

Improving Hybrid Course Delivery in Distance Education with Emerging Technologies

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ABSTRACT

As educational budgets continue to shrink, colleges and universities have turned to online course delivery as a means of increasing enrollments. In addition, with the proliferation of Internet-based course management and other software that facilitate the learning experience, many traditional courses are adding an online component, creating hybrid courses in different formats. In this chapter, we explore different strategies and technology solutions to help instructors develop rich, dynamic courses, whether they are completely online or hybrid courses that use online tools and technologies to augment the traditional class. This chapter covers the advantages and disadvantages of hybrid courses, technologies and practices available for them, emerging technologies such as Second Life™, social networks, dense wavelength division multiplexing, telepresence, satellite networks, and the use of texting in the classroom.

1.0 INTRODUCTION

Online education is often defined as involving the Internet and web-based technologies to deliver distance education. It can be delivered asynchronously, where the students and instructor do not communicate in real time, using web-based technologies such as asynchronous discussion boards, electronic repositories, and e-mail. It can also be synchronous, where the students and instructor communicate in real time using web-based technologies such as chat rooms or video conferencing over the Internet (Martinez, 2004).

While online education has become routine with 65% of graduate programs across the country using the Internet to deliver classes (Norton and Hathaway, 2008), many colleges and universities are still struggling to discover how to provide a quality educational experience. Menchala and Bekele (2008) found that a variety of technologies and learning styles as well as instructor and administrative support are required to achieve an engaged, productive, and collaborative classroom experience.

This chapter offers a variety of strategies and technological solutions that educational institutions, academic administrators, and faculty could employ to improve hybrid course delivery in distance education with emerging technologies. Readers could consider this chapter as a resource guide for delivering hybrid education. To this end, the chapter specifically addresses; what is distance education today and hybrid course delivery, advantages and disadvantages of hybrid courses versus “pure” online and traditional courses, emerging software and information systems that support teaching and learning online, and strategies for overcoming existing challenges of the classroom today and tomorrow.

2.0 BACKGROUND

2.1 Distance education today

Distance education is often defined as instructional delivery where the student is not in the same physical space as the instructor and other students. Most distance education today is delivered via Internet technologies. Distance courses can be completely synchronous where the instructor and students meet together in virtual environments such as live chat, video, or audio streaming at the same time. They can also be completely asynchronous where the students and instructors use web-based technologies such as discussion forums, blogs, wikis or social networking tools to communicate at different times and on their own schedules. Courses can use a blend of synchronous and asynchronous communications and technologies to enhance the total experience, which we refer to as hybrid classes. In addition, hybrid classes can mix a traditional face-to-face class with different online technologies. For example, many university courses use information systems like Blackboard/WebCT for course management. It is also not uncommon for a live class to be broadcast via streaming Internet video and also archived for later Internet viewing.

The value of distance education continues to grow in importance. In 2007, it was estimated that at least 2.3 million students were enrolled in online classes in the United States (Smathers, 2007). According to the GAO (2007), enrollments in higher education distance classes have almost quadrupled since 1995. The Sloan Consortium reported that over 3.9 million students nationally took at least one online course in the fall 2007 semester. This represented a 12% increase over 2006 statistics (Heck, 2009). Distance courses and programs in higher education represent a real avenue for growth, expanding opportunities for traditional and non-traditional students. This represents an opportunity as well as a reality for most institutions of higher education. With the cost of tuition rising and economic downturns across the country, providing an alternative means of educational delivery benefits everyone. Less time and cost in traveling, more potential course availability, and greater access and convenience all contribute to the value of distance classes (Jackson & Helms, 2008).

3.0 TECHNOLOGIES AND PRACTICES FOR ONLINE EDUCATION

3.1 Hybrid Course Delivery in a Mixed Educational Environment.

Traditional classes are those that meet in a physical space in real time with instructors and students present. Pure online classes, which can be synchronous (in real time) or asynchronous (the meetings are not at the same time) are held virtually, usually via the Internet. Finally, hybrid courses use a variety of techniques to combine traditional and online courses. For example, a traditional course may have online asynchronous discussions. Many variations can exist for hybrid courses.

Prior research has revealed some patterns relating to the quality of both online and traditional classes. A consensus is that the course delivery methods, student participation and involvement, the quality of instruction as well as the class culture for learning, the course and program administration, and support all represent vital factors contributing to the quality of the learning experience (Miller & Husmann, 1996). While these factors are important in all forms of class delivery: traditional, online or hybrid, researchers have found that the traditional face-to-face class usually is preferred by students. However, with new, emerging technologies and software products, online or hybrid classes may be able to simulate the rich, contextual face-to-face classroom experience if developed and implemented properly. In an interesting study, Jackson and Helms (2008) found that students offered positive and negative perspectives about hybrid classes. For example, while the distance students had more time to digest and reflect on the material, the in-class students had richer contextual cues and explanations about the content

from the professor. Similarly, distance students found that the professors who provided a variety of delivery systems (online content, YouTube videos, discussion forums, etc.) enhanced the depth of the content and class experience. In contrast, the live students still benefited from in-class explanations and the ability to explore a topic as questions arose. Therefore, both systems have their advantages and disadvantages and hybrid classes still benefit and suffer from those factors. The challenge is how to enhance the benefits while reducing or mitigating the negative aspects. New, emerging technologies and software solutions may help.

With the exponential growth of Internet use, the first collaborative technologies were termed Web 1.0. These included e-mail, video-conferencing, chat and discussion forums. One significant form of the discussion forum was called the “Community of Practice” or CoP. (Wenger and Snyder, 2000). Social learning theory suggests that people who form personal networks or communities develop relationships that enhance the learning experience. Therefore, an important component in a distance class is to actively nurture and promote these communities of practice where members regularly engage in sharing and learning, based on common classroom goals and projects. Another benefit to these Web 1.0 communities (often called discussion forums that are divided into specific interest or project groups) is the transmission and spread of tacit knowledge among participants to increase the overall learning experience.

Research in distance learning has shown that a strong sense of community is crucial in the success of distance classes. Another important element in addition to trust and rapport is a shared sense of purpose in the learning community (Conrad, 2008). For example, students who work collaboratively on projects develop camaraderie and a sense of purpose in the achievement of their class goals.

Participants in online classes also succeed when they have a high comfort level with the technologies required for use in the class. For example, using software like Blackboard/WebCT or searching the library’s online databases for research must be user friendly and seamless in the course.

New, emerging Internet-based technologies, called Web 2.0 should also be considered for distance classes. These include online social networks, blogs and wikis. As these have become more widespread across many different age cohorts, their use in distance classes should be considered among the many tools to incorporate.

Social networks, such as Facebook, have become the de-facto communication tool among traditional college students. However, these networks are also being adopted by people in all generations and many socio-economics groups. The ability to easily communicate via instant messaging, images and the incorporation of video such as You-Tube holds great promise in the virtual classroom. These new technologies and tools also have features that greatly facilitate work among students, which include shared calendars to coordinate work and scheduling, document editing, white board collaboration, and task management capabilities. Social desktops are new tools that offer a desktop area where many different applications (calendars, forums, messaging, etc.) can be accessed by collaborators in a unified manner. Even widely accepted distance educational technologies like Blackboard (webCT) have now incorporated Web 2.0 features. For example, Blackboard 9.0 has added blogs and journals that students and professors can use to easily capture and share their reflections and knowledge (Redden, 2009). These updated distance technologies are also using the digital dashboard approach commonly found in the business world to make different applications easily available to students and professors.

Another value of incorporating social networking technologies involves the ability to engage the students and increase their comfort level with the technologies and thus, with the course. According to the Technology Acceptance Model (TAM), user attitudes influence their acceptance and adoption of technologies (Lee et al., 2003). Therefore, by incorporating widely used and familiar technologies like Facebook into an online course, student can “hit the ground running” when they begin the course, feeling

confident in their use of technology and the ability to communicate effectively with fellow students and the professor. Another interesting example of a social networking tool is Twitter. This performs similar function as Facebook, and is also a widely used and accepted communication platform. According to Ritter (2008), “At Penn State, twitter has changed the culture on campus and has given us ways to connect across our university that we couldn’t have imagined. We’ve used twitter to ask for help, work on projects, discuss topics during conferences, schedule impromptu lunches, and offer things for sale. We’ve planned meetings, found opportunities to collaborate and have become a much more connected, intelligent, communicative group that now includes people from several Penn State campuses, departments and academic colleges. We are IT professionals, professors, advisers, learning designers, and students. We have used twitter to build a community that now thrives at Penn State.” Her statement clearly shows the value of a technology like this in an online class as well as across the campus.

Similarly, widespread use of video technologies such as You-Tube greatly enriches the educational experience, particularly in an online class, where students appreciate the real examples and audio-visual experience.

Beldarrain (2006) encourages the use of new, emerging technologies like Blogs (Weblogs), wikis, and podcasts. Blogs encourage writing and reflection while wikis (central knowledge repositories like Wikipedia) encourage contributions to collective knowledge building. According to Wikipedia <http://en.wikipedia.org/wiki/Podcasting>, “A podcast is a media file that is distributed by subscription (paid or unpaid) over the Internet using syndication feeds, for playback on mobile devices and personal computers.” They can be used to download audio or video files on a computer, creating new representations of ideas and communication. Bonk and Zhang (2006) extend this model by suggesting that these emerging technologies support different learning styles. For example, podcasting would facilitate an audio-learning style while blogs or communities of practice / discussion forums could support an innovative, reflective learning style. Instant messaging, chat, online simulations, and portals represent other potential technologies to create active learning in online classes.

3.1.1 Advantages and disadvantages of hybrid courses vs. "pure" online and traditional courses.

As discussed earlier, there are significant differences between traditional face-to-face classes vs. pure online classes as well as hybrid classes. While there are challenges in each type of course delivery, there are also commonalities in learning theories that can be used in any of these classes. Table 1 presents a summary of these factors.

Table 1: Advantages and Disadvantages of Different Course Delivery Methods

	Advantages	Disadvantages
Traditional face-to-face classes	Richness of the interactions, development of relationships & trust	Inconvenience of time and location. Limitations on time.
Pure Online Classes	Convenience, 24/7 access, time to digest and reflect on content	Lack of rich, personal interactions
Hybrid Classes	Can present additional online forums for reflections and discussions. May provide additional access to overcome time and geographical constraints.	May present problems if technologies are not used correctly.

Overview of the Advantages & Disadvantages of the different classes:

- Traditional face-to-face courses:
 - Advantages: Personal attention, ability to interact in a real-time environment, adapt to changing conditions or nature of the class and content, and immediacy of responses and interactions among professors and students. The professors and students also have the opportunity to develop trust, rapport and relationships over the semester. Abstract and complex issues are easier to convey and explain in a face-to-face environment.
 - Disadvantages: Inconvenience of time, travel, short, limited duration of the class, personality conflicts, not enough time to digest and reflect on class presentations and discussions.
- Pure online courses:
 - Advantages: Convenience, accessibility, ability to spend time on course content and class discussions before responding.
 - Disadvantages: Lack of rich, contextual cues from face-to-face interactions, potential feeling of separation from class, instructor, classmates, difficulties in using technologies.
- Hybrid courses: The positive aspects of both traditional and online courses can be incorporated to enhance the overall experience such as use of virtual networking tools to bring everyone together. On the other hand, the negative aspects such as a dichotomy between the traditional and online students can also be a disadvantage to a hybrid class. These topics will be explored in greater depth in the next section. This also depends on the tools and technologies used on the hybrid class. For example, traditional classes are experimenting with social networking technologies to communicate, collaborate and simulate virtual worlds with systems such as Second Life™. Therefore, the ease of use of the technologies, the fit to the goals of the course and the student learning styles will all contribute to the advantages or disadvantages of delivering a hybrid course.

If we examine theories for successful learning irrespective of the delivery method, we can find commonalities to promote success in both environments as well as the hybrid model.

3.1.1.1 Active Learning:

According to research in learning theory, active learning, otherwise known as problem based learning has been shown to be the most effective method for students to learn, apply, integrate and retain material (Burch, 2000). While it is relatively easy to present students with projects and problems in a traditional classroom, another related approach, called distributed problem-based learning (dPBL) has been used effectively in online courses (Wheeler, 2006). In this method, students collaborate on projects using virtual teams. The advantage of using problem-based learning in both types of course delivery is that it motivates and engages students in a tangible problem and creates a sense of shared purpose among the students to solve a significant problem.

In a hybrid course, this becomes more challenging. Over the past six years, teaching hybrid graduate courses, I have attempted to use this approach. In some classes, when allowing students to self select their teams, I have observed that the in-class students select each other while the virtual students tend to select each other by default. What I discovered is that this creates a “divided society” within the class with an “us vs. them” mentality, leading to sub-optimal class cohesion, discussions and knowledge sharing of the class materials and topics.

In response to this, I require all teams to

- Include both “live” and “virtual” students. Again, the live students naturally tend to develop richer relationships. However, what I discovered is that by integrating live, video-conferencing into the class and the teams, this divided structure is greatly reduced.
- Use a Diverse Mix of Technologies and require ALL students to use them.

Therefore, creating a vibrant hybrid class involves delivery of content and promoting collaboration and communication using a variety of technologies and learning methods.

3.1.1.2 Using Web 1.0 and Web 2.0 Technologies

As discussed in a prior section, experimenting with both Web1.0 technologies (e-mail, discussion forums, web pages, video-conferencing) as well as Web 2.0 technologies (social networks, blogs, wikis, podcasts) also serves to enhance the overall learning experience. People respond to different communication methods and technologies in different ways. In addition, different technologies serve to facilitate learning and communication in different ways. For example, discussion forums can be very effective for thoughtful, reflective knowledge sharing on projects and class topics. In contrast, live, two-way video-conferencing is necessary to introduce people and allow them to develop trust and relationships. Social networking sites promote more spontaneous communications while technologies like YouTube create more relevant meaning by demonstrating concepts and models.

3.1.1.3 Creating Trust and Rapport in the Class

A crucial component to a successful distance class is to establish a culture of participation and interaction among people who have had little or no personal contact. Communities of practice (CoP) which encourage respect and tolerance while clearly communicating shared goals, help to create a vibrant online class. In addition, we believe that by challenging students and creating an intellectually stimulating, creative environment, where students explore areas of interest to them, a culture can be created to improve communication and motivation in the class., thus adding meaning and value to the CoP. As mentioned above, in a hybrid class, it is imperative to require both the in-class students as well as the distance students to communicate and collaborate using the same technologies to create a sense of community and build trust and rapport among everyone in the class. Social constructivism based on constructivist learning theory that suggests construction of new knowledge is enhanced by collaboratively bringing new knowledge and perspectives among members of a learning community, thus greatly contributing to the effectiveness of the class (Cragg et al, 2008). These researchers also found that in-class students tended to rely more on interactions with the professor. In contrast, distance students relied more on the readings and each other. Therefore, in a hybrid class, more student-student interactions between the in-class and distance students as well as with the instructor would potentially enhance the learning experience for both groups.

3.1.1.4 Learner Motivation

Regardless of whether the class is face-to-face, online or hybrid, incorporating some basic elements regarding learner motivations will also facilitate the overall learning experience.

According to Keller (2008), there are four basic prerequisites to motivating students.

1. You must awaken and sustain their curiosity. Therefore, the content must be interesting and relevant to their goals. In a hybrid and online class, this is more challenging. However, using new technologies such as YouTube to clearly animate and illustrate points helps in this construct.
2. The instruction must similarly be relevant to their values and goals. Thus, as mentioned earlier, using problem-based learning with activities and projects perceived to be relevant to their career goals is helpful.
3. They must feel assured that they will be able to succeed in the class. If students feel confident that they can use the technologies effectively and be able to master the class content, they will be more motivated to learn.

4. The consequences of this learning experience must be consistent with the personal incentive of the student; e.g. they must find the class rewarding and be satisfied with it.

3.2 Technologies and practices available for hybrid courses including emerging software and information systems

3.2.1 Emerging technologies: Social Networks and Second Life.

As discussed in section 2.2.1, social networks such as Facebook, MySpace, and Twitter among others as well as software systems like Second Life have become widely used tools, especially among younger generations. However, the question becomes, do these new, emerging technologies have a valid role in distance education?

We previously argued that developing communities of practice where class colleagues develop trust and rapport for meaningful communications was a vital part of the online class experience. However, are asynchronous Web 1.0 technologies sufficient to tap into this social networking need or should newer Web 2.0 technologies also be incorporated?

According to Moore (2007), “Writing in the *Handbook of Distance Education*, Dede et al. (2007) suggest the emerging technologies are already having a significant impact on the way young people learn. Learning that uses this technology requires new—or at least more highly developed—skills. They are skills in searching the wide variety of information sources; skills in sorting and sieving the infinite volume of information available; skills in synthesizing from multiple sources of information—all a long way from traditional skills needed to assimilate “validated” sources of knowledge like that found in textbooks or a professor’s lectures. This searching requires multitasking—using more than one medium at the same time; the sieving requires “Napsterism”—the ability to make good selections; the synthesis means being creative as one recombines other people’s content in forms appropriate to one’s own purposes, which is, of course, not the same thing as merely copying it. Working in virtual reality also requires a variety of new skills, as one moves in an environment in which one no longer merely observes a phenomenon as in a book or traditional video program but becomes an agent in its creation, or at least collaborating with others in shaping it.”

Moore (2007) also suggests, “Social networking technologies should make constructivist, collaborative knowledge-making more natural and popular among learners and eventually one assumes with their teachers; intelligent search engines offer far more than merely acting as speeded-up encyclopedias for students’ research, their greater promise—though still some way off—being as tools for determining learning prescriptions for individual students (a Holy Grail that personality researchers have discussed for at least thirty years); risk-taking being one of the first requirements for learning, virtual reality environments offer opportunities for students to experiment in social as well as physical domains that were previously unthinkable. Readers will, I am sure, be able to add their own suggestions to this short list of potential benefits.”

On the other hand, he warns that these new technologies can also prove to be distractions if not structured properly within the context of the course. “The communication of tacit knowledge is more likely to occur when there is frequent and intense communication across functions and organizational levels and functions (Hage and Hollingsworth, 2000).”

Second Life™

While hybrid classes provide both students and educators with many advantages noted previously in this chapter, it also has some disadvantages. De Lucia, Francese, Passero, and Tortora (2009) stated that while learning management systems like WebCT™ provide a range of interactive and collaborative features, these functions often are not fully used and the course management system is used simply as a supplement to the “live course”. The multimedia content uploaded to course management systems is often “static”, and rarely used by students unless the instructor makes it a requirements.

My own personal experiences of teaching hybrid classes reinforce this point. I found myself using web-based course management systems such as WebCT™/Blackboard™ as a repository for assignment problems and postings for students to go and get information rather than a forum for engaged interaction. Additionally, I found that my students often demonstrated little interest in taking full advantage of its many collaboration tools like student homepages, discussion forums, and shared workspaces and often only cared to know how to retrieve assignments and upload completed assignments on time.

The challenge then became, “how I use the Internet as a medium for simulating the classroom experience when I and students do not meet in the same physical space?” One would need an electronic platform to exchange information and share ideas synchronously while at the same time keeping students interested and participating. Second Life™ provides hybrid classes with the functionality that can both take advantage of student’s interest in Web 2.0 technologies such as instant messaging, texting, and collaboration tools. At the same time, Second Life™ more accurately simulates the physical classroom experience, allows for greater interaction amongst each other, and establishes a truer sense of presence for all participating.

What is Second Life™? According to its website, Second Life™ is “a free online virtual world created by its residents. A fast growing digital world filled with people, entertainment, experiences, and opportunities.” Johnson and Middleton (2008) stated that it could be thought of as a marriage between online video gaming and social networking technologies with many e-commerce opportunities. At Second Life’s core is a virtual three dimensional environment where many remote participants can converge and engage in activities that electronically simulate real life experiences (Bourke, 2008). Examples of simulated real life activities that can be done in Second Life™ include: training, socializing with peers, project collaboration, and participating in distance education. These enhance the distance educational experience by providing a simulated environment that students can relate to.

Several universities and colleges have created virtual campuses in Second Life™. Harvard University, San Diego State University, and the University of Maine are all examples of educational institutions that have virtual islands populated with lecture halls, classrooms, and meeting places. Faculty, researchers, and information technology specialists use the virtual space to build content and enhance experiential learning for students by providing them with simulated real-world problems to overcome and simulated virtual goals to achieve.

In one example of how Second Life™ can be used for hybrid course delivery, Gainesville University of Florida runs a course called “Aesthetic Computing” using Second Life’s virtual environment. Caronia (2007) stated that 30 students in this class meet “face to face” in a real world classroom then use their Second Life space to create “digital objects” to make their abstract ideas from the course “real”. The course professor states that the Second Life™ virtual environment provides several new forms of interaction that includes opportunities for “collaboration, immersion, shared 3-D object construction, complex and general scripting capabilities, and in-world communication.

Another example of Second Life™ for hybrid course delivery is the case of SecondDMI (De Lucia et.al, 2009). In this example an experiment conducted at the University of Salerno analyzed user

impressions concerning “presence, awareness, communication, and comfort with the virtual environment.” The results of this experiment demonstrated several important factors regarding user acceptance of the virtual environment as a learning space. A few noted results include;

1. Second Life™ as a virtual environment supports synchronous communication and interaction
2. Users who were less familiar with the environment asked for information from others within the environment or looked at them to gain understanding, and
3. Perhaps one of the most important findings, “tutors and the teacher observed that students were really excited” and “many students expressed high interest in the environment to meet class mates”.

At the University of Maine’s Second Life™ virtual campus Black Bear Island, classes have been taught in a variety of subjects including a graduate level course on “Teaching and Learning in Second Life.” This course was a hybrid course that met both online in Second Life™ and in person throughout the length of the semester. Students explored the use of virtual worlds (using Second Life™) for teaching and learning. Students designed, facilitated, and even evaluated quality of their classmate’s instruction in Second Life™ by participating in virtual field trips and gained experience teaching in virtual environments by conducting and attending virtual workshops.

I have begun using Second Life™ as medium to facilitate student advising. Each semester faculty are assigned a number of student advisees. Faculty are responsible for providing academic advising about course registration and for providing guidance about which classes students should take to meet their academic goals. However, time and distance is an obstacle for both students and faculty when it comes to scheduling time to meet. Virtual advising in my office located on Black Bear Island removes the barrier of time and place and provides an environment in which I and my students can meet outside of “normal business hours”.

Second Life could additionally provide schools and colleges with solutions to the costs associated with developing and maintaining labs. Budget limitations can keep schools and universities from fully committing to developing and keeping labs up to date with relevant technologies. For example, I experienced the problems associated with inadequate technology labs. We needed to “teach out” a small group of information technology students so that they could graduate and so that we incidentally, could finally terminate the IT program that had suffered from dramatically decreasing enrollment. One of the final classes we taught was a networking course. The college simply threw together a small ad hoc network made up of old computers and related periphery equipment. Students complained to the instructor many times about the inadequacy of this network and how they felt like they were being treated like “second class students” by the college that was terminating their program. This treatment was evidenced according to the students by their woefully inadequate network lab. A virtual networking lab could have solved this problem.

Virtual laboratories are seemingly a good low cost alternative for training and teaching when budgetary and physical space is constrained. According to Weekes (2007) developing labs in Second Life is an alternative that organizations are looking at using to train employees and students. Weekes noted that companies like Cisco Systems are using Second Life as a platform to bring together employees to update them on new technologies. Manpower, a job placement organization, also uses Second Life to explore and exchange ideas about work in virtual environments. Manpower stated that the Second Life environment will be used to “train for the real world,” meaning that employees in training could find themselves learning how to run machines, perform job functions, and understand businesses processes all within the virtual environment and using those skills learned virtually in the real world!

Organizations, schools, and universities looking to keep costs down associated with training are looking at virtual worlds more closely (anonymous, 2009). In doing this though, employees have to feel like they are “really apart of the world” which can be difficult to do in other distance learning environments. Virtual worlds like Second Life then provide a training environment in which a truer sense of presence is established between the instructor or trainer to students and between student to student interaction. Michelin IT professionals needed to find a way to train IT professionals how to understand their enterprise architecture. They found that using the virtual world of Second Life was a highly effective and successful medium (Driver, 2008). Second Life provided the organization with a “highly interactive environment that combines presentations and hands on workshops.”

Second Life could therefore represent a useful tool for schools and universities to train students how to use, setup, and install networks for example. Virtual labs in Second Life also bring the added benefit of keeping trainees and students interested acknowledged by both Weekes (2008) and Driver (2008). Providing a virtual environment that allows students to learn the skills colleges and universities promise to deliver in a manner that is cost effective, scalable, and even keeps students interested creates a win-win learning environment for all participants involved.

3.2.2 DWDM technology and initiatives:

Dense Wavelength Division Multiplexing (DWDM) is an optical transmission technology that enables existing fiber optic networks to increase its bandwidth. DWDM allows multiple optical signals on different wavelengths to be transmitted on a single optical fiber strand (Littman, 2002). As a result, DWDM technology increases the capacity of fiber links by multiple orders of magnitude which translate into significant improvements in bandwidth capacity and network speed.

To illustrate the significance of DWDM’s potential to increase network data transfer rates, its bandwidth per fiber increased from 10 Gbps in the year 2000 to 400 Gbps in the year 2007. This increase in data transfer speed is relevant to educational institutions that have seen their own networks needs grow over the last few years. Schools that need to transport video, images, and audio transmissions for a variety of educational and training needs have had to look for new ways to manage network traffic and meet the network demands of supporting Web 2.0 Internet collaboration tools. DWDMs growth in bandwidth capacity means that academic institutions can increase their schools network bandwidth without having to incur significant cost related to installing newer and higher capacity network cables (Maxemchuk, Ouveysi, and Zuckerman, 2007).

Benefits of DWDM Technology

A DWDM network is made up of several optical devices such as add-and-drop multiplexers, optical gateways, optical switches and optical routers (Littman, 2002). A benefit of DWDM is that it can interoperate easily with Internet protocols (IP), asynchronous transfer mode (ATM), synchronous optical networks (SONET), and Ethernet transport networks meaning that it can be coordinated to work with most existing school networks. A second benefit of the DWDM technology is related to its cost effectiveness. Generally, the largest expense related to upgrading an existing fiber optic network is the labor. Digging up cables and replacing them with fiber optics with higher capacity bandwidth cables is so time consuming and labor intensive, organizations can significantly reduce their costs of upgrading by utilizing technologies that can take advantage of existing network infrastructure. DWDM provides this solution because it improves the efficiency of each fiber contained within an already existing fiber optic network (Maxemchuk, et.al, 2007).

Dense Wavelength Division Multiplexing provides another benefit to its users. Increased bandwidth reduces network congestion. As more and more users access the network and their data becomes more and more complex and large, a packet-switched network performs poorly, becomes unstable, and can experience oscillations in synchronizations (Chen, Fawaz, Martignon, and Pujolle, 2006). Routing protocol packets can also be lost or delayed as a result of network congestion. As a result traffic loops, black holes, and disconnected regions within the network can occur which only adds increased frustration for users transmitting data over a congested network (Chen, et. al, 2006). DWDMs ability to significantly increase the optical networks bandwidth and resulting speed will drastically reduce packet-switching errors. The implementation of DWDM technologies then can play a vital role in ensuring that distance education programs at schools and universities are successful and that students and faculty have a more enjoyable less frustrating experience.

3.2.3 Telepresence technologies for collaboration in e-learning environments:

According to Leonard and Staman (2003) telecommunication technologies available today combined with related hardware and software technology makes innovative IP video and data transmissions possible. Distance education programs that would like to create a truer sense of community for their courses can now use videoconferencing technologies to create an engaged near-“in person” experience to remote students. Not only will these tools enhance the learning experience for distance education programs but can also add value to a traditional classroom setting.

Telepresence solutions are now established by combining the technologies of the Internet, videoconferencing, and an application layer such as Cisco’s WebEx™ to establish a virtual presence. According to Chen, Fuchs, Nyland, Towles, and Welch (2000), telepresence solutions provide a truer sense of community by allowing participants from different geographic locations to work collaboratively and virtually as if they were in the same room. Telepresence then truly has the ability to totally alter almost every distance learning teaching and training situation.

deHaan and Diamond (2007) describe telepresence as a sense of “being there”. Participants in online environments do not “simply transmit and receive information passively via a technology”. These students also form unique experiences and relationships with each other. The quality of the application software or user interface provides the user with information and influences the nature of the relationship between the user and the media. Interactivity within the online or virtual environment is also necessary in establishing telepresence. Interactivity describes the extent to which users can modify and form the online environment in real time. deHaan and Diamond, (2007), state three other attributes characterize the level of “presence” in a virtual or online environment and they are:

- Speed: the rate at which the users input and contributions can be added to the environment
- Range: the number of opportunities for action at any point in time during engagement in the online environment
- Mapping: the ability of a system to map its control of changes in the online or virtual environment in a natural and predictable manner

A number of technologies and techniques exist that support distributed learning in synchronous, real-time environments (Leonard, et.al, 2003). Beyond simply including YouTube or Video feeds in a classroom, teachers can use web meeting spaces, video over Internet protocols, and network collaboration tools to expand the reach of their classes to remote sites and / or have guest lecturers from remote locations speak to their classrooms using these technologies.

When incorporating video over Internet protocol (VOIP) in a classroom Leonard, et.al (2003) suggests three possible solutions that add value to the student’s experience.

- Video on demand: this creates a “one-to-many” experience because lectures, movies, tutorials, and similar material is stored and then downloaded by distance students when the material is needed.
- Live streaming video: this also creates a “one-to-many” user experience in that although the students can hear and see in real-time, the speaker is not interacting with the audience.
- Interactive video: provides a opportunity for a synchronous “in-person” experience that is “one-to-many” as well as “many-to-many”

The interactive video option provides the greatest chance of true community and e-collaboration of the three options. In this scenario, a teacher teaches from one location while students present in the same classroom and students from remote locations hear, see, and communicate with the teacher in synchronous “real-time.”

3.2.4 Network Technology, Services, and Solutions for creating Telepresence

Schools and colleges wanting to create a truer sense of presence for remote students may consider taking advantage of videoconferencing technologies available through Cisco™ and POLYCOM®. Cisco’s WebEx™ program for example provides a suitable solution for delivering real-time videoconferencing and shared documents to participant’s desktops. POLYCOM® provides similar videoconferencing technologies as well. POLYCOM® View Station Exchange (VSX) and Personal Video Exchange (PVX) systems provide high-quality real-time voice and video transmissions to up to 20 remote users anywhere at any time with an Internet connection. Its multi-network capability support Internet protocol (IP) and integrated services digital networks (ISDN) and is session initiation protocol (SIP) compliant. The videoconferencing system also interoperates with Microsoft Live Communication Server and Nortel Networks Multimedia Communication Server (MCS) 5100 and 5200 products. (“POLYCOM® VSX 8000”, n.d).

If schools and colleges do not want to make a heavy investment in IT upgrades to achieve telepresence in classrooms interactive video tools such as Windows Netmeeting™ comes preinstalled on Windows 2000, XP and is available for free download for Windows 95/98 and NT. Windows Vista uses Microsoft’s newest version called Netmeeting™. Netmeeting is a voice over Internet (VoIP) and multi-point videoconferencing solution. As a preinstalled or free download Windows Netmeeting is an affordable solution for delivering interactive videoconferencing. In order to implement Netmeeting users only need a web camera and a microphone.

3.2.5 Wireless Technologies impact on Education

Today’s students are becoming more mobile due to the increased access to mobile technologies (Nagel, 2008). As a result, network technologies that are emerging include the increased use of mobile devices combined with wireless networks. Wireless devices use wireless network interface cards in place of NICs and require the IEEE 802.11 wireless protocol to specify hardware requirements and determine how messages can be packaged and processed for transmission over a wireless LAN (Kroenke, 2007).

Satellite networks are a particularly attractive solution for e-learning systems because of the networks global coverage and ability to provide access to remote users through terrestrial wide area networks (Koutsakis, 2006). These wireless networking technologies will have a significant impact in education within the next year because of the use of low-cost grassroots video and collaborative web technology (Nagel, 2008). Essentially grassroots video is user generated videos using readily available mobile devices such as iPod’s and video enabled mobile phones. Internet services readily available at

little or no cost to the consumer allow students or instructors to share their video's making their content easily available to their intended viewers.

Videos uploaded to an instructor's courseware site using the MP4 format, typically known as a "Podcast" is already in use in many educational institutions. Like E-learning, Podcasting satisfies an increasing need for access to educational content by students. The option of using existing satellite networks and mobile device technology combined with video technology would provide an improvement to E-learning environments synchronously conducted (Guerri, Palau, Pajeres, and Esteve, 2002).

Example of a Satellite System used for Videoconferencing

A solution available for real-time videoconferencing in e-learning environments includes the use of a satellite network for multicasting high quality video from the instructor to students using an video camera, a video server, and transmitting the video to remote classrooms via satellite broadcast down-link channel (Guerri, et.al, 2002). Students receiving the video transmissions view the video real-time through an ISDN/Internet connection connected to their workstation pc and return real-time video transmissions of themselves via a web-cam to create a sense of interaction between student and teacher; effectively creating a virtual classroom.

Components required to create the real-time videoconferencing e-learning environment include:

- Server and necessary software and hardware on the instructors side, Examples would include a video camera and workstation with an installed video card, and software to process video transmission.
- Remote classrooms with a public network that includes Internet access equipped with workstation pc's webcam's, and necessary software to return video images of themselves to the instructor
- Multicast link over a HISPASAT satellite.

By developing a videoconferencing system like this, schools and universities should be encouraged by what is possible when considering how to use satellite networks to achieve distance learning solutions. Schools and colleges developing programs to deliver courses to remote locations even in a hybrid environment could consider having live "face time" between both the instructor and students using combinations of telepresence technologies and satellite networks.

3.2.6 Applications of Satellite Network Solutions in Education

The Abbotsford School District 34 in British Columbia is deploying a new wireless network to improve access for teachers who are increasing using wireless devices in their classrooms. (Nagel, 2007). For example, many teachers in the district are using Tablet PCs to connect to wireless projectors and using laptops to connect to Smart Boards. One of the obstacles that the school district had to overcome was that of continuous and reliable access.

According to Nagel (2007) the school system provided a solution the dependability issue by purchasing 80 MAP-320 and MAP-330 Cloubris MultiService Access Points and a MultiService Controller. The access points cover about a quarter of the schools in the district and the controller allows for centralized management of the network. The school system deployed this wireless network for a number of reasons. One striking reason is that they found a number of their new instructors coming out of the universities had extensive technology-based backgrounds and demanded wireless tools enhancing learning in their classrooms. Kopf (2007) states that Auburn city schools in Alabama have found that by implementing a wireless network for their classrooms has enhanced teacher instruction. Students are

benefiting greatly by the wireless network because the instruction has moved from being “static” to more dynamic. More impressive was the fact that instruction has moved from be “teacher-facilitated” to “student-facilitated”.

Using Tablet PCs that are wirelessly connected to student’s laptops teachers were able to see exactly what students were doing, help individual students that may have had a problem with an assignment, and even redirect students caught not doing their work. (Kopf, 2007). If a teacher saw a student having a problem with a particular question, not only was the teacher able to “take control” of the students desktop and “walk them through completing the problem, teachers could also upload that students problem to a interactive Smart Board and work through the problem with the whole class if it appeared that many students were stuck on the same problem. Due to the proliferation of web enabled devices such as cell phones, PDAs, and laptops, students, teachers, office workers, and so on are demanding real-time access to the information they want when they want it. Wireless technologies have not only made the workforce mobile but it has offered several opportunities for industry’s such as healthcare to greatly increase their access to patients and improve quality of service. Lastly, wireless solution are improving cognition in schools and as illustrated in this last section improving instruction by moving from teacher-facilitated to student-facilitated.

3.2.7 Texting: Using Cell Phones in the Classroom

Today most students have cell phones with them at all times. In many cases instructors have complained that cell phones are a nuisance in class and distract student learning. A primary complaint about cell phones is that the disruptions caused by student’s texting each other and receiving or making calls while in class. The argument then against the use of cell phones in class is that these unauthorized uses of cell phones in class negate any possible academic gains that instruction combined with cell phones could provide (Sturgeon, 2007).

This argument however minimizes what cell phones are today. Wains and Mahmood (2008) stated that “today’s mobile phones have as much computing power as the computer had a few years back.” Mobile phones often come packaged with or can have productivity software packages downloaded to them. MS Office, Acrobat Reader, and other productivity tools are all examples of software that many students can use on their mobile phones. Combine this productivity power in mobile phones with the fact that most students have these sophisticated cell phones and the possibility of using mobile phones for educational purposes seems like a natural next step. The next question is how do we integrate mobile phone usage into the classroom without its use being a distraction? Linquist, Denning, Kelly, Malani, Griswold, and Simon (2007) stated that “mobile phones seem to hold promise for enabling large-scale participatory learning “in the wild”: in most any classroom with minimal student cost, without herculean instructor effort to install and maintain the technology.”

3.2.8 SMS Texting

Short messaging service (SMS) is a mobile phone application used to send quick, concise, text based messages. In one example of using mobile phones in education, researchers at the University of Lancaster explored the use of SMS texting as a means for students and instructors to communicate with each other about course work and actually took quizzes via their mobile phones texting services (Wains and Mahmood, 2008). By communicating with each other via mobile phones and participating in actual course work the school had developed a type of hybrid classroom that overcame the issue of time and space which provides an excellent solution to schools that are dealing with the problem of how to provide quality teaching to students in remote locations.

In addition to providing distance education hybrid solutions, texting also offers possible solutions related to student engagement while in the classroom. Each semester professors and instructors with large classrooms observe that many students are not engaged in the classroom discussion and are not asking questions. Much of this could be attributed to several reasons that include but are not limited to; fear of asking a “dumb” question, disinterested in class discussion, and feelings that the lecture is a “one-way” instructor led discussion in which student are expected not to be active participants. Disinterested students will often busy themselves and distract the rest of the class by socializing with friends next to them or texting friends. I actually observed on several occasions students in the same class texting each other!

According to Markett, et al. (2006), developing and incorporating technologies that receive SMS text messages to an instructors PC and then projecting student text messages comments and questions can create a interactive question and answer session during class time that can provide these benefits to the learning process;

1. Students in large classes will demonstrate greater participation in class using the SMS text messaging service
2. Students using SMS text messaging in class will be more engaged
3. Professor / Instructor will be able to better assess student understanding of course material based on SMS texting input and be able to redirect or improve delivery of lecture material as a result

SMS texting is one example of how mobile phones can be integrated into the classroom and distance education hybrid courses to increase student engagement and participation. Texting also provides an easily accessible low cost technological solution to bringing educational opportunities to students in remote locations. Additionally, simply including mobile phones as part of an academic environment schools and colleges can take advantage of several other benefits they bring with them. Today’s mobile phones such as the iPhone, Blackberry, and a variety of other multifunctional web-enabled smart phones may be tools that can be used to engage students, reduce discipline problems, and reduce truancy according to Sturgeon (2007). Like laptops and desktop PC’s, today’s smart phones are a means of putting computing technology in the hands of students.

Mobile phones provide another benefit to schools that are willing to consider adding them to their curriculum. Students equipped with smart phones means that schools do not have to go through the expense of implementing Wi-Fi capability (Sturgeon, 2007). Students would essentially have an always on access to the Internet. Students would be able to write reports, collect data, collaborate with groups, and gather information they need by surfing the Web.

According to Verkasalo (2006), mobile handheld devices such as smart phones provide students with a third benefit. Current online services used by schools such a desktop PCs still cause challenges in the spatial domain. You still need a space to place a computer and network devices such as switches and wireless routers to connect to the Internet. Smart phones with mobile services overcome most cases of spatial and temporal constraints.

To summarize the discussed technologies used to facilitate hybrid distance education, educators and schools should consider several technology solutions that are currently available. As previously stated in this chapter, these technologies offer improvements in network bandwidth, improves the sense of presence for remote students, and can increase student engagement and participation. Table 2 below summarizes these available and emerging technologies.

Table 2: Review of Existing and Emerging Technologies

Second Life™	An online virtual environment that can be used to facilitate “real time” interaction between teacher and student. The virtual environment creates a truer sense of presence with student and instructor avatars
Dense Wavelength Division Multiplexing (DWDM)	Significantly increases bandwidth on existing fiber optic networks
Telepresence	Create a truer sense of presence with the use of videoconferencing technologies delivered over IP Networks. Can offers a near “in person” experience for students participating remotely
Wireless and Satellite Networks	Provides greater access to online classrooms for distance education students spread out over a larger geographic area
SMS Texting in the Classroom	Research in this emerging use of cell phones in the classroom demonstrate that SMS texting can be used to increase student engagement and participation

4.0 CURRENT CHALLENGES: THE CLASSROOM OF TODAY AND TOMORROW

4.1 Creating equal quality in hybrid classes; making the distance experience “real”.

The lessons learned from prior research indicate that instructors who wish to teach hybrid classes need to follow some basic rules.

First, develop a hybrid system of technologies that will fit the different learning styles of the students. This will include web 1.0 technologies such as e-mail, discussion forums, and videoconferencing. Incorporation of Web 2.0 technologies will integrate the learning styles of younger students, who respond to multi-tasking and more media-rich applications like social networking sites, blogs, wikis, or YouTube type video presentations. However, ALL students must be required to participate in use of the different technologies to facilitate adoption and use of them as well as relationship building and trust.

Instructors in hybrid classes should remember the basic principles in learner motivation and incorporate that into the content, delivery and structure of the classes. This includes developing and maintaining interest and curiosity in the class and content, making the class relevant to their lives and goals, making sure that the technologies are user friendly and the class tasks and goals are attainable and that they students will find the class rewarding and satisfying.

Develop a sense of community and purpose in the hybrid class. In order to avoid an “us vs. them” mentality, make sure that students interact and communicate collaboratively. Develop teams that integrate the in-class with the distance students and make sure that they are all engaged and feel a sense of purpose and engagement in the class.

5.0 FUTURE RESEARCH DIRECTIONS

With regard to the literature and experiences about hybrid distance education in this chapter, several opportunities for future research are possible. Research that evaluates student interactivity and existing videoconferencing technologies to create a truer sense of presence for distance students is one area of continued research while research in the area of skills training in virtual labs is another.

Additional research related to virtual labs includes the transferability of skills learned in virtual environments to “real world” environments.

Teaching and learning using Web 2.0 technologies also provide several opportunities for future research. For example, student collaboration and productivity using Wiki technologies offer several opportunities for research in the areas of its efficacy in distance education environments. Lastly, it should be pointed out that even the technologies related to SMS texting in distance education provides seemingly almost endless opportunities for research as cell phones, smart phones, and the like become more and more ubiquitous in modern living.

6.0 CONCLUSIONS

Many tools and techniques are now available to create telepresence in classrooms and boardrooms today. However, a “build it and they will come” approach will not work for hybrid classes. In other words, colleges and universities cannot simply purchase distance technologies and assume that different delivery systems will be successful. Rather, a successful hybrid class will integrate a variety of technologies and learning methodologies. The savvy instructor will understand the personality and needs of the class and adapt the class content, communications approaches and use of technologies to meet the needs and goals of the students.

The continuing growth of IP networks and their growing reliability supports the development of new innovative videoconferencing techniques and how they are used to improve both traditional classroom learning and online learning. In addition, the evolution of Web 2.0 technologies such as Facebook, Second Life, and blogs among others is contributing to the vibrancy and richness of hybrid classes by bringing different members of the class together into a cohesive community of learners.

Finally, it should be noted that although much of the technology discussed in this paper could potentially improve learning, the true benefits lie in how videoconferencing and other available technologies can bring people together regardless of their geographic location. Therefore, if the correct technologies are selected for the class and if used appropriately, these technologies can facilitate trust, rapport, communication and collaboration to greatly enhance the overall learning experience.

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Keywords and Definitions

Hybrid classes, online education, distance education, emerging technologies, social networks, telepresence, video-conferencing, satellite networks, e-learning, virtual learning, virtual labs.