. The research team concluded that videoconferencing technology….should be enhanced with other networked learning tools, both synchronous and asynchronous, to increase educational efficacy. These tools could include web conferencing, e-mail, blogs, computer-conferencing, use of individualized learning objects, collaborative work project spaces, web searches and e-portfolios."

Such a statement argues for blended learning approaches where real-time videoconferencing should be combined with closely related technologies, such as on demand streaming and lecture capture, as well as other tools for both higher education and primary and secondary learning environments.

The Need to Match Technology with Instructional Strategies

Several researchers stress the need to match instructional strategies with the unique capabilities provided by videoconferencing 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." The experts, says Hayden, have identified a substantial set of videoconferencing characteristics that support constructivist learning environments. They have also identified pedagogical methods and approaches that make good use of these characteristics.

Amirian makes two related points along these lines. In her excellent review of recent literature, she stresses the fact that with videoconferencing-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 videoconferencing-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.

A direct comparison between on demand, asynchronous video streaming and real-time, synchronous videoconferencing is made by **Moridani** (2007). A pharmacogenetic therapy course was taught to 73 students located at three campuses via videoconferencing, and one year later the same course was taught to 78 students on the same campuses via asynchronous video streaming. Average course grades did not vary between the three campus sites, while students who received the course asynchronously had final grades of 89% plus/minus 7% vs. 87% plus/minus 7% in the synchronous group. The margin of error makes this comparison significantly insignificant. Nonetheless, students taught using asynchronous video lectures had lower satisfaction with the method of content delivery, and preferred live interactive sessions or a mix of interactive sessions and asynchronous video over any one method. This study speaks to the value of blended approaches in delivering distance education.

Cost-Benefit Analyses

While a great deal of additional research is needed in this area, several studies talk about the costs associated with videoconferencing 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 videoconferencing has been shown as highly appropriate for "demonstrating skills or processes" and also promotes collaboration, thereby raising the cost efficiency even more.

While we are not aware of research into the impact of High Definition (HD) videoconferencing on the classroom, we have noticed anecdotally that HD has changed the attitudes held by educators and particularly corporate trainers towards videoconferencing. Whereas videoconferencing generally was not perceived as a mainstream tool for corporate training in the past, the experience of minimal-latency HD is

leading some corporations to revisit the technology's uses – and to begin to offer full-day or large chunks of training to adult learners.

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."

Wainhouse Research believes that seeking reduced costs can be a useful method to cost justify videoconferencing, on demand video, and other online meeting tools for administrative purposes, but that reduced costs alone are simply a side benefit to a much larger picture. Put simply, the ROI from video-based technologies arises out of the immediacy, the learner outcomes, the classroom enrichment, and the ability for remote and local learners to have a richer set of interactions with their educators and one another.

> Seeking reduced costs can be a useful method to cost-justify videoconferencing, on demand video, and other online meeting tools for administrative purposes, but reduced costs alone are simply a side benefit to a much larger picture. The ROI from video-based technologies arises out of the immediacy, the learner outcomes, the classroom enrichment, and the ability for remote and local learners to have a richer set of interactions with their educators and one another. -- Wainhouse Research

Suggestions for Future Research

What we 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 or province, 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, education governing boards, or universities that invest in video-based systems.

➢ Brings to light why some programs and networks succeed where others do not. A greater understanding of success factors exists now in 2009 than was the case in 2004.

➢ Improves on the understanding of how blended approaches can best work together to serve both learners and educators.

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-based 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-based tools 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. Wainhouse Research has witnessed literally dozens of distance learning projects over the years and consulted to statewide and regional networks as well as content providers, and has seen these deployments 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-based education, a few things are known for sure: that interactivity is king, that blended tools lead to the greatest successes, that this technology is vital for expanding student access to a wealth of instruction, and that video can be seen as a remarkably useful tool when combined with robust, well-planned, student-centered instruction.

Appendix A – Bibliography

Amirian, Dr. Susan. "Pedagogy & Videoconferencing: A Review of Recent Literature," *First NJEDge.NET Conference*, Plainsboro, NJ, Oct. 31, 2003.

Anderson, Dr. Terry and Rourke, Liam, Principal Investigators. "Videoconferencing in Kindergarten-to-Grade 12 Settings: A Review of the Literature." Alberta Education and Canadian Association of Distance Education Research, Centre for Distance Education, Athabasca University, 2005.

Ba, Harouna and Keisch, Deborah. "Bridging the Gap Between Formal and Informal Learning: Evaluating the SeaTrek Distance Learning Project," Center for Children & Technology, 2004.

Bradshaw, D., Siko, K., Hoffman, W., Talvitie-Siple, J., Fine, B., Carano, K., Carlson, L., Mixon, N., Rodriguez, P., Sheffield, C., Sullens-Mullican, C., Bolick, C. & Berson, M. (2006). "The Use of Videoconferencing as a Medium for Collaboration of Experiences and Dialogue Among Graduate Students: A Case Study from Two Southeastern Universities." *Proceedings of Society for Information Technology and Teacher Education International Conference 2006* (pp. 262-267). Chesapeake, VA

Briggs, Linda L. "Can Classroom Capture Boost Retention Rates?" (Describing Chris Brittan-Powell, Coppin State University research), *Campus Technology*, 10/17/2007.

Cavanaugh, Catherine S. "The Effectiveness of Interactive Distance Education Technologies in K-12 Learning: A Meta-Analysis," *International Journal of Educational Telecommunications* (2001) 7(1), 73-88. Available online: http://www.unf.edu/~ccavanau/CavanaughIJET01.pdf.

Currie, Neil. "A Study Of The Factors That Impact Videoconferencing As A Learning Tool Within Three Regional Service Agencies In Michigan." Doctoral dissertation. Oakland University, Rochester, MI. 2007.

Greenberg, Alan D. Taking the Wraps off Videoconferencing in the K-12 Classroom: The 2009 Update. Available online www.wainhouse.com/whitepapers.

Hartman, Henry and Bob Crook. "Faculty Development Videoconferences: What We Have Learned," *T.H.E. Journal*, March 1997. Available online: www.thejournal.com.

Hayden, K.L. "Videoconferencing in K-12 Education: A Delphi Study of Characteristics and Critical Strategies to Support Constructivist Learning Experiences." *Proceedings: Conference on Distance Teaching & Learning*, University of Wisconsin, (1999, August).

Heath, Marilyn J. and Donald Holznagel. "Interactive Videoconferencing: A Literature Review," NECC, June 2002.

Irele, Modupe (A). "Relative Effectiveness of Distance Learning Systems," Lucent Technologies and The World Campus, Pennsylvania State University, 1999.

Irele, Modupe (B). "Cost-Benefit Analysis in Distance Education," Lucent Technologies and The World Campus, Pennsylvania State University, 1999.

Joy, Ernest H. "Measuring Learning Effectiveness: A New Look at No-Significant-Difference Findings," *Journal of the Asynchronous Learning Network*, Vol. 4:1, June 2000.

Keefe, David D. "A Case Study of the Integration of a Video Learning Center at an Elementary School." Doctoral dissertation, University of Virginia, Charlottesville, VA. 2003.

Kriger, Thomas J. "A Virtual Revolution: Trends in the Expansion of Distance Education," American Federation of Teachers, May 2001.

Kunz, P. "Students' Acceptance of Videoconferencing in the Lecture Context," *World Conference on Educational Multimedia, Hypermedia and Telecommunications*, 2000(1), 1680-1682. Available online: http://dl.aace.org/1711

Lockee, Barbara; Moore, Mike, and Burton, John. "Measuring Success: Evaluation Strategies for Distance Education. *Educause Quarterly*, Number 1 2002.

Lundgren, Dennis D. "Perceived Barriers to the Adoption of Videoconferencing and Recommendations to Reduce Concerns" Andrews University, 2007.

McCombs, Glenn; Ufnar, Jennifer; Shepherd, Virginia. "Connecting University Scientists to the K-12 Classroom through Videoconferencing" *Advances in Physiology Education, 2007*

Means, Barbara; Toyama, Yukie; Murphy, Robert; Bakia, Marianne; and Jones, Karla. "Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies." U.S. Department of Education Office of Planning, Evaluation, and Policy Development – Policy and

Program Studies Service. 2009. Available online at
http://www.ed.gov/about/offices/list/opepd/ppss/reports.html#edtech.

Moridani, Majid. "Asynchronous Video Streaming vs. Synchronous Videoconferencing for Teaching a Pharmacogenetic Pharmacotherapy Course" *American Journal of Pharmaceutical Education.* 2007

NEA and Blackboard Inc. "Study Finds 24 Measures of Quality in Internet-Based Distance Learning." News release, March 21, 2000.

Newman, Dianna; Du, Ying; Bose, Mohua, and Bidjerano, Temi. "A Content Analysis of Videoconference Integration Plans." Paper presented at the Society for Information Technology and Teacher Education International Conference, Orlando, FL, 2006.

Owen, Robert and Bosede Aworuw, "Return on Investment in Traditional Versus Distributed Learning," *10th Annual Distance Education Conference*, 2003.

Russell, Thomas L. *The No Significant Difference Phenomenon: A Comparative Research Annotated Bibliography on Technology for Distance Education*, North Carolina State University, IDECC, 1999, 2001.

Shaer, Bassam, and Fuchs, Andreas, "Work in Progress – Student Learning Outcomes in an Engineering Distance Education Setting," *ASEE/IEEE Frontiers in Education Conference 2008*, October 2008.

Szente, Judit. "Teleconferencing Across Borders: Promoting Literacy—and More—in the Elementary Grades. *Childhood Education*, Annual Theme 2003.

Sweeney, Marilyn Ann. "The use of videoconferencing techniques which support constructivism in K–12 education." Ed.D. dissertation, University of Massachusetts Lowell, 2007.

Twigg, Carol A. "Innovations in Online Learning: Moving Beyond No Significant Difference," Center for Academic Transformation at Rensselaer Polytechnic Institute, The Pew Learning and Technology Program, 2001.

Yost, N. "Lights, Camera, Action: Videoconferencing in Kindergarten." *Society for Information Technology and Teacher Education International Conference 2001*(1), 3173-3175. Available online: http://dl.aace.org/4175.

About the Author

Alan D. Greenberg is Senior Analyst & Partner at Wainhouse Research. As consultant, analyst, and strategist, Alan has worked in the telecommunications, videoconferencing, software and services, and multimedia arenas for more than 25 years, holding positions with Texas Instruments, VTEL, and several Austin, Texas-based startups, and consulting to many organizations. He is distance education and e-Learning practice manager at Wainhouse Research, and co-lead analyst on WR's *WebMetrics* web conferencing survey program. He has conducted research into dozens of distance learning networks, was product marketing manager for a set of turnkey classroom packages, and has led a number of educational and training initiatives, including serving on the Keystone Conference Steering Committee. Most recently he authored the three-volume segment report *The Distance Education and e-Learning Landscape* and authored the white papers *Best Practices in Live Content Acquisition for Distance Learning Networks*, *Emerging, Converging Collaboration Solutions for K-12 Learning Communities*, *The 2009 Update: Taking the Wraps off Videoconferencing in the U.S. Classroom*, and *Super-Size Bandwidth and Two-Way Video in the Classroom*. He also has authored reports on conferencing endpoints & bridges, streaming video, web conferencing, and voice/fax services. Alan holds an M.A. from the University of Texas at Austin and a B.A. from Hampshire College. He can be reached at agreenberg@wainhouse.com.

About Wainhouse Research

Wainhouse Research, www.wainhouse.com, is an independent market research firm that focuses on critical issues in the distance education, Unified Communications, and rich media conferencing fields. 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 a variety of reports that cover all aspects of rich media conferencing, 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/.