



The Impact of Broadcast and Streaming Video in Education

What the Research Says and How Educators and Decision Makers Can Begin to Prepare for the Future

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Foreword

The first decade of the 21st century was marked by rapid change, market interdependencies, environmental awareness, social cohesion, and the rise of young generations as key influencers of global change at the political, economic and social levels. The Internet and technological inventions of this period served as fuel and catalyst for these events, but also contributed massively to radical changes in traditional approaches to the fields of research, science, and education.

At Cisco, we believe that high-quality education and technology have the power to change the world by developing the human talent required to seize the opportunities that arise from global change. Cisco's Global Education group helps governments and institutions worldwide achieve their education 3.0 vision through the use of technology and the development of the higher-order capabilities required in 21st century learners. Video, as a fundamental agent in the process of education transformation, facilitates collaboration, accommodates for different learning styles, increases engagement and excitement among students, helps maximize school and university resources, and improves learning outcomes.

In an effort to collect existing research and document the benefits of video in improving learning and the overall quality of the classroom experience, I am happy to introduce this paper and share it with the wider global community of teachers, school officials, administrators, decision makers, and education stakeholders. The paper draws on multiple studies conducted in recent years, and also on the results of Cisco's worldwide experience helping education institutions implement video technologies. The paper encourages readers to see video technologies as an enabler and a complementary tool for high-quality 21st century education. In order to maximize the gains of video, it is imperative to have a forward-looking pedagogy, a solid professional development program for teachers, and true integration of video technology with curricula.

As the world continues its journey into the second decade of the century, the propagation of video technologies in education is poised to accelerate because of the proliferation of portable devices and the explosion of Internet and mobile phone users. Also driving adoption are the increased understanding and appreciation for these types of technologies by young people, as well as their constant desire to interact and collaborate at any time beyond the classroom and campus' walls.

The opportunity is clear, the technology is here, and the timing is right. It is now up to us to responsibly adopt video technologies in the classroom, guiding our students on how to best profit from them and contributing to the development of the appropriate skill sets that will help them fulfill their role as global citizens of the 21st century.



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Executive Summary

Introduction

In concert with global macro-economic changes and the growth of social interconnectedness worldwide, education is undergoing a major shift, as brick-and-mortar classrooms are opening up to rich media content, subject matter experts, and to one another. This shift has been influenced largely by technological and pedagogical trends, greater worldwide access to the Internet, an explosion of mobile phone users, and the appreciation for these technologies by young people, as well as by teachers. Video appears poised to be a major contributor to the shift in the educational landscape, acting as a powerful agent that adds value and enhances the quality of the learning experience.

This paper draws on multiple studies conducted in recent years, and also on the results of Cisco's worldwide experience helping education institutions implement video technologies. It describes in detail the impact of these technologies in improving high-quality education, learning outcomes, and the development of 21st Century skills.

Some of the applications of broadcast and streaming video discussed in the white paper include:

Basic instruction	In foreign language classes, history and geography lessons where students can bring a subject to life, stimulate their ability to recall facts and events, and experience places they wouldn't otherwise experience.
Advanced instruction	In science subjects like physics, mathematics, astronomy and biology allowing students to expand their understanding of complex concepts by strengthening the links between abstract ideas and practical applications.
Classroom enrichment	Video gives students the opportunity to travel to remote places outside the classroom walls without leaving school.
Accelerated learning	One-way streaming blended with other online methods of communicating is one of several ways of ensuring that learners can take the college-level courses they need.
Distance education	To make courses, lectures, and faculty accessible to populations in remote areas and also to students with disabilities or with physical impairments.
Global student collaboration	Video technologies can help students connect with peers located in different campuses and in different countries so that they can interact with different cultures, exchanging information and learning from each other.
Communications	Video can also be used to stream instructional/informational or entertainment related content at campus public areas such as cafeterias, auditoriums, and stadiums.
Professional development	Using video technologies has proven helpful for primary and secondary in training teachers when sharing resources, exchanging ideas, recording and evaluating themselves, and taking full advantage of professional development opportunities they might otherwise miss.

The paper encourages educators, superintendents, administrators, deans, and information and communications technology specialists to see video technologies as tools that enable and support the learning process and that need to be complemented with forward-looking pedagogies, solid professional development programs for teachers, and a true integration with curricula.

Impact of Video in Education

Although the impact of video and multimedia technologies in educational outcomes is a field of ongoing research, the pedagogical impact of video can be summarized by three key concepts:

- 1) **Interactivity with content** (the learner relates to visual content, whether verbally, by note taking or thinking, or by applying concepts)
- 2) **Engagement** (the learner connects to the visual content, becoming drawn in by video, whether on-demand or real-time)
- 3) **Knowledge transfer and memory** (the learner may remember and retain concepts better than with other instructional media)

Because video combines many kinds of data (images, motion, sounds, text) in a complementary fashion, learning can be adjusted more easily than with other tools to the diverse learning styles and individual learning pace of students. With video, the learner has more control over the information he receives and an additional opportunity for deeper learning by being able to stop, rewind, fast-forward, and replay content as many times as needed.

Enhancement of Academic Performance

Although open questions still exist about the real impact of video and other multimedia materials in education, numerous studies show how video and multimedia tools support and enhance learning. Some of the conclusions of the studies analyzed in this paper show enhancement in the following areas:

Grades and performance: On-demand video has been shown to impact grades and test performance through a large number of studies conducted by colleges and universities. Some studies have led to the conclusion that students who engage in [viewing streaming video] outperform peers who are in a traditional face-to-face classroom.

School readiness: Educational television has been shown to have a positive impact on school readiness, including letter and number recognition. Positive relationships have been found between childhood viewing of educational television and cognitive performance at both preschooler and college levels.

Student's collaborative abilities: Access to video apparently encourages students to develop their problem-solving abilities via collaboration with others, which has important implications for future workers in a world more driven by teamwork, collaboration, and multicultural awareness.

Overall academic development: Educational TV can have positive effects on the intellectual and academic development of children. Similarly, many studies are beginning to confirm that blended learning—the combination of face-to-face and online instruction—can be equal to or superior to either face-to-face or online-only programs. Many blended learning programs include on-demand or real-time video as program components.

Workforce preparation: Video content and video literacy—both the understanding of how to take full advantage of video as a communications tool and knowing how to use technology itself—are considered a core competency when students leave university. Video can better prepare students for the workforce because it develops skills such as creativity, sociability, exposure to the spotlight, and civic responsibility, as well as qualities like self-esteem and cultural understanding.

Development of 21st Century Skills

Student Motivation: When students are given the opportunity to create digital material for classroom use, the feeling of empowerment, ownership, and sense of purpose is much higher. This in turns enhances the students' motivation toward a particular subject and also contributes to the development of additional skills such as innovation, creativity, leadership, social interaction, and project management.

Learner Engagement: An essential finding across multiple studies reviewed in this paper shows that on-demand streaming content increases student engagement. Individual control over the pace of learning enables students to review segments repeatedly of a lesson and feel that they are learning more effectively.

Learner conceptuality: Cross-cultural understanding can also be enhanced through video because of the “reality” or “conceptuality” provided by it. This can often decrease isolation, increase cultural awareness, and even help minimize xenophobia.

Social skills: Several studies point at a clear positive impact on the enhancement of children’s social and affective skills. Also, when students are allowed to create their own videos and share them with their peers as part of their classroom experience an effective part of learning (teaching to others) is developed.

Digital and multimedia literacy: Multimedia helps foster other 21st century skills such as critical thinking, problem solving, communication, and collaboration. In parallel, increasing use of video by students is bringing them closer to media and IT technologies, demystifying and placing them in the hands of learners as tools for content creation.

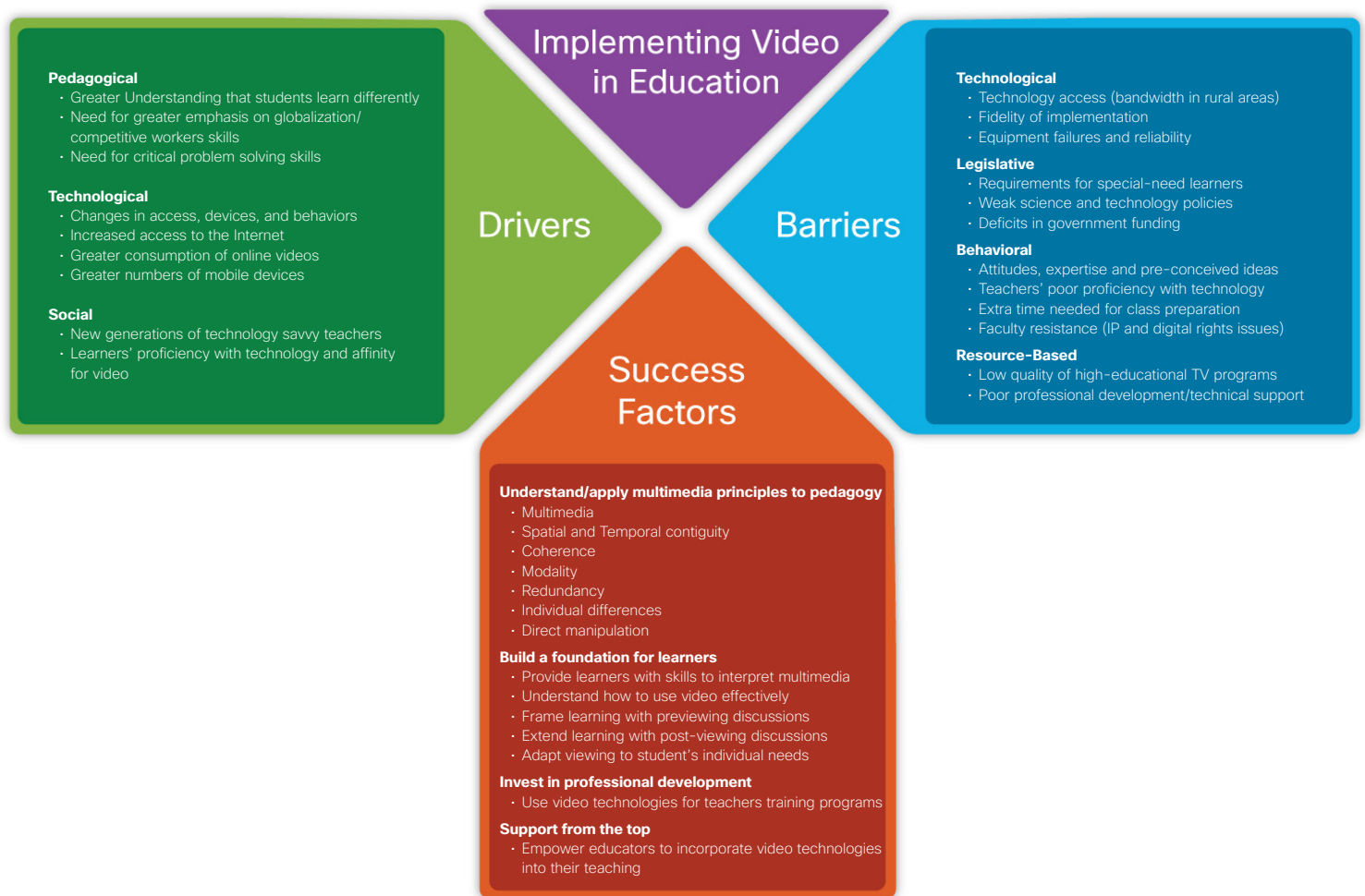
Adopting Video Technologies in Education

Successful adoption of video technologies in the classroom is a process that requires time, a clear vision of education transformation, proper integration with curricula and alternative methodologies, as well as the continuous engagement and support of teachers, learners, administrators and parents. Some of the drivers, barriers and success factors discussed in the paper are summarized in Figure 1:



Figure 1. Drivers, Barriers and Success Factors of implementing Video in Education

Source: Wainhouse Research



The use of video is only beginning to meet the needs of today's and tomorrow's learners. Video can help educators address the challenge of different learning styles and enhance the way in which today's children and youth access, absorb, interpret, process and use information. While not a panacea for good teaching, video is clearly an essential tool that can have a powerful impact on student retention of information as well as on student engagement.

As 21st century learners need to learn to be global citizens and to collaborate with others, learner-generated video will be a powerful tool in the hands of students. A common element of the 21st century skills movement is the practice of students creating multimedia content and delivering presentations to authentic (community stakeholders) audiences, and doing so throughout their education. Learners must be taught to be wise consumers of multimedia and must also be given the skills necessary for creating it.

The rapid availability of video tools supports the changing role of the educator. Teachers will increasingly perform the mentoring role both in person and over distance, across geographies and time and across different media. This will turn the world into a universal multimodal classroom, giving learners, educators, and their institutions access to vast amounts of content worldwide. Broadcast and streaming video will be essential elements of that multimodal learning model.

Cisco Video solutions for Education

- **Cisco Media Experience Engine (MXE):** Cisco MXE effectively captures and disseminates rich media information such as video across multiple endpoints and input formats. No matter what devices are used to capture video or display it, Cisco MXE optimizes video for viewing.
- **Cisco Show and Share®:** This webcasting and video sharing solution allows schools to create video libraries with simple tagging, archiving, commenting, and retrieval of stored video assets.
- **Cisco Quad™ platform:** This campus wide collaboration platform combines social networking with communications, teaching and operational information, and content management systems to create dynamic, secure professional learning communities.
- **Cisco Cius™ tablets:** The Cius tablet supports secure videoconferencing, mobility, and integration with Cisco Unified Communications solutions to empower teachers.
- **Cisco Virtual Desktop Infrastructure:** This solution enables schools to securely deliver a consistent desktop image to all user endpoints on its network from the data center. As a virtualized solution, it provides significant cost savings while simplifying management and control.
- **Cisco TelePresence solutions:** Cisco TelePresence solutions create live, “face-to-face” experiences over the network, empowering collaboration. Two-way or multipoint interactive video facilitates teaching, learning, and administration.
- **Cisco WebEx® solution:** Cisco WebEx® provides flexible instruction with extended reach online. Interactive features include real-time testing and grading, instant feedback, assessment tracking, breakout sessions, and hands-on labs to deliver a variety of dynamic e-learning opportunities.
- **Cisco Digital Media Suite:** This solution provides a content manager and video portal application that allows you to post video, tag content, provide feedback, and access libraries of media material.
- **Cisco Lecture Vision:** Lecture Vision is Cisco’s new solution to help educators create, manage, and share educational content with their students. The capability to capture live and recorded lectures to be easily accessed by students anywhere, at any time, on any device, including PCs, smart phones, and tablets. Cisco Lecture Vision allows you to brand and edit content and create video libraries with simple tagging, archiving, and retrieval of stored video. It also allows educators and students to collaborate on live and recorded content through tools such as social commenting, rating, and word tagging. It features integration with Cisco Pulse®, a video product that allows users to easily find videos based on what’s spoken and who’s speaking, allowing you to quickly zero in on portions of videos that are of most interest. Cisco Lecture Vision also provides integration and interoperability with interactive whiteboards during the capture process, allowing institutions to maximize their current investments.
- **Cisco Services:** Cisco Services works with learning institutions to implement cost-effective, well-planned, and robust network-based solutions for true 21st-century professional development environments. Cisco Services helps facilitate the rapid deployment of new applications with minimal disruption, while helping ensure a manageable migration path that protects and amplifies focus on academic achievement and budget requirements. Cisco Services includes a skilled, inclusive, and diverse professional bench—from technical support professionals and network architects, to application specialists and business consultants. To prepare for deploying Cisco video solutions, Cisco has created the Cisco Medianet Readiness Assessment Service, which assesses customer network infrastructures and their ability to transport the media-rich applications that need to be deployed. Through information collection and network profiling, infrastructure assessment, and application assessment, the service provides recommendations that help you prepare, plan and design your network for successfully implementing video and other media-rich applications.

Introduction

In the past 50 years, globalization, technology, and demographic shifts have dramatically redefined economic development, business, and societies at large. Economies have been intertwined as never before. The United States, the European Union nations, and other players have contributed to a complex web of economic interdependence, while countries like Brazil, Russia, India, and China have emerged as significant engines of growth. In parallel, work-and-life changing technologies like the Internet, mobile devices and social networking platforms such as Facebook and Twitter have transformed the way we interact and communicate with each other, helping us traverse the boundaries of geography and time, and making us active participants of other people's destinies.

In concert with the growth of social interconnectedness worldwide, education is undergoing an equivalent shift, as brick-and-mortar classrooms are opening up to rich media content, subject matter experts, and to one another. Two types of trends, **pedagogical** and **technological**, influence this shift:

Pedagogical Trends

- Greater understanding of how people learn, specifically that “one size does not fit all.”
- In developed countries, general agreement that schools and higher education institutions are challenged to address their missions in a rapidly changing world. In developing nations, a newfound emphasis on globalization and competitiveness.
- Critical problem solving, communication, and collaboration skills are now considered by most educational theorists to be just as important as-if not more important-than the ability, for example, to score well in multiple choice tests.
- Students' transition from passive receivers of content to active designers of their learning experience.
- Decline of brick and mortar institutions, and the rise of online learning and distance education. In North America, for example, the Sloan Consortium reported a 21 percent growth rate for online learning versus 2 percent overall higher education growth¹ in 2010.
- Major adoption of visual media as essential instruction mechanism, with increasing numbers of educators using video in the classroom.

Technological Trends

- Worldwide growth in access to the Internet: from 250 million worldwide Internet users a decade ago to 2.08 billion Internet users in 2011.²
- Propagation of video across multiple platforms. Currently, internet video accounts for 40 percent of all consumer Internet traffic, and will reach 62 percent by the end of 2015. The sum of all forms of video (TV, video on demand [VoD], Internet, and peer-to-peer [P2P] communications) will continue to be approximately 90 percent of global consumer traffic by 2015.³
- Proliferation of video-enabled devices such as smartphones and touch pads introducing a new type of lightweight solution for both educators and learners. By 2015, mobile video will represent about 66 percent of the world's mobile data traffic; mobile video will more than double every year between 2010 and 2015.⁴

There is no doubt that technology is a major contributor to the shift in the education landscape. Video, in its various guises and modalities (broadcast television, Laserdiscs, camcorders, videocassettes, DVDs, streaming video, satellite video, webcams, videoconferencing, lecture capture) has been a strong enhancer of education. It appears poised to be another powerful change agent adding value to the learning process while at the same time enhancing the quality of the learning experience.

This paper views video as both the sum of electronic capturing, recording, processing, storing, transmitting, and reconstructing of a sequence of still images that represent scenes in motion⁵, and as a pedagogical aid that can be used in many ways: as a **tool for learning**, as a **medium for collaboration**, and as a universal **language**.

This paper outlines the advantages of **broadcast and streaming video** as an effective tool for accelerating learning in the 21st century; it describes the impact of these video technologies in improving high-quality learning, and shares best practices and lessons learned from Cisco's work helping educators and decision makers across the globe implement video solutions. Although research is only beginning to tell the true story of video, the paper also draws on significant amounts of studies that have already been conducted in this field. The audience to which this paper is addressed includes:

- **Educators** wishing to gather more information about the advantages of broadcast and streaming video solutions in comparison to other tools for learning.
- **Superintendents, administrators, deans, and information and communications technology (ICT) specialists** seeking to find out more about available video technologies and their usability.



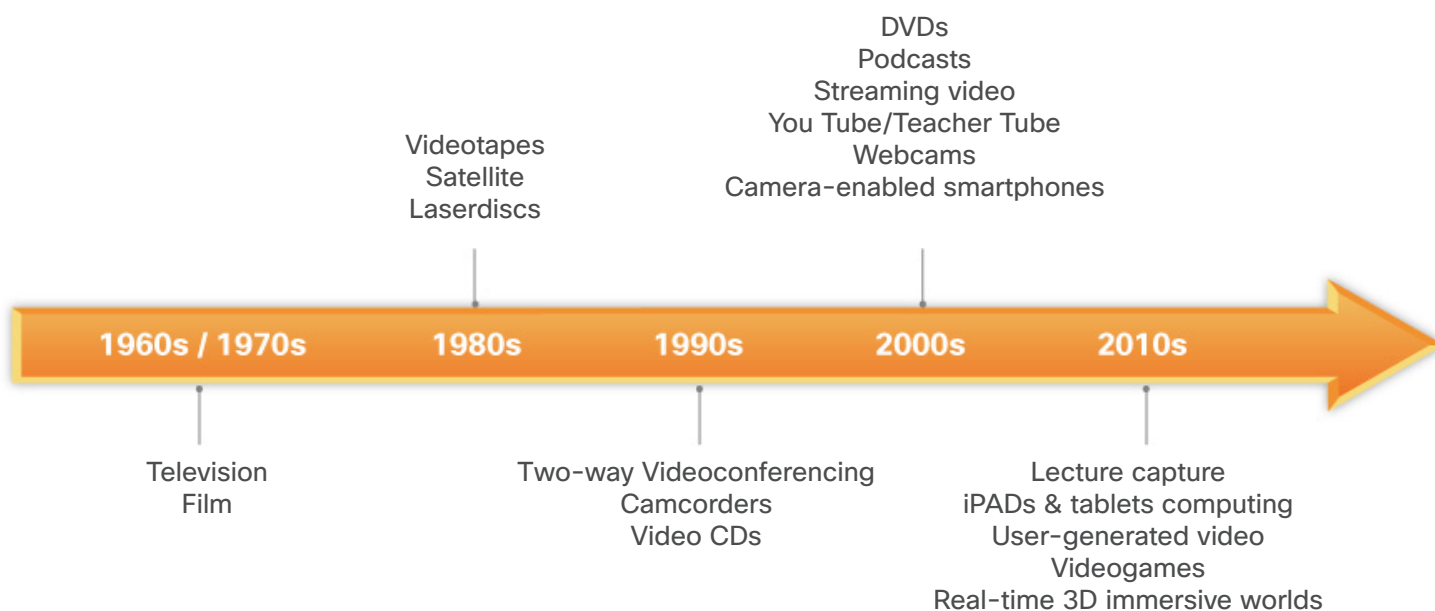
Background

Timeline

Video as a change agent in the classroom has undergone a unique cycle of adoption over time (Figure 2). Broadcast television and film were first used sparingly, primarily as out-of-the classroom forms of enrichment (assignments to supplement class work).

Figure 2. General Timeline for Visual Technologies in the Classroom

Source: Wainhouse Research



In the past 50 years, there has been a shift in viewer's behavior. Viewers have moved away from being passive spectators absorbing the images and content displayed on the screen ("reactive theory of viewing" – Winn, 1977) and have become active observers applying individual experiences and understanding to their viewing ("cognitively active theory" – Anderson, 1983).⁶

Beginning in the 1980s several new forms of video came along: LaserDiscs and the VHS videotape were popular methods of enriching the classroom with content, whatever the subject matter. Additionally, satellite delivery—which had already been available—became a more common method of delivering instruction in distance education networks. Camcorders made it possible for educators and students to begin to create their own analog content, although the means for broadly distributing that content did not yet exist.* In the first decade of the 21st century, classrooms became connected to the Internet sufficiently that digital content could more easily be distributed globally. Within a few short years, YouTube came to dominate the notion of how to bring video into the classroom for enrichment—and how to empower learners to create their own content. Devices like webcams and smartphones also came of age around the same time. Podcasts have brought the ability to create discrete audio files that could be delivered for educational purposes—and enhanced podcasts added video to the equation. DVDs brought the ability to build upon use of VHS resources, enabling greater depth of material because of the ability to add content digitally.

* A type of lecture capture, a time-consuming and costly manual distribution of analog or digital content (audio or audio/video) has been common at some universities in the past.

Digital technologies have brought about the seamless convergence of **broadcast video and streaming video**, where “silos” of networks and devices are no longer a factor and where video can now be delivered over multiple networks and to multiples types of devices. These technological improvements are critical; they mean that educators can spend more time focusing on their pedagogical goals, on individual student performance, as well as on content quality. The convergence of broadcast video and streaming video also gives students additional tools to better control their individual learning process, allowing them to pause, rewind, replay, and download content for later review either in the classroom or in the comfort of their own homes. It also has opened up access to user-generated video and the “back and forth” of instructor-to-learner and learner-to-learner interaction, which stands in contrast to the old instructional video model.

Key Definitions

Broadcasting is the distribution of audio and video content to dispersed audiences via any audiovisual medium.

Streaming video (also known as webcasting when conducted over the Internet) is the equivalent of broadcasting to large audiences and of making content accessible to learners in either synchronous or asynchronous fashion.⁷

A streaming broadcast might be live or recorded, with the core content flowing one way and having somewhat limited interaction capabilities. However, in recent years some streaming solutions have incorporated features that allow users to conduct live chats, post messages, edit, and tag, and share content, thus facilitating and promoting interaction.

Lecture capture systems are a subset of streaming products specifically designed for capturing and managing classroom content for learner access later on. Lecture capture systems help make content searchable and automatically blend not just audio and video, but also other productivity tools like PowerPoint, PDF files, flash animations, video clips, polls, surveys and other types of rich media content.

There are three primary ways to deliver video in education.

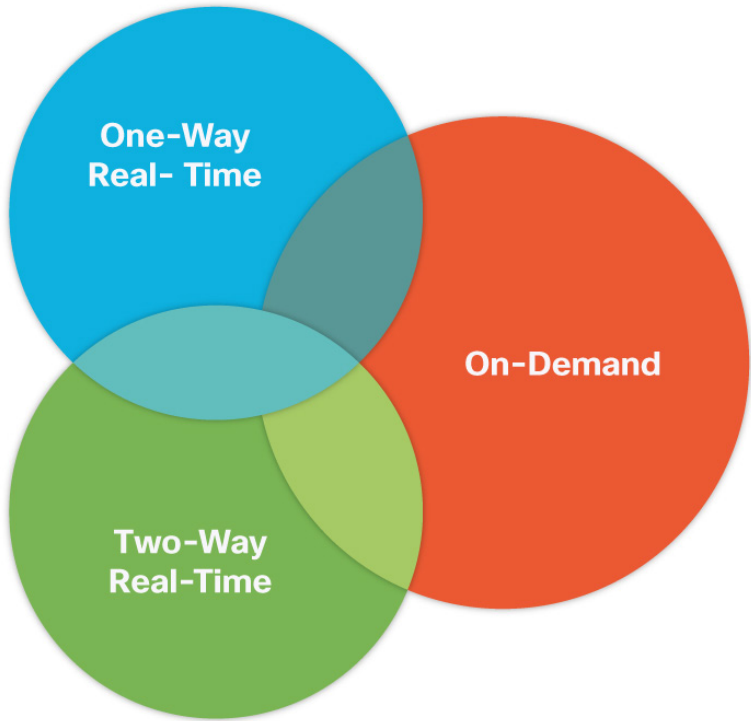
- **On-demand video**, which may be locally based or delivered on demand via the Internet.
- **One-way video**, which may be time-ruled, packaged, broadcast TV, on-demand streaming video, or real-time, instructor-based satellite TV.
- **Two-way interactive video**, which includes interactive videoconferencing, compressed interactive video (CAVE), video teleconferencing (VTC), and telepresence, a collaborative technology delivered by Cisco as the Cisco TelePresence® System (not the focus of this paper).



On-demand and **one-way** video technologies are characterized by being able to reach large audiences but offer relatively low interaction, whereas **two-way interactive video** technologies are characterized by their ability to offer higher levels of exchange and interactivity but reach out to more targeted or smaller audiences. As Figure 3 suggests, three groupings often function individually as media for teaching, while also at times functioning in tandem.

Figure 3. Three Major Groupings of Video for Education

Source: Wainhouse Research



The media through which video is accessed have evolved over time, based on a combination of cost and value equations (how affordable are the technologies) and pedagogical purpose (what are we trying to accomplish with these technologies). Table 1 provides examples of what is included in each video technology category. Table 2 lists the specific ways these technologies are delivered in the classroom.

Table 1. Examples of On-Demand, One-Way, and Two-Way Video

Source: Wainhouse Research

On-Demand Video	One-way Real Time Video	Two-way Real Time Video
- Longer format Digital Video Discs (DVDs), Video Home System (VHS), and Laserdiscs. Examples of content delivered this way include movies, educational programming, and on-demand broadcast content - Shorter format segments including YouTube clips, enhanced podcasting, and video-on-demand (VoD casting) delivered via streaming capabilities - Lecture capture, including archived lectures made available on demand via streaming capabilities - Video games, which can be delivered on demand or in real time	- Broadcast content, including educational programming - Streaming video, including live class or public events - Lecture capture, a form of streaming video that in some instances is delivered as live streaming as well as archived for on-demand viewing - Satellite delivery, which includes live instruction	- Satellite delivery, which in some instances includes two-way or multi-way live instruction - Interactive videoconferencing and telepresence technology, which consists of two or more locations connecting with live instruction, presentations, and collaboration

Table 2. Instructional Video Media

Source: Wainhouse Research

Instructional Video Media	On Demand Video	One-way Real-Time Video	Two-way Real-Time Video
DVDs, VHS, Laser Disc	X		
Broadcast Content		X	
YouTube Clips / Enhanced Podcasting / VODcasting	X		
Streaming		X	
Lecture capture	X	X	
Satellite		X	X
Interactive Videoconferencing			X

Applications

The later sections in this report describe the impact of video in the classroom. In this section, we offer a perspective on the uses to which **broadcast and streaming video** are put.

The major categories of applications include **basic instruction**, **classroom enrichment**, **accelerated learning**, **distance education**, **global student collaboration**, **communications via digital signage**, and **professional development**. Obviously within each area there are sub purposes at work. While we cannot describe every application and purpose, we list here below a sampling of how video is incorporated into each major application area.

- **Basic instruction:** In language classes by using web or DVD-based audio/video clips of speakers, visual or auditory stimuli are associated allowing better comprehension and expansion of vocabulary. Flood (1995) found that video has the potential to enhance the learning of foreign languages because its portrayal of “dramatized cultural context” with materials that illustrate the interconnection of language and culture, essential when learning a foreign language.⁸ Other examples include use of video in history and geography lessons where students can bring a subject to life, stimulate their ability to recall facts and events, and experience places they wouldn’t otherwise experience.
- **Advanced instruction:** ACPB (1997) teacher survey reported that video was used more in science than in any other subject area. The use of video for instruction of science subjects like physics, mathematics, astronomy and biology allows students to expand their understanding of complex concepts by strengthening the links between abstract ideas and practical applications. It also helps demystify these disciplines, which are often perceived as difficult, and increases student’s interest, engagement, and in-class participation. Videos are uniquely suited for taking students on “impossible” field trips, such as a trip inside the human body, and that can illustrate complex, abstract concepts through animated 3D images and show experiments that cannot be done in class.⁹
- **Classroom enrichment:** Video gives students the opportunity to travel to remote places outside the classroom walls without leaving school.



► Success Story

Pymble Ladies' College in Australia¹⁰ comprises five schools with a total of over 2100 students who expect to connect anywhere in the world, anytime, and from any device.

The need of making video available seamlessly across platforms and the pupils' desire for adding motion, color, and immediacy to their learning experience, prompted the Directors of the Institution to invest in **Cisco video technologies** like Digital Media signage, Cisco Media Experience Engine (MXE), Show and Share, and WebEx®. At Pymble Ladies' College, students use video to enrich their classroom experience connecting with experts, expanding knowledge frontiers and embarking on virtual tours like visiting life from the classroom with a diver at a Great Barrier Reef's exhibit.

"As soon as they come in, they are incredibly excited, and when they realize they can ask questions directly to someone in a diving suit underwater they are just fascinated...anything that is going to excite students is going to excite teachers." Mrs. Amanda Paterson, Head of Science, Pymble Ladies' College, Australia.



- **Accelerated learning:** Many rural and even urban secondary schools lack instructors in certain areas. One-way streaming blended with other online methods of communicating is one of several ways of ensuring that learners can take the college-level courses they need.
- **Distance education:** Thanks to the use of video, distance-learning programs have made courses and lectures accessible to populations in remote areas and also to students with disabilities or with physical impairments. Using video technologies for distance education programs is also of particular value to higher education institutions to for example expand their campus presence into other areas of a city, other states, and even to other countries. Research shows that distance learning through video technologies can be as effective as traditional instruction, provided enough room is left for interaction between students and lecturers and between students themselves.
- **Global student collaboration:** Research shows that it is through interaction with other peers that deeper and more sophisticated learning can occur. Video technologies can help students connect with peers located in different campuses and in different countries so that they can interact with different cultures, exchanging information and learning from each other.

► Success Story

The **Darla Moore School of the University of South Carolina** has developed an outstanding reputation on collaboration. Over the course of many years, the school has incorporated video technologies into the course structure in order to enable its students to interact with faculty and experts outside the campus. As an example, in an Organization Design class, students were connected with executives from NBC Universal in New York, to present and discuss findings and recommendations for a project they had been working on together. The School sees video collaboration technologies as a first step towards creating a live, interactive global classroom and an integral part of business education going forward.

- **Communications:** Video can also be used to stream content at campus public areas such as cafeterias, auditoriums, and stadiums. That content may be purely instructional or a blend of entertainment and information.
- **For professional development:** Primary and secondary school educators have strict requirements for professional development. Often they can meet these requirements through online tutorials with video components, where they can see either live instructors or review recorded sessions at their own pace. Recorded lessons also help “pre-service” teachers to become familiar with classroom settings before starting their field placements. Increasingly, busy educators are also taking advantage of recorded seminars and online virtual communities when they miss the “live” version. Using video technologies has proven helpful when sharing resources, exchanging ideas, recording and evaluating themselves, and taking full advantage of professional development opportunities they might otherwise miss.

Table 3 summarizes the applications of on-demand, one-way, and two-way video described above.

Table 3. Applications of On-Demand, One-Way and Two-Way Video

Source: Wainhouse Research

	On Demand Video	One-way Real-Time Video	Two-way Real Time Video
Basic Instruction	X	X	X
Advanced Instruction	X	X	X
Classroom Enrichment	X	X	X
Accelerated Learning		X	X
Distance Education	X	X	X
Global / Student Collaboration	X	X	X
Professional Development	X	X	X



The Impact of Video in Education

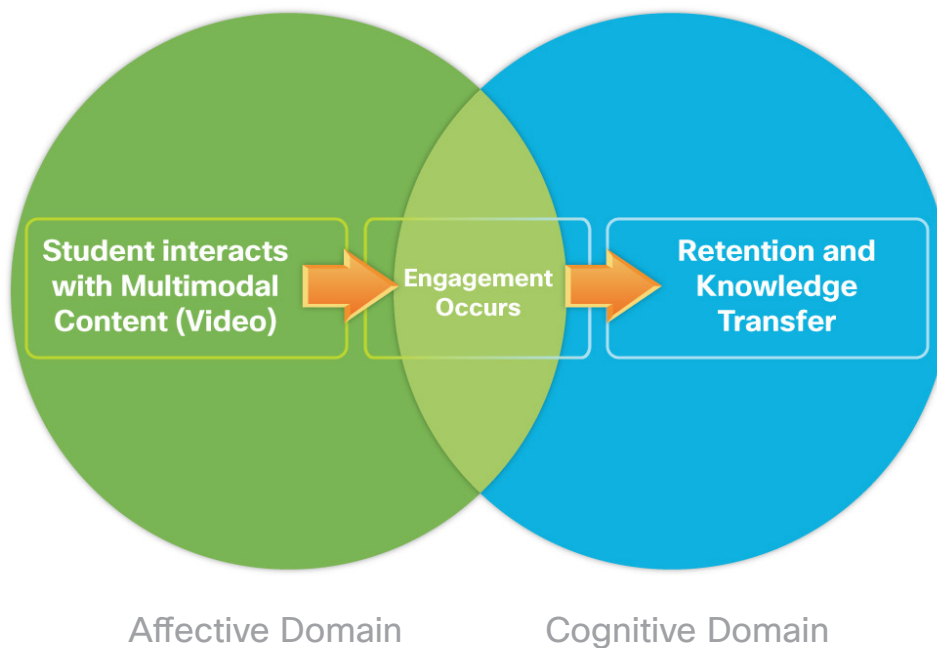
After closely reviewing more than 100 studies specifically related to research into all forms of video, 50 were selected as those showing clearly the impact of video in education. These studies lead us to believe that the pedagogical impact of video can be summarized by three key concepts:

- 1) **Interactivity with content**
- 2) **Engagement**
- 3) **Knowledge transfer and memory**

These are part of a continuum in which interactivity with content becomes the key principle and a means for cognitive development: the learner **interacts** with visual content, whether verbally, by note taking or thinking, or by applying concepts. **Engagement** occurs when the learner connects to the visual content, becoming drawn in by video, whether on-demand or real-time. Interactivity and engagement begin in the affective realm, the feeling side of learning. In order for interactivity to take place, the quality of the video experience should be high. Once engagement occurs, the continuum then flows into **knowledge transfer and memory**: the learner, according to some studies, may remember better.* The net result in theory is a combination of affective and cognitive development, and retention of content.

Figure 4 The Multimedia Learning Continuum

Source: Wainhouse Research



Video as an Additive Enhancement to Analog Tools

Just as one method of transmitting knowledge has never been enough, any individual grouping of media may never be sufficient. This is why texts, oral presentation, recorded audio, slides, and other forms of media *invite* enhancement by video. Video does not just add emphasis, however. It is becoming central to learning, a need felt not only by students who are growing up with rich digital technologies, but also increasingly by educators.

* Some debate exists on memory enhancement. Most studies believe visual content helps learners remember concepts and ideas and practices; a few disagree.

According to a survey by the Corporation for Public Broadcasting on the use of video and television in North American schools, 92 percent of the teachers interviewed considered that television and video helped them to be more effective teachers, and 88 percent responded that the technology enabled them to be more creative. Also, almost 80 percent observed highly positive student outcomes as a result of their classroom use of video technology (Corporation for Public Broadcasting, 1997).¹¹

Video not only consolidates visual and auditory stimuli into a single package, but also helps “bridge the gap between schools’ artificial environment and the outside world, bringing reality into the classroom.”¹² Another advantage of video as a learning tool is its outreach power, as large numbers of people, including those in remote areas, can learn directly from experts without having to travel.

Because video combines many kinds of data (images, motion, sounds, text) in a complementary fashion, learning can be adjusted more easily than with other tools to the diverse learning styles of students. With video, the learner has more control over the information he receives by being able to stop, rewind, fast-forward, and replay content as many times as needed. Howard Gardner’s multiple intelligences theory (logical-mathematical, linguistic, spatial, musical, bodily-kinesthetic, interpersonal, intrapersonal and naturalistic) concludes that traditional teaching methods, including lecture and textbook approaches, may only appeal to learners who lean toward a linguistic approach. However, teaching methods that include the use of video and audio will, in effect, “reach more students and provide more opportunities for neural development and learning” (Marshall).¹³

Research has also shown that the value of video is highly correlated to its integration within the curriculum and how it fits into the overall instructional sequence.¹⁴ That is why video should be seen as a complementary tool for learning rather than a substitute. Educational television, films, newspapers, textbooks, podcasts, radio, the web, and other type of media and educational technologies should be used in conjunction with traditional methods to enhance learning and promote student achievement.

How Video Technologies Enhance Students’ Academic Performance

The impact of video and multimedia technologies in educational outcomes is a field of ongoing research. To date, most of the research on the use of ICT in schools has focused on small samples, lacked rigorous controls, and has not been generalized to address large student populations.¹⁵ Although open questions still exist about the real impact of video and other multimedia materials in education, numerous studies show how video and multimedia tools support and enhance learning, offering a bigger advantage when contrasted with traditional unimodal methods.

A 2008 study commissioned by Cisco found that adding visuals to verbal (text or auditory) learning can result in significant gains in basic and higher order learning.¹⁶ Another study of 2500 sixth-graders and eighth-graders in Los Angeles showed a statistically significant increase in math achievement scores when students used streaming digital video on demand (Boster, 2004). In another example, Bryant, Alexander, and Braun (1983) found that viewers of early childhood educational programs demonstrated improved reading skills, mathematics skills, increased Peabody Picture Vocabulary Test (PPVT) scores (which estimate IQ and readiness for school), higher visual processing and spatial perceptual skills, and increased knowledge of health and human anatomy, as well as higher cultural awareness and better attitudes toward people of different races.¹⁷

Skills in the cognitive domain revolve around knowledge, comprehension, and critical thinking regarding a particular topic—and there is no shortage of literature exploring how video supports cognitive development and improves academic performance. Most of the research thus far on the impact of video on cognitive development has been conducted on higher education learners using video on demand, while most of the research on the impact on primary and secondary school learners has centered on one-way real-time video and broadcast video, with some research on on-demand video.

A series of studies conducted by the Children's Television Workshop (CTW) showed that after exposure to programs such as 3-2-1 Contact and Square One TV, children had an improved ability to recall facts, demonstrated higher problem-solving capabilities, and increased their overall interest in math and science (Children's).¹⁸ Another study from TV Ontario (1995), which surveyed teachers regarding the use of instructional video, concluded that the programs not only considerably sparked students' interest in class, but also allowed them to learn new information and helped them understand new concepts better (Stern).¹⁹

Some of the specific academic benefits of video include its impact on:

Grades and performance: On-demand video has been shown to impact grades and test performance through a large number of studies conducted by colleges and universities.²⁰ Some of these studies have been conducted using control groups and experimental groups, ensuring that true comparisons can be made and showing significant grade improvements among members of the experimental groups. This has led some to state that "Students who engage in [viewing streaming video] outperform peers who are in a traditional face to face classroom."²¹ Other studies are somewhat more subjective—for example, those that survey students regarding their opinions concerning their grades or other aspects of their educational experience. Retention rates also are being positively affected, according to some studies.

School readiness: Educational television has been shown to have a positive impact on school readiness, including letter and number recognition.²² This can be a long-term determinant, as according to the tone of the more in-depth analyses of educational television, "a positive relationship has been found between childhood viewing of educational television and cognitive performance at both preschooler and college levels."²³ Many teachers also believe that video content stimulates student's creativity (47 percent) and is more effective than other types of instructional resources or content (31 percent).²⁴

Students' collaborative abilities: Access to video apparently encourages students to develop their problem-solving abilities via collaboration with others.²⁵ This has implications for future workers for a world where there is ever greater emphasis on teamwork, collaboration, and multicultural awareness. Many on-demand video platforms support some type of student collaboration.

► Success Story

West Texas A&M University (WTAMU) in Canyon, Texas, is extending its reach to students and educators across the state and around the world by using Cisco® videoconferencing and online learning technologies. The WTAMU College of Business uses **Cisco Show and Share® solutions** for its Cultural Intelligence course, allowing students to create and upload videos, share them with students in Russia and Germany, and record their perspectives.²⁶

Overall academic development: A review of numerous research studies found that educational TV can have positive effects on the intellectual and academic development of children.²⁷ Similarly, many studies are beginning to confirm that blended learning—the combination of face-to-face and online instruction—can be equal to or superior to either face-to-face or online-only programs. Many blended learning programs include on-demand or real-time video as program components.

Workforce preparation: Students in colleges and universities expect video training as practical workforce preparation. A recent study by Forrester Consulting²⁸ shows not only that students learn through video content, but also that video literacy—both the understanding of how to take full advantage of video as a communications tool and knowing how to use technology itself—is considered a core competency when students leave university. Video can better prepare students for the workforce because it develops skills such as creativity, sociability, exposure to the spotlight, and civic responsibility, as well as qualities like self-esteem and cultural understanding. Video training can help students learn more global awareness, as well as how to position and convey messages appropriately, how

to present themselves to others, and how to address audiences. Video (accompanied by proper instruction) can also help students of all ages prepare for a future as global citizens because it allows them to meet students and teachers around the world, experience their culture, language, and customs while gaining a deeper understanding and respect for different values and ideas.

Many universities and school districts have been in the position recently to assess the impact of streaming, on-demand video on learner *satisfaction* and *performance*. Table 4 identifies a number of recent studies that support net positives.

Table 4. Some Quantitative Studies Related to Performance Improvements
Source: Wainhouse Research

Year Published	Institution	Key Findings
2006	Clemson University School of Education, ²⁹ South Carolina, United States	87 percent of students using lecture capture felt that it was a valuable part of course materials.
2009	Charlotte-Mecklenburg School District, North Carolina, United States	Composite retest scores on North Carolina’s science end-of-year exam for grades 5 and 8 increased by 44 percent when students used streaming video.
2010	University of Massachusetts, Lowell, Massachusetts, United States	91 percent of students using lecture capture felt it helped them learn course material.
2010	University of Colorado at Boulder, ²⁹ Colorado, United States – Undergraduates	91 percent were confident or somewhat confident that watching lecture capture improved their learning in class.
2011	Bergen Community College, Paramus, New Jersey, United States	10 percent jump in average grades in both biology and CAD/CAM courses using lecture capture.



How Video Technologies Ignite Student Creativity, Collaboration, and 21st Century Skills

Access to video can help to motivate students, engage them, and create a distinctive context for their learning experience.

► Success Story

The **Broadmeadows School Regeneration project** in Australia uses **Cisco video technologies** to create a 21st century teaching and learning environment. The incorporation of video in the classroom has allowed Broadmeadows students and teachers to: broadcast school announcements, participate in cross-curricular projects, use pre-recorded classes to overcome teacher shortages, leverage Internet video for in situ professional development and leverage Internet-based digital video to enhance self-directed learning. In addition, the technology combined with other project initiatives has not only contributed to a measurable 15 percent increase in literacy but also to a transformation in student and teacher attitudes towards the educational process.

"We've seen a massive shift in perception across the board. From the student's perspective teacher effectiveness has gone up significantly. From a staff perspective two of the key drivers are around student motivation and classroom behavior and both of those have improved dramatically." Wayne Craig, Regional Director of the Northern Metropolitan Region Department of Education and Early Childhood Development (DEECD), Victoria, Australia.³⁰

Student Motivation: Numerous studies reveal that learners are more motivated to interact with educational content when the content uses narrative storytelling, uses some degree of personalization, or offers some degree of control over how the content is accessed. Moreover, when students are given the opportunity to create digital material for classroom use, the feeling of empowerment, ownership, and sense of purpose is much higher. This in turns enhances the students' motivation toward a particular subject and also contributes to the development of additional skills such as innovation, creativity, leadership, social interaction, and project management.



► Success Story

With the aim of improving teaching and learning practices across 29 Lebanese schools, in 2010 Cisco funded the **I-DO project**,³¹ an effort supported by Lebanon's Ministry of Education and implemented by the International Education Association (IEA) to engage students and teachers with interactive digital technologies like video, wikis, and blogs to develop in-depth, science-research-based projects.

The most beneficial aspect of I-DO is the shift in teaching methodology from passive to active teaching, which enables students to take ownership of their learning, co-construct their knowledge, and share results. The process of planning media-related outcomes helps to develop a wide range of skills related to creative arts, technology, social interaction, communication, and project management, which results in greater autonomy and a deep sense of responsibility. Students were excited to think that their research would be shared with others who would find it useful, both in science content and as an example of a student-created product. The fact that others may learn from their research and video presentation gave students a deep sense of purpose, commitment, and responsibility. Learning had a purpose other than "learning for a grade," and was therefore arguably more meaningful and authentic.

"Before, group work was everyone alone at home and we would put them together at school. Now, we have learned to work in collaboration with each other and to be one team—to share and to work together in the classroom—and how to talk to people, ask questions, and get information. We are now more interested in the information than in the grades and exams." Students of Omar Farroukh High School.

An analysis of the information gathered also shows that the project had a dramatic impact on teachers and students' teaching and learning, motivation and relations: science became more relevant and enjoyable, and relations between teachers and students and amongst students improved. Teachers reported that they preferred this new method of teaching to the traditional approach. One of the teachers interviewed said the project changed her entire style of teaching; she now allots more time for reflecting and discussing questions with students than focusing on how many right answers she gets.

The program shows that collaborative projects structured around scientific research and the use and creation of digital and social media can significantly improve teaching and learning.

Learner Engagement: Many of the studies of supplementary video materials that are traditionally delivered via physical media—for example, DVDs and other multimedia formats—have shown that use of these materials lets students learn at a "pace that suited themselves."³² Longitudinal studies have shown that preschool children who watch educational programs like *Sesame Street* spend more time reading and engaged in educational activities.

At the same time, on-demand streaming content can be engaging, enabling learners to review segments repeatedly of a lesson and feel that they are learning effectively. This is an essential finding among a number of studies: individual control over the pace of learning increases student motivation and engagement, often because it uses a technology with which students are familiar or that they can easily grasp.^{33 34 35 36 37}

► Success Story

During Cisco's work on the **21S initiative in Mississippi**,³⁸ a math teacher used video recording to allow students to record and edit on-demand videos explaining how to solve a particular math problem and then upload them on a website for online viewing and sharing. The approach provided extended learning beyond the classroom, giving students control over the content they created and shared, leading to a remarkable increase in learner engagement and performance.

Finally, learner engagement with others outside the classroom is achieved via both real-time and on demand technologies. For primary and secondary school learners, who spend many hours of the day enclosed in brick-and-mortar institutions, any outside contact with fellow students elsewhere using user-generated video can be indispensable.

► Success Story

The focus on 21st century skills such as problem solving, collaboration, communication, time management, and self-management, rather than short-term outcomes like passing a course or writing a paper, prepares students for the world outside school. At the **iSchool** in New York City, projects involving the use of video technology helped students engage with a world outside their own high school classroom. Students conducted videoconferences with other youth from around the world to learn about their reaction to the terrorist attacks of 9/11. After compiling the video recordings, the iSchool students presented their work to the 9/11 Museum staff, who accepted this project as part of an exhibit. Students also worked with the New York Historical Society and Public Broadcasting Service to help create a website that will provide information for young visitors to New York City. By working on these projects, students not only developed knowledge relating to video literacy, web design, history, and cross-cultural communication, but also used video as a tool to engage with peers outside their classrooms.³⁹

Learner contextuality: Studies show a preference for video elements over pure text and/or static images, in part because some programs of study lend themselves to delivery via video. Similarly, cross-cultural understanding can be enhanced because of the “reality” or “contextuality” provided by video, which can often decrease isolation and even help minimize xenophobia.^{40 41}

Social skills: A clear positive impact on pro-social skills has been seen, with several studies indicating children’s affective skill—for example, sharing and acceptance of others—are enhanced.⁴²

Social skills are also built when students are allowed to create their own videos and share them with their peers as part of their classroom experience. “One of the most effective ways to learn something is to teach it to others.”⁴³ Studies show that when students are allowed to take a piece of knowledge and create something with it, their understanding of the information is much more profound than if they were to simply absorb the material.”⁴⁴

► Success Story

The **I-DO project** in Lebanon requires classes to produce a classroom video, wiki, or blog that contributes to the knowledge of other students. Distilling one’s learning to create a two to three minute video is a complex task. It requires selecting a specific topic for the video, formulating a clear message, writing a scenario and a script, shooting, and editing. Students need a lot of practice and experience to learn how to use the tools and what to include in the content. Creating a video not only generates innovation, creativity and artistic skills; through the process, students also develop important social and organizational skills such as respect for one another’s opinion, positive interdependence, accountability, and leadership.

Digital and multimedia literacy: Increasing use of video by students is bringing them closer to media and ICT technologies, demystifying these technologies by placing them in the hands of learners and making them tools for content creation. At the same time, multimedia helps to foster other 21st century skills such as critical thinking, problem solving, creativity, communication, and collaboration.⁴⁵

Adopting Video Technologies in Education

Drivers

Pedagogical, technological, and social drivers are helping to foster adoption of video technologies in education. Pedagogical factors include those items mentioned earlier in this paper: greater understanding that students learn differently; the need for greater emphasis on globalization and competitive worker skills; and recognition of the need for critical problem solving skills. Technological factors include changes in access, devices, and behaviors; increased access to the Internet; greater consumption of online video; greater numbers of mobile devices like smartphones and touchpads. Social drivers are twofold: a new generation of teachers has entered the workforce having grown up with technology, resulting in greater willingness to incorporate it in and outside of the classroom. In some countries, teachers' attitudes towards video also seem to be changing at a faster pace. The more teachers get familiar with the technology, the more they feel prompted to use it and to find optimal ways to incorporate it in their methodologies. According to the American Public Broadcasting System's (PBS) annual teacher survey on media and technology, the percentages of teachers finding value in multimedia and video content has increased each year since 2007.⁴⁶ Results for 2010 show that:

- 68 percent believe that video content stimulates discussions.
- 66 percent believe video increases student motivation.
- 55 percent believe it helps teachers be more creative.
- 62 percent believe video helps teachers be more effective.
- 61 percent believe video is preferred by students.
- 42 percent believe video directly increases student achievement.

Another factor driving adoption today is the learners' proficiency with technology and their affinity for video. Where teachers and learners alike may have been camera-shy in the past, today many of them are more willing than ever to be in front of, or behind, the camera as they incorporate video into teaching and learning. This makes video in the classroom somewhat "viral," as learners see their peers using video and adopt video themselves for learning.

Barriers

Challenges do exist for wider adoption of video in the classroom. These challenges can be categorized as technological, legislative, behavioral, and resource-based.

Technological barriers: Some institutions find on-demand streaming video to be a challenge due to access to the technology, especially when bandwidth is lacking—an issue frequently found in rural areas. Others cannot afford the bandwidth from their service providers necessary to deliver the quality of service (QoS) expected by their teachers and learners.

The way students and teachers use the technology and the fidelity of the implementation might also hinder success. The fidelity of technology implementation in a school is determined by leadership, teacher proficiency, professional development, fit with curriculum, school culture, and pedagogical approaches, and to some degree by levels and types of technology access.⁴⁷

Equipment failures and reliability also represent significant barriers to adopting video or any other type of technology in the classroom. Technical glitches might stem from the hardware as well as the software, and teachers do not typically have the background to troubleshoot quickly when problems arise. Continuous technical problems with the equipment might jeopardize the flow of information and the flow of the class, creating frustration and reducing the teacher's motivation to use the technology.

Legislative barriers: Some challenges are legislative in nature. Technologies in some countries must meet requirements of special-needs learners; in other cases, there might be an absence of a science and technology policy or even a deficit in government funding directed towards the implementation of new technologies in the classroom. Legislatures might fail to grasp the benefits of bringing technology to education, thus neglecting essential investments.

Behavioral barriers: Behaviors, attitudes, expertise, and preconceived ideas can become important barriers when adopting any new technologies or teaching methods. According to Polin (1992), there are four stages in the adoption and integration of multimedia technology into the classroom:⁴⁸

- 1) **The Comfort Zone**, when the instructor gets acquainted with the equipment and its operation.
- 2) **Disjointed Instructional Use**, when the instructor is able to work with the technology, but is still unable to integrate it with his or her instructional goals.
- 3) **Integrated Instructional Use**, when the teacher is able to integrate the technology into the instructional plans, but the technology still drives the plan.
- 4) **Transparent Integration**, when the focus moves from the technology to the content and instructional strategies. At this stage, the technology is no more than one of many tools used by the teacher to accomplish the educational goals.

Educators typically go through these phases when incorporating new technologies into their teaching methods. Some educators are reluctant to “teach” to a camera and feel at a disadvantage vis-a-vis their students regarding proficiency in technology. They have to work within the own school's culture, vision, resources, and guidelines for teaching or often have to adjust their own behaviors to improve interactivity.



When teachers use new technologies in the classroom, they often need to dedicate more time to class preparation, research, and coordination than when they give traditional lectures. The instructor may need additional time not only to get trained in the technology and familiarize himself with the equipment, but also to identify the appropriate place of the session(s) within the curriculum, research the appropriate content to use, plan for the recording of the lesson, and develop supporting materials such as handouts, slides, and further reading notes. For certain subjects (for example, mathematics, physics, and chemistry among others), teachers need to allot additional time for subsequent demonstrations and exercises that facilitate and consolidate the information transmitted through video. In the case of distance learning, instructors also need to take into account additional factors such as accessibility of supporting materials and extra time and interaction mechanisms for addressing follow-up questions, as well as engagement strategies that keep students motivated once the session has finished.

Another attitudinal challenge that is worth mentioning is faculty resistance. This is especially the case among some post-secondary educators who lack appreciation of on-demand technologies, particularly if they believe that intellectual property and digital rights issues may be at play. However, as several high-profile institutions have begun to post classes for public consumption online in recent years, more educators are accepting streaming lecture capture (as an example) as a net positive for professors, departments, and institutions.

Resource-based barriers: Some studies find the percentage of high-quality educational TV programs to be low.⁴⁹ This, of course, depends on the subject matter and educational level being discussed. For example, textbook publishers have become more media savvy in recent years tying together textbooks (digital or print), rich educational media, video, and Web 2.0 capabilities. This will improve over time.

Often resource challenges have to do with lack of professional development or technical support more than with the technology itself. Sometimes problems associated with the adoption of video gets confused with weak application of the technology (something that can easily be rectified through focus, training, enhanced content, or additional infrastructure).

Success Factors

Much of the research into video and learning has helped identify two major areas of concern: when does video enhance or improve learning, and what are the success factors that lead to those improvements? Design and pedagogy are factors that determine the effectiveness of video in education. Although strong pedagogical taxonomies have been designed by a number of academics, the challenge is much bigger: many educators lack an understanding of when and how to apply video. Understanding good practices can help institutions improve success in incorporating video technologies in the learning process.

Understand and Apply Multimedia Principles

In recent years, researchers have shown that increases in learning can occur when multimedia designers follow basic principles. Cognitive overload is one danger to avoid: “the limitations of working memory are a primary impediment to learning.”⁵⁰ Mayer and Moreno developed a widely recognized set of principles to help educators address how best to utilize multimedia without causing cognitive overload.⁵¹ Table 5 provides a ranking ordering of the key methods of incorporating multimedia into an educational setting.

Table 5. Mayer's Principles of Multimedia Design

Source: Wainhouse Research

Principle	Basis
1. Multimedia	Words and pictures work better together than either alone.
2. Spatial contiguity	Students learn better when words and pictures appear close to one another.
3. Temporal contiguity	Students learn better when corresponding words and pictures are presented simultaneously rather than presented successively.
4. Coherence	Students learn better when extraneous words, pictures and sounds are excluded rather than included.
5. Modality	Explaining graphics with audio improves learning. Animation and narration are better than animation and on-screen text.
6. Redundancy	Explaining graphics with audio and redundant text can hurt learning. Avoid reading on-screen text. Students learn better from animation and narration, than from animation, narration and on-screen text.
7. Individual differences	Design effects (animations, etc.) are: A. Stronger for low-knowledge learners than for high-knowledge learners and for B. Stronger for high-spatial learners than for low-spatial learners
8. Direct manipulation	As frequency and complexity of material increases, impact on knowledge transfer increases.

When these principles are applied to instructional multimedia materials, the students using these materials “on average, outperform students who learn using traditional approaches with single modes.”⁵²

As educators consider when and how to use video, often they are faced with a simple dilemma: when to use video, when to use text. One truism followed by some teachers is: “video is best for showing dynamic processes, while text is best for studying in depth.” But the author who makes this statement goes on to say, “A problem for online educators is to determine when to use video, audio, static images, and text so that they have the best pedagogical effect. Usually, the best choice is a mix of these, as appropriate.”⁵³ And while we agree that mixing as appropriate makes sense, we do believe that video is effective for more than simply showing dynamic processes, if for no other reason than that its narrative power lends itself to retention of content. Limiting use of video to teaching dynamic processes misses the power of storytelling.

Build a Foundation for Learners

Video itself, as stated earlier, is a tool for learning that when properly applied reaps wide benefits. It's also a medium for collaboration, and a language unto itself that is of universal appeal. As a tool, however, it can be misused. We believe video is best used not in isolation but as a piece of the scaffold for learning. Learners still must have, or be provided with background or supplementary knowledge. "Student learning is greatly enhanced when each student's prior knowledge is made visible."⁵⁴ And "outcomes are greatly enhanced and extended when the video is integrated into the rest of the lesson."⁵⁵

Part of the foundation is to provide learners with the skills to interpret multimedia. "Unless students have been trained to interpret visuals, the impact of multimedia will be minimal."⁵⁶ One academic, Ohler, puts it differently: "Being literate now means being able to read and write a number of new media forms, including sound, graphics and moving images in addition to text."⁵⁷ Yet content must always remain age- and skill-appropriate.⁵⁸

To provide learners with skills and understanding means that educators themselves must have the required set of skills. This does not mean every educator must become a filmmaker. It does mean educators need to understand how video adds value to the classroom, how to use it most effectively based on his/her teaching style and content requirements, and how to appropriately inculcate learners with the appropriate skill sets.

► Success Story

At **Duke University**⁵⁹, video technologies are changing the classroom experience. "The professor would pre-record a video for a topic that we are going to discuss and either asks us to watch it before class or watch it afterwards while he does a more interactive approach to it in class." Wesley Brown, Student, Duke University.

".. you make the classroom the place were those questions get really engaged and you get the fact-based material taught elsewhere." Peter Lange, Provost, Duke University.



The underlying research available provides useful recommendations to educators on how to incorporate video into teaching. Fisch (2004)⁶⁰ gives particular importance to the role of adult mediation and suggests important strategies to educators:

- Frame the learning with previewing discussion, setting video into a context, and elaborating on content that might be difficult for students to grasp
- Extend the learning via post-viewing discussion
- Adapt the viewing experience to the students’ individual needs

Rogow (1997)⁶¹ encourages teachers to plan their lessons ahead of time and identify the goals they are trying to achieve by using video as an instructional tool: spark interest, inspire, carry on complex demonstrations, enrich curricular content, practice a skill, reinforce or review a topic. He also defines a three-step process for teachers to promote interactive viewing in the classroom (Table 6):

Table 6. Rogow’s Three-Step Process for Enhancing the Outcomes of Video Presentation in the Classroom

Step 1 - Prepare	Step 2- Participate	Step 3- Connect
• Preview the program to be sure it meshes with teaching approaches and the class’ learning goals. • Determine the setting and length of the video: home viewing, in class, whole segments or clips.* • Set clear expectations for the students: be direct about the intended outcomes of viewing a particular video and the follow-up activities that will take place. • Practice with the equipment and cue up the relevant portions to be viewed.	• Preface the viewing with a few key questions and/or learning objectives. • Pause video to flag important concepts and to allow for questions. • Use captioning features to reinforce narrated information. • Consider a second viewing, especially for younger children. • Break students into small groups for discussion, or have them write down their thoughts and then share the results with the larger group.	• Choose follow-up activities that connect to hands-on experiences. • Explain all connections made, especially for early-grade students.

Source: Wainhouse Research

Another factor to consider is the attention span of students. Just as one study showed that use of short video clips was up for one experimental group while use of longer clips has declined, it is apparent to many educators that shorter videos are best suited to younger students. At any age, teacher presence during the presentation of video is important.^{62 63 64} When a “talking head” is part of the video presentation, the rule of thumb is a 15-minute segment. If more than that, “the talking head better have some ‘tricks up its sleeve’ to maintain interactivity and retain attention span.”⁶⁵

* Barss (2001) suggests that 10–15 minute clips are most effective as they don’t overtax children’s concentration and allow time for focused discussion



At the end of the day, all types of video can have a strong effect on the relationship between teachers and students. For one thing, video can bridge a shortfall contained in many asynchronous learning programs: the isolation and lack of timely guidance. Adding a contextual element helps anchor a learner, providing both affective support and helping to drive cognitive development.

Invest in Professional Development

Research bears out the need for ongoing, sustained professional development. Professional development is viewed as “key to successful use of multi-media instruction.”^{66 67 68} Similarly, “being able to use multimedia tools well is important not just to today’s students but required for today’s teacher.”⁶⁹ In part this is because if used inappropriately or ineffectively, technologies like video and multimedia can detract from the learning experience. But we agree with those who say that, “it is the quality of the pedagogy, not the technology per se that is the differentiator (in good teaching).”⁷⁰ Video-based technologies can support effective teachers, but it is not the technology itself that makes the difference. It is an enabler.

It helps when the technologies educators may incorporate into their own curricula are used for professional development, as this can result in first-hand experience about what works and what is less effective. One survey of school districts in North America determined that about 50 percent of those educators surveyed use video casts, podcasts, and streaming video for professional topics and examples of best practices.⁷¹



Support from the Top

Top-down support is a decisive factor for successful adoption of new technologies in the classroom. Educators feel more empowered when they have the support of their principals, and might be able to better integrate the technology into their teaching.

► Success Story

The **Mooreville School district** in North Carolina, US, is home to some 5600 students in grades K-12, distributed across three elementary schools, two intermediate schools, one middle school, one high school, and one technology and learning center. When Dr. Mark Edwards joined the Mooreville School district as superintendent, he found a school board galvanized around the single goal of dramatically transforming teaching and learning in the county. The board adopted a strategic plan with clear goals for the utilization of technology resources in all classrooms, focusing on academic achievement, engagement, opportunity and equity. Investing in professional development was given special significance and attention at a level unlike anything district teachers had seen before. For the first time, they were empowered to customize their learning (and that of their students) according to need. They were also encouraged to take a leadership role in creating an innovative, engaging curriculum using the new technology tools.

“The professional development was differentiated by content level, grade level, and each teacher’s response level. Then we did a lot with building ‘distributed leadership’ capacity, in every part of the district. Now Mooreville doesn’t have just two or three leaders in each school; we have 15 or 20 in each who are helping their colleagues, and helping refine their work.” Dr. Mark Edwards, Superintendent Mooreville Graded School District.⁷²

There are many studies highlighting good practices for adoption of video technologies in the instructional process. Appendix 1 identifies important studies and their findings. The studies selected on Appendix 1 are based on applicability and merit and not intended to be comprehensive.

New Frontiers

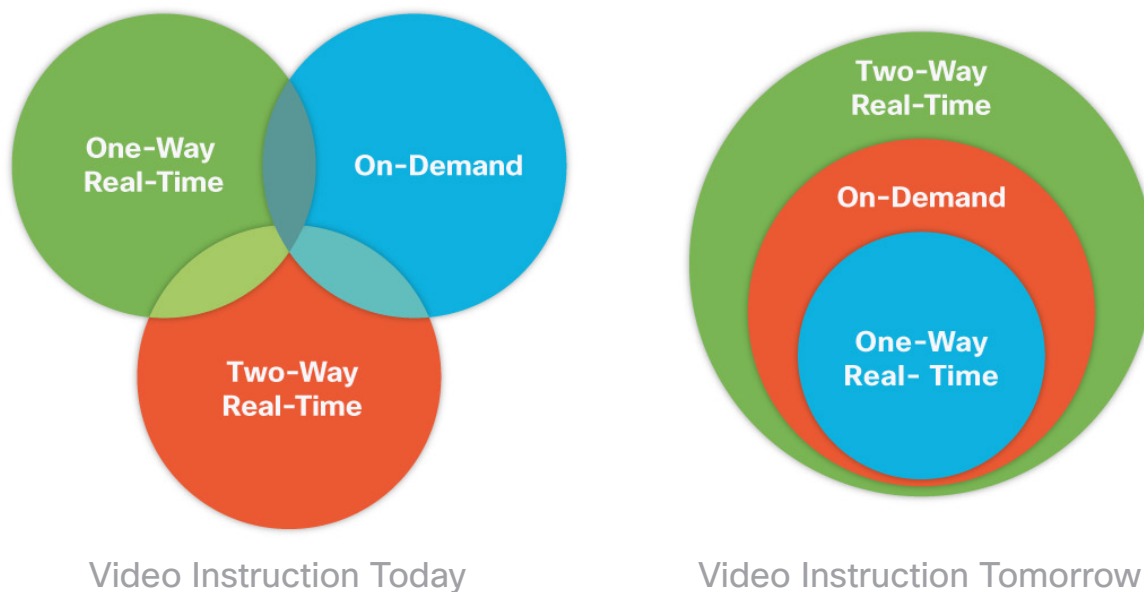
We began this paper describing the rate of change taking place today and how a range of devices will impact education and the delivery of video for educational purposes. We also described how the changes that have occurred took place gradually, as the many discrete forms of video entered the classroom individually over time.

What will change is the ubiquity and frequency of use of video. Because of the contextuality and richness video adds to educational processes, and because the infrastructure and technologies necessary to make it ubiquitous are finally here, educators will increasingly find opportunities to use and deliver video literally anywhere and anytime to three main devices: computers, smartphones or tablets, and televisions.

Similarly, the lines between the major forms of video delivery will begin to blur as the tools become available for shifting or adapting one medium into another, or one video segment into many formats (Figure 5). One major obstacle to adoption traditionally was that learners may have lacked a common set of tools, or institutions lacked the infrastructure for delivery to a common set of devices. Those obstacles are fast disappearing as technological developments provide solutions that address educator and learner needs.

Figure 5. Video Instruction Today and Tomorrow

Source: Wainhouse Research



Increasingly the boundaries between the different methods of instruction will dissolve and educators will find themselves with a number of possible methods of drawing upon existing video resources and creating new ones.

How Cisco Stays on Top of These Challenges

For many years, Cisco has been at the forefront of technological developments. Cisco's video solutions enable educators to improve communications inside and outside the classroom, expand learning opportunities, empower and engage students, teachers, parents, and communities at large, provide access to educational resources, and facilitate a collaborative learning process. Through these solutions, Cisco is helping schools and higher education institutions overcome distance and financial barriers to expand curriculum options, maximize resources, increase student engagement, improve learning outcomes, and deliver the type of education required for 21st-century global citizens. Cisco video solutions include:*

*For further information about Cisco video solutions, please visit: <http://www.cisco.com/en/US/products/hw/video/index.html>

- **Cisco Media Experience Engine (MXE):** Cisco MXE effectively captures and disseminates rich media information such as video across multiple endpoints and input formats. No matter what devices are used to capture video or display it, Cisco MXE optimizes video for viewing.
- **Cisco Show and Share®:** This webcasting and video sharing solution allows schools to create video libraries with simple tagging, archiving, commenting, and retrieval of stored video assets.
- **Cisco Quad™ platform:** This campus wide collaboration platform combines social networking with communications, teaching and operational information, and content management systems to create dynamic, secure professional learning communities.
- **Cisco Cius™ tablets:** The Cius tablet supports secure videoconferencing, mobility, and integration with Cisco Unified Communications solutions to empower teachers.
- **Cisco Virtual Desktop Infrastructure:** This solution enables schools to securely deliver a consistent desktop image to all user endpoints on its network from the data center. As a virtualized solution, it provides significant cost savings while simplifying management and control.
- **Cisco TelePresence solutions:** Cisco TelePresence solutions create live, “face-to-face” experiences over the network, empowering collaboration. Two-way or multipoint interactive video facilitates teaching, learning, and administration.
- **Cisco WebEx® solution:** Cisco WebEx® provides flexible instruction with extended reach online. Interactive features include real-time testing and grading, instant feedback, assessment tracking, breakout sessions, and hands-on labs to deliver a variety of dynamic e-learning opportunities.
- **Cisco Digital Media Suite:** This solution provides a content manager and video portal application that allows you to post video, tag content, provide feedback, and access libraries of media material.
- **Cisco Lecture Vision:** Lecture Vision is Cisco’s new solution to help educators create, manage, and share educational content with their students. The capability to capture live and recorded lectures to be easily accessed by students anywhere, at any time, on any device, including PCs, smartphones, and tablets. Cisco Lecture Vision allows you to brand and edit content and create video libraries with simple tagging, archiving, and retrieval of stored video. It also allows educators and students to collaborate on live and recorded content through tools such as social commenting, rating, and word tagging. It features integration with Cisco Pulse®, a video product that allows users to easily find videos based on what’s spoken and who’s speaking, allowing you to quickly zero in on portions of videos that are of most interest. Cisco Lecture Vision also provides integration and interoperability with interactive whiteboards during the capture process, allowing institutions to maximize their current investments.
- **Cisco Services:** Cisco Services works with learning institutions to implement cost-effective, well-planned, and robust network-based solutions for true 21st-century professional development environments. Cisco Services helps facilitate the rapid deployment of new applications with minimal disruption, while helping ensure a manageable migration path that protects and amplifies focus on academic achievement and budget requirements. Cisco Services includes a skilled, inclusive, and diverse professional bench—from technical support professionals and network architects, to application specialists and business consultants. To prepare for deploying Cisco video solutions, Cisco has created the Cisco Medianet Readiness Assessment Service, which assesses customer network infrastructures and their ability to transport the media-rich applications that need to be deployed. Through information collection and network profiling, infrastructure assessment, and application assessment, the service provides recommendations that help you prepare, plan and design your network for successfully implementing video and other media-rich applications.

Conclusions

The use of video is only beginning to meet the needs of today's and tomorrow's learners. A great deal of brain research has been undertaken in the past few years. Some of that research has identified the many ways in which learning styles vary—and video can help educators address this fact and adopt an approach Harvard's Clayton Christensen highlights as essential for innovating how the world learns: student-centric learning.⁷³

At the same time, the research indicates that children today are fundamentally different from previous generations in the way they think and in the way they access, absorb, interpret, process and use information, and above all, in the way they view, interact, and communicate in the modern world.⁷⁴ Students today are increasingly visual-spatial learners, able to multitask and interact with multimedia. While not a panacea for good teaching, video is clearly an essential tool that can have a powerful impact on student retention of information and on student engagement.

One could argue that the type of video is immaterial: whether a learner is interpreting a video clip, a broadcast presentation, or a lesson delivered via two-way video, the learner is in interpret, absorb, and digest mode. But hopefully we've shown that the type of video is indeed important. This is because video must be applied carefully, according to the pedagogic need at hand. Now that "silos" are much less of a factor and video can now be delivered over multiple networks and to multiples types of devices, how educators address their pedagogical goals will change.

The latest expectation for video is that just as 21st century learners need to learn to be global citizens and to collaborate with others, learner-generated video will be a powerful tool in the hands of students. Besides the group collaborative work enabled by other forms of video, learner-generated video means an educator can ask students to demonstrate how they would solve problems or teach others. A common element of the 21st century skills movement is the practice of students creating multimedia content and delivering presentations to authentic (community stakeholders) audiences, and doing so throughout their education. Thus, learners must be taught to be wise consumers of multimedia and must also be given the skills necessary for creating it.

Finally, the rapid availability of video tools supports the changing role of the educator. Traditionally an in-person mentor, teachers will increasingly perform the mentoring role both in person and over distance, across geographies and time and across different media. This will turn the world into a universal multimodal classroom, giving learners, educators, and their institutions access to vast amounts of content worldwide. Broadcast and streaming video will be essential elements of that multimodal learning model.

Appendix 1: Research that Identifies Improvement and Success Factors when Implementing Video in the Classroom

- **Streaming Video: Overcoming Barriers for Teaching and Learning** – This study features case studies of undergraduates in the fields of catering, fashion and teaching surgery. The experimental groups attended class but also had access to 30-second clips of content. Students in control groups attended class as usual with no access to video clips. The students with access to the streaming segments reported greater success in learning the content. One says, “Some parts I actually watched several times. It was very interactive. I found it better than attending a natural lecture because things I missed I could go back to [to] listen [to] again.”⁷⁵
- **Bringing the Classroom to the Web: Effects of Using New Technologies to Capture and Deliver Lectures** – This study followed 280 physics students who were divided into three groups: personalized video (live video of lecturer plus slides), neutral video (audio only of lecturer plus slides), and control group (normal in-class lecture). Surveys and focus groups were conducted. An interesting finding was that the control group focused more on their professors rather than content, which decreased the transfer of knowledge compared to the video group students. Overall, students responded more positively to the personalized video lessons than the other two modes of delivery.⁷⁶
- **The Effect of Context-Based Video Instruction on Learning and Motivation in Online Courses** – the authors of this study examined whether video-based instruction developed using constructivist principles can affect student learning. The study compared performance and attitudes of graduate students using video-based versus text-based instruction. A pre-post test covered understanding of material and motivation and retention. “The mean understanding rate was not significant between the two groups, however, video-based was perceived as being more effective in regards to retention of material.” The learner attention in the video-based instruction was significant in favor of video-based instruction over text-based instruction.⁷⁷
- **Multimodal Learning through Media: What the Research Says** – This overview of the research of multimodal learning debunks Edgar Dale’s Cone of Learning and provides a synopsis of the factors that make multimodal learning effective. Included in the findings: “Significant increases in learning can be accomplished through the informed use of visual and verbal multimodal learning.” But some caveats exist: “Unless students have been trained to interpret visuals, the impact of multimedia will be minimal.”⁷⁸
- **Zeus: E-Training Teachers in Rural Areas through Satellite** – This paper describes the findings from an implementation of the Greek ZEUS (Satellite Network of Remote Schools) project. The goal was to demonstrate how good-quality distance training, enriched with broadband applications, can be delivered to teachers working in very remote areas of Greece. Overall findings from the project surveys and observations included the following: Interactive training over satellite reduced feelings of isolation and increased opportunities for teachers and communication with colleagues. A full 100 percent of participants preferred satellite-based live interaction for training as compared to asynchronous online training.⁷⁹
- **Instructional Video in e-Learning** – This study compared interactive streaming video to no interactive streaming video. Interactive video is defined as “the use of computer systems to allow proactive and random access to video content based on queries or search targets.” This online learning environment enabled self-paced, just-in-time learning. The dependent variables were learning effectiveness, as measured by students’ test scores, and perceived learner satisfaction, as measured by a survey instrument. Four subject groups consisted of 34 undergraduates in each group. The results indicated that the interactive video with random content access may have “helped students enhance understanding of the material and achieve better performance, while no interactive video may have little effect.”⁸⁰

- **Reports on the Effect of the United Streaming Application on Educational Performance** – Two primary math groups, grades 6 and 8 were studied. The 6th grade group consisted of 1914 students and the 8th grade group consisted of 793 students. The experimental group had its math lessons supplemented with streaming video. Post-test results indicated that the experimental groups scored an average of 4.8 percent higher than control groups.⁸¹
- **Deepening Connections** – In this yearly PBS survey of primary and secondary school teachers, the 2010 report reflected key findings from 1401 teachers. Teachers who stream or download video content increased from 55 percent in 2007 to 76 percent in 2010. Teachers' use of short video clips (3 to 5 minutes) was up 29 percent compared to 2007. Use of longer segments (10 minutes or more) was down significantly. (We believe that this may reflect an improved understanding of how to utilize video most effectively in primary and secondary education.)⁸²
- **Technology in Schools: What the Research Says** – In an annual survey of educators by the Metiri group, educational television was rated as one of the top 10 technologies used in schools. A review of numerous research studies found that educational TV can have positive effects on the intellectual and academic development of children. One study of note found that “after analyzing 120 episodes across 40 program titles, only 1 in 8 children’s educational television programs (13 percent) met high-quality standards.” The Metiri report concluded that the efficacy of instructional programming “depends on the inclusion of high-quality content and sound pedagogy.”⁸³
- **Integrative Review of Educational Television for Young Children: Implications for Children from Low Income Families** – This review of literature discusses studies on instructional television. Longitudinal studies showed that preschool children who watched educational programs, and Sesame Street in particular, spent more time reading and engaged in educational activities. They also performed better than their peers on standardized measures of letter-word knowledge, vocabulary size, mathematics skills, and school readiness. These differences remained significant “even after controlling for variables such as parental education level and primary language spoken at home.” Long-term effects were found when the children subsequently entered school.⁸⁴
- **Can Distant Learning Method Be a Useful Substitute to Frontal Learning among Undergraduate Students?** – This 2009 study was based in remote locations in Israel in which adult students used a combination of live video feeds supplemented with telephone and video recordings known as “OFEK.” These classes were compared to regular face-to-face classes. Questionnaires revealed that students preferred studying through OFEK methods rather than “frontal” classes.⁸⁵
- **Interactive Televised Distance Learning versus On** – Campus Instruction: A Comparison of Final Grades-College level courses from the University of Nevada were delivered in a traditional face-to-face method and by live television with audio links. For none of the college subsets analyzed did the difference in means favor the on-campus, face-to-face students when grades were compared. “This defies conventional wisdom that generally holds that on-campus courses will produce more favorable outcomes. Significant differences favored the remote-site final grades for two of the four college-based subsets.”⁸⁶

Appendix 2: About the Authors

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