

Examining the Impact of Synchronous Video on Distance Education Delivery and Outcomes

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ABSTRACT

One of the greatest controversies with distance learning in higher education has revolved around which delivery methods are most effective and most closely replicate the traditional classroom experience. Course delivery technologies can generally be classified as asynchronous or synchronous, or a combination of the two (hybrid). This paper presents an evaluation of these methods as background for an exploration into the current trend towards use of synchronous video (video conferencing) as a primary course delivery mechanism. Research has shown that video conferencing in education has proven to be problematic, despite its promise for improving student and faculty communication and collaboration. The reasons for this will be examined and the new generation of high end video conferencing technologies (telepresence) will be examined for their potential to resolve these challenges. It will be shown that telepresence offers an excellent solution for many of the drawbacks of current video conferencing technology, but that it has the power to completely revolutionize distance learning in ways that may be in opposition to distance education's primary goal of delivering courses to those whose lifestyles or locations make it difficult to attend traditional classes. Educators are advised to pursue further research on telepresence to assess its many unanswered questions, and to take the time to evaluate how telepresence enhances or detracts from the mission of their institution's distance program before implementing this new technology.

Categories and Subject Descriptors

K.3.1 [Computers in Education] Computer Uses in Education - *collaborative learning, distance learning.*

General Terms

Human factors, educational theory

Keywords

Distance education, asynchronous and synchronous learning, videoconferencing, telepresence, collaboration

Introduction

For many educators, the primary research concern in the area of distance learning has been in validating that distance education is a viable delivery format. For many years, distance learning experienced an identity crisis as both the public and other educational institutions questioned whether this format produced the same learning outcomes as traditional classroom education. There was concern about whether a student could learn as much remotely and whether a course taken at a distance should be treated as equivalent to on campus courses. This was also complicated by the number of illegitimate diploma mills that had sprung up offering distance learning diplomas with little or no academic work required. Educators were also concerned about whether one technology was better than others in terms of learning outcomes.

The research overwhelmingly showed that students learned just as much at a distance as they did in traditional classrooms. Thomas L. Russell compiled the results of hundreds of reports, summaries, and papers on the subject to demonstrate this. Additionally, the research showed that there was "no significant difference" in the technology used for delivery, so long as it was suitable and reliable. Acknowledging this, says Russell, allows us to stop expecting technology to be the "be-all end-all to education", and start exploring the ways it can give students an edge beyond learning outcomes. Rather, it should be used as a tool for "reaching expanded populations". [2]

Armed with such knowledge, educators no longer had to focus on justifying distance learning in general, and began focusing on specific areas that could make the experience more satisfying for the students and faculty involved. One topic of interest has been in exploring asynchronous versus synchronous communication and its effects on distance learning.

Comparing synchronous and asynchronous communication

Distance education can generally be classified in one of two categories; synchronous and asynchronous. Synchronous learning is that which happens in real time.

Communication is immediate and similar to what may be experienced in a traditional classroom. Asynchronous distance learning is more akin to independent study. Often, a student is given a set of tools such as access to a course website or course CD where they can login per their personal schedule to view lectures, complete assignments, send emails to the instructor or classmates, or communicate via a bulletin board. Early distance education systems were nearly all asynchronous, but the current trend is strongly in favor of synchronous methods. In actuality, most current distance education systems use blended or hybrid methods where the different methods are combined. "Ideally, hybrid learning combines the best of both worlds" [10], though the reality is that many educators perceive hybrid learning as a transitional state from the legacy asynchronous systems to modern synchronous systems. To understand why this movement in favor of synchronous education is occurring, we must first examine the characteristics common to each methodology.

Asynchronous learning can be completed at anytime by the student provided that course expectations and deadlines are met. This is one of the primary advantages to this type of learning. Distance education, as originally conceptualized, was designed to make it possible for students whose location or life circumstances made it difficult for them to come to campus for traditional classes. Since coursework could be completed according to the student's schedule, adult students with full-time jobs and/or families could work around their schedule. Students who lived far away from a college, no longer had to move closer or make a long commute to campus. Asynchronous learning is highly flexible, and has made college possible for many more students for whom it has not been in the past.

Asynchronous education also offers flexibility in how each individual chooses to learn. Course material is frequently offered in a variety of formats which may include pre-recorded lectures, lecture notes, multimedia clips, and readings from textbooks, periodicals, or other websites. Each individual has some degree of freedom in choosing the material that best suits their learning style and course objectives. Additionally, the assignments in asynchronous courses often require writing and critical thinking or completion of projects, rather than rote memorization of material. Because of this, asynchronous learning is often favored by students who are self-motivated and who get little out of traditional classroom experiences. Conversely, the sometimes less structured curriculum of an asynchronous course proves more difficult to less organized or self motivated students.

Some claim that shy or introverted students have fared particularly well in asynchronous distance learning courses. Though an in depth comparison of introversion versus extroversion is beyond the scope of this paper, it is important to note a few important details on these two

personality types. First, extroverts are typically outgoing people who get energized by being around and communicating with others. Extroverts tend to speak and act quickly, often without thinking through their comments or actions until later. It is estimated that extroverted people comprise about 80% of the population. Despite a common misconception, introverts like people as well, but find it exhausting to be around them all the time. Introverts are energized by their inner world of ideas and reflection and require alone time to recharge. Introverts may be shy and have trouble speaking up in groups. Part of this is due to the fact that they need time to formulate their ideas before speaking about them, and this often doesn't work with the fast-paced verbal exchanges favored by extroverts. Introverts often prefer to communicate in written form because of this.

In many traditional courses, class participation is expected, and those who are uncomfortable speaking in front of groups, or who have trouble responding quickly to a question or scenario may be perceived by a predominantly extroverted academic community as poor students or lacking intelligence. Asynchronous education has provided an environment where many introverted students are more comfortable, allowing them to excel academically where they might not have otherwise.

Of course, any educational method that favors one personality type or learning style is going to leave out those on the opposite end of the scale. One of the biggest complaints about asynchronous learning is that it offers little opportunity for interaction with the instructor and other students. Email and bulletin board discussions do not appeal to students who get more out of verbal exchanges and for whom social interaction and a sense of community are important. When interaction is lacking in a course, the instructor may be unaware of student needs and unable to adapt the course content as needed. Students may be confused by assignments and course objectives. Feelings of isolation, frustration, and even anger may be experienced by the student. [10] Instructors also have difficulty observing many of the unspoken clues that they can normally obtain just by observing students such as fidgeting, facial expressions, or diligent note-taking. [15] Without this feedback, it is much more challenging to be an effective teacher.

Synchronous education on the other hand, makes real time communication possible by allowing "participants to communicate via video/computer conferencing, audio-graphic conferencing, picture phones, chat sessions and instant messaging. It stimulates face-to-face dialog and promotes a sense of community." [10] This is the core difference between synchronous and asynchronous learning methods and it touches on many important areas of the educational experience.

Synchronous learning has been shown to have better overall student outcomes. Courses are more engaging and motivation is higher. Camaraderie with other students is important to many people and the interaction gained in a synchronous course helps to foster social, behavioral, and physical skills development. [10] “Community building is at the heart of human learning. (When) students feel that they belong to a learning community, they are more apt to persist in solving problems and therefore succeed”. [16]

Effective communication is admittedly more difficult when those communicating are unable to read facial expressions and body language. Without these important cues, it is hard for students to experience an instructor’s enthusiasm for a topic which leads to lower student motivation. Additionally, non-verbal cues lessen the possibility of misunderstandings. Emotion is a critical part of effective communication, and asynchronous methods of communicating offer little to facilitate this other than text-based emoticons. [12] Synchronous distance learning maximizes the potential for effective communication.

Though synchronous education has a lot to offer, there are tradeoffs. As discussed earlier, introverted and extroverted students often have different learning styles and needs. Though asynchronous learning offers some clear advantages to introverts, synchronous learning is likely to be more appealing and effective amongst the extroverted population. Often when one delivery method is chosen by an educational institution, the other personality type is left at a disadvantage.

Another disadvantage of synchronous education delivery is that a large amount of flexibility is lost by the student. Since communication is to occur in real time, classes need to be scheduled at regular dates and times that may not meet the needs of many students. When you consider that one of the primary objectives for distance learning in the first place was to allow learning opportunities for students whose lives were not conducive to regular on campus attendance, this is a major drawback. This will be explored in more depth later.

The Appeal of Videoconferencing

Many educational institutions are focusing their distance course development efforts around live streamed video presentations. Distance education has matured and legacy asynchronous delivery systems are being retired due to both real and perceived inadequacies and complaints from students and faculty. Video conferencing is moving to the forefront of next generation distance learning. Numerous studies support the widespread belief among students, educators, and analysts that video conferencing is able to encourage interactivity in learning and is an “indispensable” learning tool. In fact, synchronous video could be said to demand interactivity. [1]

Part of the appeal of videoconferencing is that it “supports fluid conversation” and “takes the distance out of the education.”[8] Further, Anderson says that synchronous video offers benefits over pre-recorded video or no video at all if students and instructors seize the opportunity created by the technology to learn from each other through interaction.

Though the majority of universities with distance programs are still using primarily asynchronous systems, synchronous technologies are being slowly introduced into the mix. For some, this is as simple as real-time text based messaging (chat) sessions. Others are using web conferencing systems that allow for real-time audio and file/desktop sharing. It is unknown how many universities have taken synchronous technologies to the next level by offering courses with live streamed video, but several well-known universities including the University of Washington, USC, Rensselaer Polytechnic Institute, USC, and Penn State have established distance education programs incorporating synchronous video.

Research on Synchronous Video

Though distance education has been a popular topic for research in the last decade and much has been analyzed in terms of synchronous communication in general, there are relatively few studies that evaluate courses delivered via real-time synchronous technologies. This is probably due in part to the fact that the technology itself has only recently achieved a level of maturity and affordability to educational institutions.

The University of Washington is one school that has tested synchronous video in actual courses and is perhaps the most compelling case study to be found. In partnership with Microsoft, the university was chartered to develop the Conference XP platform, an educational based video conference system. Prior to designing the system, the university conducted a distance learning course using existing video conferencing equipment to help them discover the issues that would affect the new design. The study was conducted by joining a local site on the university campus with a remote site at a company. The two sites were both outfitted with conferencing equipment, cameras, and microphones. Viewers from the local site were able to see the students at the remote location, but remote viewers were only able to see video of the instructor and hear audio, but not see the other students. In this first study, student surveys and observation showed little participation by remote students, and an abundance of technology issues including poor audio quality, problems transferring data from the electronic white board, and interruptions/failure of the video conference system.

Further research using the newly developed Conference XP platform surfaced most of the same problems and more. Technology problems were still at the top of the list, but feelings of disconnection were a constant second. The

instructor still had a hard time reading the body language and facial gestures of remote students, mostly because the size of the projection was too small. This made it difficult to provide feedback and read the understanding (or lack of) from the remote group. The instructor also felt removed from the remote students and that he didn't really know them. Local students echoed the same feelings. It was as if these remote persons weren't really there. Though working technology was a necessity for remote students, it was not for the local ones. Local students still found the interruptions extremely distracting and one local student stated that they'd prefer to be in a class that was not broadcasting to remote students. [8]

It is surprising and telling that so many problems persisted in the second study despite awareness and attempts to rectify issues discovered with the first study. Perhaps this is testament to just how difficult video conferencing can be and how many variables are involved.

The Open University in the United Kingdom is another institution that has been at the forefront of distance education and is the top distance learning provider in all of Europe. They conducted a qualitative study on a voice groupware system called Lyceum. This system allows for two-way synchronous audio in conjunction with whiteboard and file sharing capabilities for class brainstorming, note-taking, and posting slides. Though students rated the course positively and felt it enhanced their learning, they too complained of poor audio quality and internet bandwidth issues as having a negative impact. Additionally, it brought forth the observation that online collaboration can be much more exhausting than the live version. It takes much more concentration when audio is inconsistent and faces can't be seen to hear and understand what others are saying. The conclusion was that technology based teaching sessions need to be shorter. Additionally, students had problems installing and testing the system, reminding educators of the burden of technology on students and the need for good support systems. [6]

Tradeoffs and Challenges with Synchronous Video

It would appear that synchronous video is not living up to its expectations. Here we will explore further issues that explain why this is. As mentioned previously, technology difficulties are at the top of the list. Most often, this is the result of insufficient bandwidth to support the infrastructure. Klass points out that most students rely on internet service providers that do not support the data rates typical of the local area networks used within businesses and universities.[13] This can have a huge impact on the reliability of the video stream. Schools are often unaware of this issue because it is not experienced when the stream is tested from other web browsers on campus. Some students may combat this issue by connecting to the class session using their employer's often faster network, but this is not an option for all students.

Another challenge created by the technology is that the audio and video streams are sometimes not synced up. [8] This can be confusing when a person's lip movements and body language as seen on video do not match the audio that is being heard since it does not match the way people naturally communicate. On that same vein, the often small projection size and low resolution of the video (implemented as a way to conserve bandwidth) do not allow clear views of facial expressions which aid in understanding. [8]

Additionally, some course delivery systems such as the popular Elluminate program, only allow the person with control of the virtual microphone to speak. Nobody else can interject their comment until the first speaker releases the microphone. If the instructor is lecturing using this microphone or a student is in filibuster mode, students cannot interrupt to ask questions or make comments. They have to somehow get the speakers attention by raising a virtual hand or sending a chat message. These visual cues are likely to be missed by the speaker, and students miss opportunities to participate.

Not only do issues such as these force students and faculty to adapt to the technology instead of it adapting to them, it also creates inequity for remote students in terms of opportunities to be seen or heard and reduces the amount of possible interaction. Remote students get short changed and may experience some of the isolation that was frequently reported in asynchronous delivery methods. This is a serious problem since the primary goal of synchronous video instruction was to increase the amount of real-time interaction among students and instructor.

All these outstanding issues beg the question of whether synchronous video has really lived up to its expectations. Are the gains made by increased interaction worth the extra frustration, time, and cost it takes for video-conferencing? Given the evidence, it would be easy to conclude that technology has not actually come as far as first thought, and that it might still be years before audio and video can be synchronously streamed in ways that minimize these negative effects.

Introducing Telepresence

Several companies, however, are offering advanced video conferencing technologies that they claim will solve the majority of the problems experienced by current systems. These new technologies are grouped under the category of telepresence. A telepresence system is a high-end videoconference system that uses the technology in such a way that it gives the appearance of individual(s) being present at a location other than where they truly are.

Cisco describes its leading telepresence solution in a white paper:

Cisco Telepresence enables eye-to-eye contact between participants as well as allowing participants to observe non-verbal cues. Through the use of multiple video cameras and screens, students and educators are able to see one another at the same time they are viewing shared video, and are able to conduct an electronic dialogue without the constraints of time and place.

The quality of audio and video, the size of the images, and the specially tuned environment are designed to make participants feel as if they are all sitting around the same table despite being miles apart. With Cisco Telepresence, the image resolution is up to ten times better than existing video conferencing and voice and video are synchronized.

Cisco Telepresence rooms are carefully designed complete with lighting, furniture, and acoustic details to support a virtual learning environment. Cisco's solution for camera placement at eye level provides the most effective method of delivering eye contact gaze perspective, and they dynamics of human meeting within the practical limits of the two-dimensional world. Critically audio is high-fidelity and directional as well, further enhancing the sensation of same-room presence as well as increasing intelligibility overall. [5]

All this is accomplished with the use of very large plasma displays that project the participants at actual size. The displays are placed at distances that create a comfortable sense of personal space between the individuals at each participating site. When a telepresence solution is purchased, designers and systems engineers from the provider conduct complete room and site surveys to ensure proper lighting, furniture arrangement, and compliance with established network requirements. These are not self-installed systems – the site surveys ensure consistency and quality of service, greatly minimizing and even removing the technical difficulties experienced by typical video delivery systems. As one would expect, all this comes at quite a cost – current ranges generally run \$50K to \$300K per room installed.

In addition to Cisco, a number of companies including Teliris, HP, Polycom, and Digital Video Enterprises offer telepresence solutions that vary in the number of persons that can be projected, number of displays and sites supported, room, and network requirements. All of the

leading solutions, however, are designed to address the deficiencies in typical videoconference systems and will be grouped into the single category of telepresence for the purpose of future discussion.

The Future of Telepresence in Distance Education

There is no question that telepresence is an exciting technology full of possibility for distance education delivery. In fact, as these systems become more affordable, the potential exists to completely revolutionize distance learning the way that the introduction of the WWW did over a decade ago. It's always easy to be seduced by the promises of new technology, however. Before we jump ahead and decide that telepresence is the future of distance education, it is important to examine the impacts that this technology might have on the distance education landscape.

One of the first things that one might notice about telepresence is that it is remarkably similar to attending a class in person. Everything the instructor says and does is seen and heard by the remote site as well as by those physically in the room with them. Every student in attendance has the same opportunity to be seen and heard. There is no longer any significant difference in attending a class locally versus a remote site.

What this means for universities, is that course websites, web conferencing, and learning management systems are no longer mandatory. Remote students have the same opportunity for receiving information as local students, simply by attending class at a remote telepresence site. In traditional classes, students who show up for class get copies of the syllabus, get to hear and learn from the lectures, take tests, participate in class discussions and projects, and turn in assignments. Those who don't show up miss these activities; learning and/or grades suffer as a result.

In many ways, such a setup would make delivery of distance education much easier. Instructors who taught courses via traditional methods would not have to make any changes to the curriculum or process in order to deliver the class at a distance. So long as the educational institution had a telepresence solution in place, the instructor would only have to teach from a telepresence room. On the surface, this sounds ideal. Instructors would no longer have to have any specialized training in distance education or be wizards at using all the technologies needed to conduct a distance course, as is the case with current course delivery systems. Additionally, the inequities between distance student and on-campus student would be almost completely obliterated. The only special mechanism that would still be needed was a way for distance students to transmit assignments or tests. Email would easily fill this need with no additional technology burden to the school.

Unfortunately, distance education delivered in this manner would result in some major losses as well. First of all, courses delivered through telepresence, like traditional on-campus classes, would offer less support for diverse learning and communication styles. One of the great things about distance education in the past decade, is that it has inspired a great deal of research on how differences in personality and learning style affect what a student gets out of a class. Traditional classes have been said to appeal more to auditory, verbal, or extroverted learners than visual, written, or introverted learners, as most of these courses revolve around the instructor verbally delivering a lecture or verbal classroom discussions among students. In this environment, students who are better at processing information visually, communicating in written form, or are shy are at a disadvantage.

The hybrid distance courses that are currently offered at many universities are better at balancing varying student needs. For example, the software Elluminate allows students to ask questions or make comments via audio microphone or written chat client, depending on their personal communication preferences. Additionally, most current online courses provide a level of anonymity that may be comforting to a shy student, as most of these systems do not broadcast video of the individual student (rather just the instructor) and audio participation is optional (and only available if the course is delivered synchronously). In most cases, written communication through email, chat, and bulletin board discussions are the norm. If distance learning went entirely in the direction of telepresence, this aspect would be lost.

A second and possibly more severe consequence of courses delivered via telepresence is that distance students would lose most of the flexibility that made distance learning so attractive in the first place. As discussed earlier, the number one goal of distance education programs is to enable persons who cannot attend class at regular times to have a flexible learning environment. The majority of distance students are adult learners with jobs and/or families – both of which can interfere with the ability to attend class at a set day and time. Additionally, distance programs reach out to students who live far away from a university and cannot commute or relocate in order to attend classes. With current distance courses, students generally only need a computer with an internet connection, and possibly certain software. Telepresence on the other hand, is very costly and out of reach to all but the wealthiest students. Affordable individual telepresence systems are still many years away from realization. To participate in a class delivered through telepresence then, students would have to find the closest participating telepresence site, and show up there at designated dates and times. These sites are likely to be few in number and will most likely be situated in high population areas, at least initially. The scarcity of viewing sites, and the

inflexibility in schedules would be a huge loss to the students for whom distance learning made a college education possible.

Of course, there are scenarios where telepresence is an attractive distance learning option. One such scenario is the ability to deliver a single course to multiple schools. Many specialized courses have to be cancelled due to low enrollments, especially at the graduate level. The ability to deliver a course to several universities would allow school's to broaden their course offerings without having to hire additional faculty. Students would benefit from the additional choices. Telepresence would also enable better collaboration between one or more universities and/or companies for the purpose of joint research projects.

Evaluating Telepresence

Still, there is much that is unknown about telepresence that should be explored before universities put forth the enormous cost of implementing such systems. With telepresence being such a new technology, there is almost no research that proves its effectiveness, but rather only anecdotal evidence that is often prepared by a solution provider's marketing team.

One of the challenges with the study of distance education in general, is that usually only one delivery method is tested. For example, a university may study the effect of using Blackboard during one semester and collect student test scores and qualitative feedback about the experience from students via surveys. Though this may help a school to learn what needs to change to make Blackboard usage more effective, it doesn't actually compare this delivery method with others that might have been used. Still, educators may try to compare courses that have too many different variables. A humanities course delivered asynchronously by one instructor cannot be adequately compared with a math course delivered via synchronous video by a different instructor. One would never be able to isolate whether discrepancies in outcomes were the result of differences in teaching style, the subject matter, technical issues, or other factors.

For distance education research to be truly useful, it needs to remove as many extraneous variables as possible. An ideal research study to evaluate telepresence would be structured as follows. Three different sections of the same course would be taught by the same instructor. The first section would be taught using only asynchronous methods. The second would use a typical hybrid system that includes both synchronous audio or video and the use of an asynchronous course website. The third section would be taught using only telepresence. A study structured in such a way would allow for much more accurate comparison between delivery methods.

Naturally, all sections of the course would need to focus on the normal measures of effective teaching and learning including individual participation, test scores, student and faculty satisfaction, etc. The birth of telepresence, however, opens up many other questions that should be explored that are perhaps unique to this technology.

Some questions that telepresence research should address include:

1. Do faculty and students have different perceptions of each other dependent on whether the person is physically in the room with them or “telepresent”, and do these perceptions affect learning outcomes, final grades, or instructor evaluation? Many of us have experienced a surprise at meeting somebody in person whom we have seen on video or even talked to on the phone. Our perceptions often change after a live meeting. Is telepresence real enough to eliminate this issue?
2. How do faculty and students feel about being on camera and microphone and does this affect participation or effectiveness of communication? Most of us know someone (or are that someone) who hates being photographed or followed around with a video camera, or become tongue tied when leaving answering machines that are recorded. Would this be an issue with the use of telepresence? Some research already suggests that it would [18]. This should be explored further.
3. Can people really pick up on non verbal communication cues as easily through telepresence as they can in person? All the telepresence providers claim yes, but where is the proof?
4. Do students feel more motivated and engaged by this delivery format? Student satisfaction is strongly linked to learning outcomes as well as the likelihood of completing a course of study.
5. Is this delivery method more widely accepted by those who still doubt the validity of distance learning? Though the research consistently shows distance learning as effective as traditional learning, there is still a bit of a stigma attached to it. Employers often rate graduates of distance programs lower than those of traditional programs and some universities do the same when evaluating students for graduate study. Additionally, the most prestigious universities rarely offer degrees at a distance. Would telepresence change that?

Conclusion

Telepresence is certainly an exciting technology development that holds great promise for improving communication and collaboration amongst students and faculty in distance learning programs. The technology is so

advanced that it can remove many of the barriers previously experienced by asynchronous and low bandwidth synchronous delivery systems, including reduced participation, feelings of isolation, technical interruptions, and poor communication. Despite all these positive attributes, educators need to be cautious about implementing telepresence until they've thoroughly evaluated how it meets the objectives of their school's distance learning mission. Flexibility and availability of courses could be severely compromised with telepresence as could support for diverse learning styles. Additionally, this new technology area has undergone little actual research. A telepresence solution is too costly to be taken lightly and without full understanding of its true impact on educational outcomes and student/faculty communication.

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