

## ABSTRACT

Title of Document: ONLINE AND TRADITIONAL LECTURES: EVALUATING EFFECTS OF SOCIAL PRESENCE AND LEARNER CONTROL

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Online courses are rapidly replacing traditional, face-to-face lectures in American universities (Allen & Seaman, 2011). As technology improves, this trend will likely continue and accelerate. Researchers must evaluate the impact of online courses compared to their traditional counterparts. This two-part study quantifies the effect of two variables – social presence and learner control – on students’ recall, application and perceived learning levels in different lecture formats. Students in introductory courses at a four-year, public, American university were randomly assigned into three groups to view distinct lecture formats, one in a traditional classroom and two via the Internet. Upon viewing the single lecture, the students were asked to fill out a test and survey to quantify teacher immediacy, recall and application, and perceived learning levels across lecture formats. The study found that different levels of social presence and learner control affected students’ perceived learning levels but did not impact recall or application.

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by

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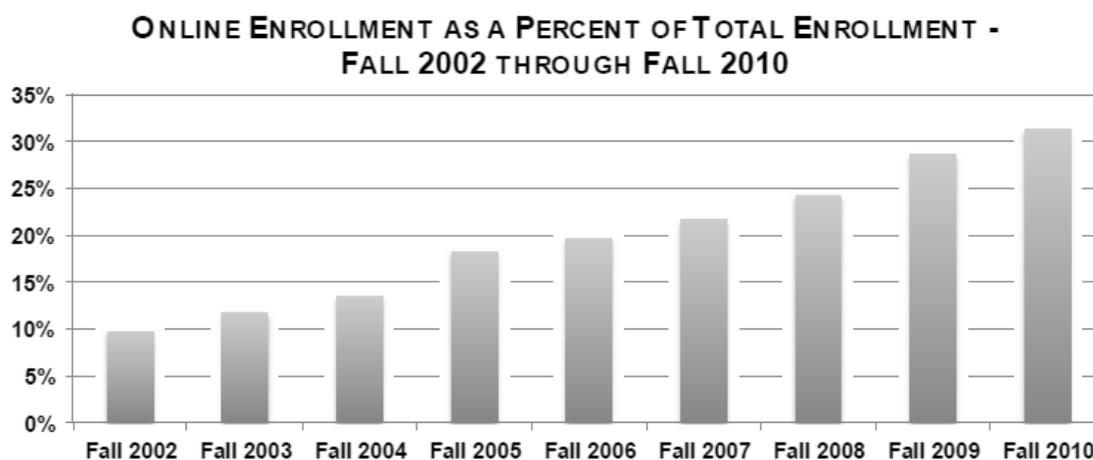
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## CHAPTER ONE: INTRODUCTION

### Background and Relevance

Online education has become increasingly important as Internet technology continually evolves, allowing educators to reach audiences with fewer limitations due to timing and geography. Particularly in higher education, virtual classes are beginning to replace traditional ones. An annual study by the Babson Survey Research Group found that more than 6.1 million students were enrolled in at least one online course in 2010, a number that has grown steadily and significantly since 2002, as seen in Figure 1 below (Allen & Seaman, 2011). The same study found that 31.3% of all higher education students took at least one online course in 2010, and 65% of higher education institutions consider online learning to be a critical part of their long-term strategies (Allen & Seaman, 2011).

Figure 1: Online Enrollment Trends



(Allen & Seaman, 2011)

In addition to use of online courses at traditional institutions, one of the most recent – and popular – phenomena in online education has been the introduction of the MOOC (Massive Open Online Course). MOOCs have been around for several years but

have mostly been utilized by a niche technological community. In 2012, however, institutions of higher learning realized the limitless potential of MOOCs and established programs that would broadcast lectures for free to virtually anyone with an Internet connection. Harvard University and the Massachusetts Institute of Technology now offer free online courses through their program, edX (Lewin, 2012). By providing courses for free, edX allows these institutions to collect data on how students learn and how best to fit that to an online environment. Because the technology is continually changing and the online medium is still relatively new, edX demonstrates how educators are using a learn-as-you-go attempt to optimize the online learning experience. Other universities have launched similar programs with free educational content, including the University of Michigan at Ann Arbor, the University of Pennsylvania, and Stanford and Princeton Universities (Selingo, 2012). These initiatives are a part of the Coursera program, whose broad goal is to make high quality higher education accessible to the masses, increasing opportunities for those who may not have the financial or geographic means to attain this education otherwise (Severance, 2012).

Yet the popularity of MOOCs presents its challenges as well. Because these courses are so popular (they enroll in the tens of thousands), it is impossible for the instructor to offer feedback to individual students. There is also the question of how to grade students effectively, especially in non-technical subjects where answers to exam questions are more subjective. For this reason, early MOOCs have generally been used with more quantitative subjects, though less technical courses will surely proliferate as these massive courses become more widespread. Cheating is another issue (Belkin, 2013). Students are so anonymous in a 10,000-person lecture that they are able to work

together and turn in identical homework without any instructor intervention, if they choose to (Belkin, 2013). Despite these challenges, MOOCs have established themselves as an emerging force in higher education and have shown themselves to be equipped to confront problems (Pappano, 2012).

For the general public, high quality, online tutorial videos have become a common source for learning a particular topic. The Khan Academy, which was founded in 2009 by Sal Khan as a tutorial for his niece, now offers more than 3,100 free video lessons, and even gives users the chance to track their learning progress. Only three years after its conception, the Khan Academy reached about 6 million learners each month. However, Khan's intent in creating his academy was not to replace the traditional teacher, but to free up more time in the classroom for interactive group learning, instead of using it to lecture students ("Khan Academy Takes Personal Tutor Online," 2012).

Daphne Koller, a founder of Coursera, had an intention similar to Khan's in creating the Coursera company with Andrew Ng. Creating videos of her lectures with interactive quizzes, she said, "frees up the classroom time for more meaningful interaction between me and my students" (Severance, 2012, p. 8-9). This idea was combined with Ng's desire for a way to share higher education internationally, and now allows universities to teach material online in a fashion that mimics the strengths of a traditional classroom – one in which students take in a lecture or other form of instruction in person.

Some establishments have found that they can use online resources not only as a free resource of distance learning, but for profit as well. The University of Phoenix, for example, which serves students both in person and online, offers "virtual organizations"

to its students, allowing them to simulate working for a corporation, school, or government. The University of Phoenix's online campus serves more than 307,000 students, which speaks to the growing popularity of this emerging learning format as the organization's traditional campuses are shrinking in popularity ("University of Phoenix-online," 2012).

While MOOCs and other means of reaching a mass audience differ from the online classes examined in this study, they demonstrate the gradual growth of acceptance of the online learning environment. MOOCs and online universities like Phoenix are becoming more popular, as are online courses at other universities. These developments in the popularity and accessibility of online learning prompt many in education to wonder whether an online classroom presents a viable replacement for the traditional lecture hall, and how they can most effectively use it.

### **Research Problem**

A certain stigma has been attached to the idea of online education, as many students acknowledge that the independence and flexibility offered by online courses come at a price—a loss of direction from and communication with the instructor (Armstrong, 2011). In a survey of people with experiences in distance education, many students who have taken online classes attributed the stigma to a decrease in accessibility of people and resources, but even more so to a general skepticism about distance education (Berge, 1998). However, trends since 2002 of increased numbers of online students suggest that this fear is waning (Allen & Seaman, 2011). Specifically, some students have remarked in online class criticisms that they “miss the instant interaction between student and instructor,” despite attempts to create interactive features in the

online setting (Sullivan, 2001, p. 809). Meanwhile, some teachers surveyed have expressed that they think of online teaching as faceless, that it diffuses the value of earning a degree, and that they fear they will be replaced by videos and software (Berge, 1998). While much has changed technologically since these studies were conducted, a stigma remained for some in recent years. Even as recently as 2011, one-third of academics surveyed from more than 2,500 higher education institutions said that learning outcomes in online instruction were inferior to those in a traditional, face-to-face instruction setting (Allen & Seaman, 2011).

Another aspect to keep in mind is that students react differently to teaching styles and learning formats, based on their gender, culture, learning preferences, technological experience, and a plethora of other factors. For instance, one study found that females scored significantly lower than males on assessments in an online course when there was no significant difference between genders in the same course delivered via traditional or hybrid class models (Brown & Liedholm, 2002). Another study found that, student success aside, males and females have significantly different perceptions of the strengths and weaknesses of online courses (Sullivan, 2001). Other studies detailed later in this thesis found that cultural characteristics, personal learning styles and motivation levels can be amplified in an online course model, having greater effects on the student's success or satisfaction (Chang & Ho, 2009; Olaniran, 2009). Additionally, students with less Internet experience or prior opportunity to use the Internet might be disadvantaged in an online setting (Wang & Chen, 2011).

Despite these potential problems that can contribute to a stigma against online education, every learning environment has its disadvantages. Although the Allen and

Seaman (2011) survey mentioned previously found a significant amount of skepticism remaining in academics, it also found a small, but notable, increase since 2003 in the number of academic leaders who see learning outcomes in online classes as equal or superior to those in a traditional class – the percentage climbed from 57 to 67 from 2003 to 2011 (Allen & Seaman, 2011). Over time, students have opened up to the idea of learning in an online environment. More than a decade ago, when research in Internet education was just budding, some students were already beginning to respond positively to the types of interaction available in an online class setting, although these numbers were low (Sullivan, 2001). In a 2006 study, asynchronous communication (the kind most often used in an online class) was found to facilitate communication with comparable depth to that of a traditional class and learning outcomes in these online classes were found to be equal to those of traditional courses (Tallent-Runnels, 2006).

With attitudes about online education evolving, the opportunity arises for institutions to use this technology advantageously in conjunction with their traditional teaching methods. Some educators desire an efficient way to teach the basic principles of widely studied subjects, as lecture classes meant to do so are often overcrowded. One such example is the economics program at the University of Maryland. About one-third of students who graduate from the university will take ECON200: Principles of Microeconomics, and a single professor in this subject may be teaching as many as 900 students in a semester (R. Schwab, personal communication, September 27, 2010). Due to this alarming ratio, the department is continuously seeking new ways of effectively teaching the class to a mass audience. In the Fall 2012 semester, ECON200 was taught in a blended format by Dr. Cindy Clement, in which both traditional and online methods

were used. In the Spring 2013 semester, Dr. Robert Schwab taught all of the nearly 900 ECON200 students in a blended learning course ("UM Testudo schedule," 2012).

Another question lies in determining how these online courses should be taught. In some cases, instructors are able to simply record the lecture that they give in the traditional classroom and upload it on the Internet. However, this method is difficult to arrange, and impossible if there is no traditional equivalent to the online class being recorded. Instructors may instead choose to create a recording of their material without a live audience. A format such as this, however, has an inherently lower level of social presence – the degree to which a person is perceived as “real” in mediated communication (Short, Williams & Christie, 1976). The question is whether social presence affects students’ cognitive and perceived learning. This social presence can change based on the type of media used. We also question how social presence affects teacher immediacy – the teacher’s perceived accessibility to students – and students’ cognitive and perceived learning levels. Teaching methods with varying levels of social presence have been apparent in the existing literature, as well as in personal interviews (M. Zachariah, B. Dixon, personal communication, September 16, 2010; R. Schwab, personal communication, September 27, 2010). The traditional classroom offers more social presence than a video, which can in turn have varying formats. These formats include videos with no audience or course material presented with a voice-over (Walker et al., 2011; Khan, 2012). Interviews with University of Maryland faculty suggested that instructors noticed a difference in student performance depending on the level of social presence in the learning environment (M. Zachariah & B. Dixon, personal communication, September 16, 2010; R. Schwab, personal communication, September

27, 2010). One study looked into the presence of other students and found that this peer presence, real or perceived, can affect a student's satisfaction with learning (Richardson & Swan, 2003). Dr. Bonnie Dixon, a chemistry instructor who also manages her own chemistry education research through the National Science Foundation, saw a noticeable difference in the learning outcomes of her students based on whether the class is taught in person or online (personal communication, September 16, 2010). Dr. Dixon, Dr. Robert Schwab, and Dr. Michael Zachariah, all at the University of Maryland, have said that their own teaching styles are greatly compromised when they must teach without a live audience, especially Dr. Schwab, an Economics professor who has recently formatted his ECON200 class to fit an online environment (M. Zachariah & B. Dixon, personal communication, September 16, 2010; R. Schwab, personal communication, September 27, 2010). Some teachers have said that teaching in an online environment with less teacher-to-student interaction not only affects the teaching style, but the students' perception of the learning community, as there is only so much a teacher can do to create interaction without taking questions from an audience (Berge, 1998).

Numerous studies have simply compared the traditional classroom setting to one or more types of online classrooms. The results of these studies have been, for the most part, inconclusive and contradictory, which suggests that further study in the field is necessary (Means, Toyama, Murphy, Bakia, & Jones, 2009). However, many of the studies found differences in cognitive learning and/or perceived learning in each lecture format (Menzer et al, 2007; Peterson and Bond, 2004), both of which are dependent variables in which we are interested. These differences in perceived learning and satisfaction were due not only to the nature of the medium, but the student's perception of

social presence in the online environment (Richardson & Swan, 2003). Additionally, learner control is a feature on the online learning environment that can vary greatly from that in traditional learning environments. The ability for students to pace themselves is a simple, but important feature of learner control that is present in most online formats, and is often a capability that students value highly (Wuensch, 2008; Tallent-Runnels, 2006). The relationship between social presence, learner control, teacher immediacy, perceived learning, and cognitive learning is complicated, but cannot be ignored when evaluating the overall weaknesses and strengths of online learning as a pedagogical medium.

Several factors differentiate our study from those that came before. First, our study is different because we randomly assigned students to an online or traditional classroom. The vast majority of the studies we found compared sections that were already divided based on student choice. This is a significant factor, because different types of students may perform differently in an online course. Because we split an already-established class into sections, we removed the aspect of learning preference from the study. All of the students in the study are enrolled in a traditional classroom. It is important to note that outside of the limitations of our study, students have a choice in class format, and can select the learning environment that best fits their preferences. However, as online education becomes more popular at major universities, students are sometimes required to complete a class online rather than in a traditional setting, such as in the new format for ECON200 at the University of Maryland. Therefore, it is important to conduct a random study such as ours, so that we can study the relative effectiveness of these online formats even for students with learning styles less conducive to online formats.

Another difference in our methodology was that we conducted our study over the course of just one week, rather than an entire semester. Most of the studies we examined compared the effectiveness of classroom environments over the semester, and often continued the test for even longer. However, because we were working with students in a randomized experiment, we needed to limit our intervention to just one or two class lectures. If we had been able to continue the study for longer, it would have been interesting to see the effect on the data.

Last, our experiment is unique because we dealt with an Economics course, a Chemistry course, and a Criminal Justice course, subjects with very different course structures and student bodies. CHEM135 is intended for entry-level Engineering students, and is a rigorously demanding course that involves complicated math and science concepts. On the other end of the spectrum, CCJS105 and ECON200 are general education classes that students from a variety of majors and age levels take, and are mostly open-ended concepts. By experimenting with an online component in both classes, we broadened our conclusions to fit a more complete representation of a student body.

In developing our methodology, we considered the many aspects of online education such as interactivity, learning preferences, student pacing and more. It was after we examined online tactics in use that we chose our online media. Speaking with Dr. Robert Schwab at the University of Maryland, we learned that the format in use for the online ECON200 classes was a slideshow with audio overlay of the professor's voice (personal communication, September 27, 2010). We were surprised to find that in a world with expansive technological possibilities, the main strategy in an online course

required of many students was to simply digitize the existing lecture format. Because this was a format in use, we wanted to test its effect on students' experiences.

By creating a unique methodology with a diverse set of subject groups, we were able to isolate and assess the effects of our independent variables of interest – social presence and learner control. In testing these factors, we aimed to further define the fundamentals of effective education in a lecture format, specifically determining students' performance and satisfaction in terms of cognitive and perceived learning. Specifically, in order to define these fundamentals, we sought to answer the questions below.

### **Research Questions**

In order to evaluate the effects of these variables and their relationships to each other, we used three studies to evaluate four related research questions. The first two questions focus on the aspects of teacher immediacy and perceived learning as influenced by different video lecture formats:

RQ1: How will cognitive learning levels differ among students experiencing three different learning environments with different social presence: a traditional classroom (A), a video lecture with a student audience (B), or a video lecture without a student audience or view of the instructor(C)?

RQ2: In addition, how do the perceived learning and teacher immediacy levels differ among these environments?

In evaluating research question 1, we used two experiments – one in ECON200 and one in CHEM135. However, for the CHEM135 experiment, we eliminated group B so as to better isolate social presence and its effect in a faceless teaching video.

The second two research questions introduce the element of learner control to evaluate its importance, while keeping social presence constant among the online groups. The online group watched the same lecture video, but one group could pause the video and one group could not.

RQ3: How will cognitive learning levels differ among students experiencing three different learning environments: a traditional classroom (A), a video lecture with no pause or rewind capabilities (B), or a video lecture with pause and rewind capabilities (C)?

RQ4: In addition, how do the perceived learning and teacher immediacy levels differ among these environments?

### **Hypotheses**

Regarding RQ1, which we tested in the ECON200 and CHEM135 experiments, we expected the three groups with different levels of social presence would perform differently on a test of recall and application, demonstrating different levels of cognitive learning. We also used ECON200 and CHEM135 to test RQ2, expecting to find that groups A, B, and C would show different levels of perceived learning and teacher immediacy.

Regarding RQ3, we expected that the three groups with different levels of learner control, in the form of pacing, would demonstrate different levels of the recall aspect of

cognitive learning, as shown on a test. Regarding RQ4, we expected to find that groups A, B, and C would show different levels of perceived learning and teacher immediacy.

### **Significance**

As the popularity of online classes is only increasing, and more institutions turn to online education as a way to deal with high enrollment, it is as important as ever to know whether online education is effective, and, if so, what features make it effective. In order to clarify this matter, we chose to answer the questions listed above, examining the interactions between social presence, learner control, cognitive learning, perceived learning, and teacher immediacy (See Appendix E for definitions). In doing so, we hope to make clear whether the basic distance learning methods currently in use are serving students appropriately. This information is important for both the present and the future. It can help students to assess the effectiveness of the learning environments they are forced into by high enrollment rates, or a necessity for convenience. It can help educators to know how best to reach students in these online learning environments. Finally, it can help educational institutions to plan better for a future in which online classes will likely, if not definitely, have an influential role.

## **CHAPTER TWO: LITERATURE REVIEW**

In order to answer questions about online learning environments, a complete understanding of online learning and its history is necessary. The beginning of the online education story lies in a brief history of distance learning, a category to which online learning belongs. This historical context is followed by an analysis of synchronous and asynchronous learning, and a look into the advantages and disadvantages of online learning. Finally, our literature review will detail the variables of interest to this study – social presence, learner control, cognitive learning (in the form of recall and application), perceived learning, and teacher immediacy. With a better understanding of these factors, one can better assess the relationships between them in various learning environments.

### **History of Distance Learning**

Although today learning apart from one's teacher implies the use of Internet media, distance education did not begin with the advent of the World Wide Web. In fact, distance learning has a long and rich history that stretches back centuries. In order to locate a concrete starting point for distance education, it is necessary to first define the term. According to Moore & Kearsley (2012), "Distance education is teaching and planned learning in which teaching normally occurs in a different place from learning, requiring communication through technologies as well as special institutional organization" (p. 2). These technologies have evolved—starting with letters, then radio, television, teleconferences, and finally the Internet—and have been integral in shaping the course of distance learning.

The first true instance of modern distance education is still debated by scholars, but some point to an ad in *The Boston Gazette* on March 20, 1728, as the origin of the

phenomena. Caleb Phillips, a shorthand teacher living in the city, offered a weekly course by mail to students out in the country wishing to cultivate the skill. In those times, post was the dominant form of communication over large distances, and remained the sole medium for distance learning until the advent of the radio in the 20th century (Bower & Hardy, 2004). The trend caught on across the Atlantic a century later. In the mid-1800s, the pioneer instructor Isaac Pitman offered courses in Biblical study to anyone able to send a letter in Great Britain, not just the residents of his local community (Power & Gould-Morven, 2011). The University of London followed Pitman's lead and began several correspondence courses beginning in 1858, where students could engage in "home study" or "independent study," as it was called at the time.

As the postal service lowered their rates and became more reliable in the latter half of the century, correspondence courses became more popular. Anna Ticknor, the daughter of renowned Harvard professor George Ticknor, established the first official correspondence school in the United States. The Society to Encourage Study at Home offered women the chance to study at their own pace in the comfort of their own houses. Ticknor provided over twenty courses in a variety of subjects via the mail and hired other educated women to personally attend to student needs (Bower & Hardy, 2004). In New York in 1878, John Vincent created a correspondence class lasting four years under the auspices of the Chautauqua Literary and Scientific Circle. Five years later, it was authorized to award diplomas and degrees, thereby validating distance learning as a viable educational approach. Established brick-and-mortar universities seized the increasing popularity with educating students at a distance by establishing correspondence courses. In 1874, Illinois Wesleyan College began to offer courses via

mail; the Correspondence University of Ithaca followed suit in 1883 (Bower & Hardy, 2004). Yet many early distance courses aimed to teach students a particular skill rather than provide a prolonged liberal arts education. Newspaper editor Thomas Foster of the Colliery Engineer School of Mines, for example, taught mine safety through correspondence courses (Moore & Kearsley, 2012).

With the advent of radio in the early 20th century, distance education was transformed, with students learning in a purely aural format. The Latter Day Saint's University in Salt Lake City became the first institution to receive a federal educational radio license in 1921. The Universities of Wisconsin, Minnesota, Illinois, and others soon followed, as did K-12 "schools of the air." By 1925, the University of Iowa had offered the first radio course for credit with an enrollment of 80 students (Power & Gould, 2011). However, the era of distance learning on the radio was plagued by a lack of professionalism from instructors and was cut short by the encroachment of yet another technology, television.

For several decades, television was seen as a medium through which students could obtain a well-rounded education. The University of Iowa was one of several schools to broadcast instruction before World War II, in the subjects of oral hygiene and astronomy. However, it was after the war when education over television reached new heights. Nearly 200 out of 2,000 total frequencies were allocated to noncommercial use, and universities and community colleges capitalized by creating "telecourses" that were delivered through this media. Johns Hopkins University presented the "Continental Classroom" on NBC for course credit, and Pennsylvania State University and others followed suit. New York University's successful "Sunrise Semester" ran on CBS from

1957 to 1982 (Simonson, Smaldino, Albright, & Zvacek, 2000). Moore and Kearsley (2012) noted, “By the mid-1980s, there were around 200 college-level telecourses produced by universities, community colleges, private producers, and public and commercial broadcasting stations” (p. 31). Primary and secondary schools also offered courses through television, and by 1956, all of the public schools in Washington County, MD were connected by a closed-circuit television service. Clearly, there was a substantial market for courses offered via the television, not only in the United States but abroad. China provided perhaps the most comprehensive education programs on TV of any country. Because of its centralized nature, the Chinese administration found it useful to streamline its higher education through both television and radio. By 1985, the government employed nearly 25,000 scholars to teach approximately 30,000 courses on TV, and an incredible one in five higher education students were studying via a radio or television university (Simonsen et al., 2000).

The establishment of the British Open University in 1969 is cited as a watershed moment in the development of distance education. It offered a comprehensive curriculum with “full degree programs, sophisticated courses, new media and systematic systems evaluation” (Holmberg, 2002, p. 9). The success of the Open University illustrated that students could receive a satisfactory education without physically attending a class. More importantly, it provided a model for other countries to provide significant public funds for this emerging and successful model of higher education (Holmberg, 2002). Turkey created Anadolu University in 1981 as a part of widespread education reforms in that country. Reaching over 500,000 distance education students by 2005, many of them working part or full-time jobs, Anadolu became the largest

university in the world. The Open University of Hong Kong, formed in 1989, remains popular not only with its own residents but with those living in mainland Asia, boasting an enrollment of over 100,000 students. Spain's Universidad Nacional de Educacion a Distancia represents Europe's largest distance learning institution, serving 130,000 learners (Simonson et. al, 2000). In the 1970s, distance education became a truly global phenomenon as Canada, Japan, West Germany, South Africa, and even Sri Lanka and Pakistan opened universities focused on distance learning (Moore & Kearsley, 2012). Technological advancements were integral to the success of these distance education universities. The addition of teleconferencing in 1970s and 80s into the distance education arsenal allowed for greater interaction between instructor and student. Learners could ask questions and offer feedback to teachers instead of being forced to digest an asynchronous learning relationship – one in which teacher instruction and student learning take place at separate times (Moore & Kearsley, 2012).

Throughout its history in the postal service, radio, television, and teleconferencing, distance education has been seen as a viable means of educating people, though never as a complete substitute for a brick-and-mortar traditional classroom. The Internet as a technology is changing that perception. The Web has catalyzed a revolution in education. Instructors can reach global audiences at the click of a button, bandwidth is greater than ever—and only increasing—and the possibilities for greater interaction through a variety of media are endless. Not to mention students can receive an education online at a lesser monetary price to both the student and the institution, once housing, transportation, and facilities costs are eliminated. Considering all of these features, it is no surprise to see the ever-increasing popularity of online courses.

## **Web-based Distance Learning**

Web classes have been around since the 1980s, but the explosion in online education can be traced to the early 2000s, as networks became faster and capable of transmitting higher amounts of data (Bower & Hardy, 2004). Community colleges, generally home to students learning more specific skills or working part-time jobs, were pioneers in delivering courses via the Web in the United States. In 2001-02, a Department of Education study reported that 90% of public two-year colleges offered online courses (Bower & Hardy, 2004). Other studies have illuminated the popularity of distance learning in the 21st century. Nearly 2.5 million American students were enrolled in online courses in 2005, and this number is expected to increase by 20% annually (Allen & Seamen, 2004). In 2004, 90% of all public universities were offering online courses, not to mention the high number of K-12, private, and military institutions that use the Internet as a medium to educate (Allen & Seaman 2004). While there is no doubt that online education is prevalent and popular, its effectiveness in educating students remains in question and will continue to be investigated.

## **Synchronous versus Asynchronous learning**

There are two different types of online learning formats. In a synchronous format, everyone participates at the same time (Means, Toyama, Murphy, Bakia, & Jones, 2009). In a face-to-face environment, this format is fulfilled by a traditional lecture, when teachers and students are all present at the same place at the same time. Synchronous learning can also take place online, in the case of a live webcam or a discussion chat room. On the contrary, asynchronous learning is a more student-focused style, when students learn the material on their own time. Most online classes studied use an

asynchronous style, in which students watch a video or listen to a lecture on their own (Purcell, et al., 2013).

Numerous studies have compared the student behaviors in each format and the effectiveness of a synchronous versus asynchronous format. Chou (2002) divided a class into two text-based, audio-video conference sections, one live and one recorded. She then monitored transcripts from both conferences. She found that a higher percentage of social interactions occurred in the synchronous group, while students in the asynchronous discussion spent more class time discussing task-oriented content.

Hrastinski (2008) also divided a class into a synchronous and asynchronous online section. In the synchronous section, the class communicated by a scheduled three-hour discussion. In the asynchronous section, students had one week to participate in an online discussion board. Like Chou (2002), Hratinski found that students in the asynchronous discussion spent a much higher percentage of time discussing content-related issues, while students in the live chat spent more time planning tasks and seeking social support.

Offir et al. (2008) researched student satisfaction in each type of online format. Offir and colleagues compared two online sections. They found that the interaction level between students and their teacher, which was higher in the synchronous section, was a significant factor in the effectiveness of the teaching method, as measured by test score. They also concluded that synchronous learning is more effective among students with a high cognitive ability.

Most classes can be split into synchronous and asynchronous definitions. As the aforementioned research indicated, different types of students perform differently in each

section, and students learn differently in each format. Our research will compare these two learning preferences.

### **Factors in choosing an Online Education**

An important advantage of online education is that it allows learners to have a greater sense of control of their educations. Several studies we encountered showed that this learning style appeals to certain types of learners, while other students would be more hesitant to take a class in which they have more control and therefore more responsibility over the learning experience (Diaz, 2010; Barnes, 2004; Zapalska, 2006). Therefore, an important part of determining the effectiveness of online education is to evaluate a student's learning style and determine whether an online class would fit the student's needs.

Diaz (2010) asked students to fill out a survey to determine what learning style best described them. He used the results of the survey to divide students into the following descriptions: Independent, Avoidant, Collaborative, Dependent, Competitive, and Participant (Diaz, 2010). Diaz then allowed students to choose between two sections of a course, one online and one in person. He found that students who enrolled in the online option tended to be more independent, and were driven by more intrinsic motives, while students in the traditional classroom environment were more dependent and desired to work with other students and the professor. Barnes (2004) asked students enrolled in an online course to best describe their learning style, and found that two-thirds of the students fit best into a divergent learning style, meaning that they rely more on observation rather than actions to comprehend lessons.

Zapalska (2006) further divided learning styles into visual, auditory, reading/writing, and kinesthetic learners, and after an online class asked students which format they preferred. Interestingly, he discovered that auditory learners were least likely to prefer an online class. Eom and Wen (2006) asked 397 students who completed at least one online course at a university to define their learning style, and reported that visual and reading/writing learners found online classes to be most advantageous. On the other hand, Muir (2001) adapted an online class to fit various learning styles and compared standardized test scores with those from a traditional class. Muir found that online education is easily adaptable, and can be changed to fit any student's learning style.

Wuensch (2006) went a step further by asking students to evaluate and compare online classes with face-to-face classes. Students at 46 different universities across the United States were asked questions about their most recently completed online class and most recently completed traditional class. The results of the survey indicate that online classes were "greatly superior" in convenience and allowing self-pacing. Students also reported that face-to-face classes were more difficult, better facilitated communication with the instructor and peers, required more effort, provided better evaluation of their learning progress, and led to greater overall understanding of the subject material.

### **Variables of Interest**

In order to determine the most fundamental characteristics of online and traditional learning formats, we chose to isolate a select group of independent and dependent variables. Although social presence and learner control levels differed in each experimental group based on theories detailed below, cognitive learning, perceived

learning, and perceived teacher immediacy were measured to assess the effects of these changing factors. In order to make these adjustments and measurements, a complete understanding of the following terms is necessary: social presence, learner control, cognitive learning, perceived learning, and teacher immediacy.

**Social Presence.** Social presence is the independent variable of interest with research questions one and two. Social presence theory was developed by Short, Williams, and Christie in 1976 in order to explain the effect that telecommunication media have on communication practices. They defined social presence as “the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships” (65). In other words, social presence is a measure of how “real” a person is perceived through communication media. According to this theory, social presence is an objective attribute belonging to each medium of communication, and that face-to-face interaction inherently has the highest level of social presence. Videos have a lower level of social presence than a face-to-face interaction, while audio alone has a still-lower level of social presence (Short, Williams, & Christie, 1976). This distinction is the basis for choosing the three video lecture formats that we tested in our experiments. Although these three modes (traditional, video, and audio) were distinguished in the 1970s to apply to offline methods of distance learning, they remain applicable in today’s Internet age. MIT OpenCourseWare and other university formats utilize videos that are made available over the Internet and include a visible teacher, similarly to how video lectures may have been seen in the time of Short, Williams and Christie’s theory. Podcasts are used as well for learning purposes, providing students with the ability to learn while driving, walking, or perhaps completing other tasks

(Lowenthal, 2009). Finally, the Khan Academy and similar formats represent a medium between the video of a teacher and the audio alone - while these Khan-type lectures offer no visible teacher, they do provide a visual context for the audio material.

Despite Short, Williams, and Christie's theory that some learning formats inherently have more social presence than others, advances in distance learning technology such as online teaching tools, discussion boards and software have allowed the opportunity for instructors to facilitate higher social presence in an online distance learning environment. However, the responsibility to increase social presence lies with the instructor, who can use discussion in a conference-like format to increase interaction between students and instructor (Gunawardena, 1995). Nevertheless, in a large lecture-style class format that is popular in the large-university environment, especially among introductory classes, discussion is neither present in the traditional lecture hall setting, nor is it present in the recorded video lecture typical in an online section. Because this is the only format used in our experiment, Short, Williams, and Christie's theory remains relevant and applicable in assessing the social presence of our experimental lecture formats.

Additionally, social presence has not only been seen as an inherent characteristic of a particular learning environment, but also as an independent variable that can affect the levels of interaction students choose. Social context, communication, and interactivity are the most important elements of social presence, which can impact the acquisition of knowledge in any environment; however, interactivity of the instruction and interaction between students and the material are separate measures, and the inherent social presence of a learning environment can affect the students' ability and comfort

level for interacting with the material (Baskin, 2004). This interaction with the material could have an effect on cognitive learning and perceived learning, a potential implication that our study will examine.

Furthermore, while perceived social presence may be manipulated in lecture format with the use of discussion modules and more interactive elements, one study showed that this manipulation takes time, and is not automatic, so in the case of a one-lecture study, these additions could be non-applicable (Na Ubon, 2005). In this same study, the researcher highlighted the importance of affective (emotional) communication and interaction between tutors and students in an online environment, and how this emotion was able to affect the social presence of the tutor in the environment over time (Na Ubon, 2005). However, in the context of a university lecture, such affective interaction cannot be facilitated effectively among hundreds of students in a traditional, face-to-face format, let alone in an asynchronous online distance-learning format.

Social presence has not been shown to correlate with cognitive learning (Mackey & Freyberg, 2010). However, social presence has been shown to have a positive correlation with both perceived learning and instructor satisfaction (Richardson & Swan, 2003). Similarly, social presence has a positive correlation with both nonverbal and verbal teacher immediacy (Bozkaya & Aydin, 2007). Consequently, social presence has been more associated with the emotional side of learning, but these studies used already-established online classes in which students enrolled by their own choice. Therefore, the students' learning preferences could affect their choice, and in turn, satisfaction with the course. Our study will use a population of students who have no choice in the medium from which they must learn. Students will be randomly assigned to groups, so they will

have no ability to choose a test group based on their learning preferences. This method is comparable to testing students of various learning preferences who would be forced to enroll in online classes at any given university due to an increasing number of essential classes that are only being offered online. In these cases, students have more diverse learning preferences, so some may not perform as well or think as highly of these online classes. Additionally, these online classes in the aforementioned studies employed different interactive elements to increase student-teacher interaction such as discussion boards and email. We will focus on the lecture video only to assess that media's value without the added benefits of interactive software.

**Learner Control.** Learner control is the independent variable of interest in research questions three and four. As technology improves, the methods for watching an online lecture will change rapidly, so this is an area that could see significant evolution in the future. In online learning, it is more likely that “learners make their own decisions concerning the aspects of the path, flow, or events of instruction” (Williams, 1996). In terms of our investigation, many online classes allow students to learn at a pace they control individually. This feature of online learning environments, called learner control, is worth examining because it has been studied in many designs, and has been shown to have advantages in online learning, as detailed in the studies cited below.

Learner control can manifest itself in multiple aspects of the online learning experience. The main characteristics that can affect learner control levels are sequence, pacing, and content (Milheim & Martin, 1991). While the online learning environment provides opportunities for customized interaction with material via technological means such as applications and discussions, even a basic asynchronous online model allows

students to have greater learner control, as they can move at individual paces instead of keeping up with a large group lecture or discussion in real time (Means, et. al., 2009). Students can sometimes choose the order in which to learn the material, how quickly to move through the material, and what material is most important for them to emphasize.

A 14-week field study on junior high school students in Taiwan found that in a technology-mediated virtual learning environment (TVLE) using audio, video and online interactions, the high level of learner control led to better test scores than students in a traditional learning environment (Chou & Liu, 2004). The students in the TVLE also reported higher levels of self-efficacy and satisfaction with their learning than those in the traditional setting. In this setting however, students were able to interact with the teacher and with each other in the TVLE learning format. Because this interaction took place, it becomes difficult to figure out whether the students were more satisfied because of their control over the learning process, or because it was relatively interactive compared to other online learning formats.

In another example, Chang and Ho (2009) used an experimental study to find that in a web-based language course, students performed better with a learner-controlled instructional experience than in a program-controlled one. In this case, learner control constituted the presence of multimedia elements such as audio material and links to other sources of related information on the Internet. While this does not alter the sequence or pace at which students learn the material, it does allow them to choose which material to emphasize by allowing them to peruse the available links. Chang and Ho (2009) also looked at the students' success in each of these environments as compared to each student's locus of control, which they define as the amount of responsibility students

accept for their learning success. The study then found that even students with an external locus of control, who place less responsibility on themselves to learn, performed better in a learner-controlled environment than in a program-controlled one (Chang & Ho, 2009). This trend suggests that even though all students learn differently, higher levels of learner control can be universally beneficial.

Several other studies have found a student preference for an online format with higher learner control levels rather than a traditional classroom setting, such as pacing, sequence, and content management controls. The ability for a learner to have control in the instruction has been shown to make learning more appealing, and has led to more student motivation (Corbalan, 2005). According to Winterbottom (2007), when they have the opportunity to learn from online podcasts or summaries more students indicated in a survey that the ability to repeat class material made the online learning beneficial. Rose (2009) found that students surveyed from both online and traditional courses “overwhelmingly” expressed satisfaction with instructor-made videos, noting the ability to pause and watch more than once. In this study, 74% of the students surveyed said they watched the videos more than once.

However, these studies do not conclude that learner control is a standalone factor in the quality of a learning experience. Schreiber et al. (2010) found that while students enjoyed the convenience of listening to a podcast, they found it to be a less engaging teaching method, and expressed a clear preference for the live lecture format. Buckley and Smith (2008) concluded that multimedia with additional learner control options enhance the educational experience for students, but only in coordination with traditional methods. Chang and Ho (2009) found that learner control does not necessarily overcome

pre-existing barriers to learning. While they found that more learner control benefitted all students regardless of their locus of control, those with an internal locus of control still performed better. For some, that barrier might be mental, but for others it is experiential, as shown by Wang and Chen (2011), who found that students with fewer years of Internet experience had lower learning success. Although use of the Internet is more widespread now than it was even just a decade ago, a discrepancy in digital competency still exists between students. This discrepancy can be even more apparent when cultures differ among students, a variable with increased importance in a university setting (Olaniran, 2007). Olaniran (2009) also found that learner behaviors and preferences are often influenced by culture and determine the ideal learner control level for a particular student.

Additionally, because researchers are so often interested in complex online environments, it is difficult to see which factors actually contribute to student's success and satisfaction. For instance, in Chou and Liu's study (2009), the format of the TVLE included three different factors of learner control. The question remains whether one of these factors was more important than the other two, and whether the combination of all three was necessary or only one factor could impact student's success and satisfaction. Also, in Chang & Ho (2009), because learner control was instituted in the form of additional material, one can question whether learner control via pacing and sequence might have more of an impact on learners with both internal and external loci of control. Because of these issues, and because of the comments about repetition in the studies by Winterbottom (2007) and Rose (2009), we became most interested in testing one factor of learner control—pacing.

The learner control factor in which we are most interested is the ability to pause, rewind, and repeat parts of a recorded lecture. Bassili and Joordens (2008) found that students who were able to use the pause and rewind feature of a media player in an online introductory psychology class scored significantly higher on a test, and also felt more satisfied by the online course than students who were unable to pause or watch it again. Tallent-Runnels (2006) found that in asynchronous learning formats, students favored the ability to learn at their own pace, a feature that is unavailable in synchronous traditional environments. However, Sullivan (2001) found that some females see this responsibility to self-pace as a negative characteristic. This finding is interesting to note, and may have something to do with these females' locus of control, but may yield more interesting findings in a randomly controlled environment. Another study looked into many characteristics of online learning, and found that self-pacing and convenience were the most notably positive characteristics mentioned by students (Wuensch et. al., 2008). Yet if self-pacing were removed, how would students perceive online learning? Would they be able to benefit from other aspects of learner control if the learning environment were synchronous? Answering this question begins by isolating pacing as a variable to see its effects.

In order to focus on the pacing aspect of learner control, we used our second experiment to test the difference between traditional learning, online learning with self-pacing, and online learning without self-pacing. We measured not only student performance on a test of recall, but also perceived learning and teacher immediacy because they also contribute to the student success in education. The relationship of these dependent variables to the independent variable of learner control levels will help

us to assess an additional feature of the online learning experience. In order to fully understand these relationships, a full understanding of the dependent variables is necessary as well.

**Cognitive Learning.** A central variable to this study is the measurement of learning outcomes. Do students learn more in a traditional lecture, or do they fare better when receiving instruction over virtual media? The issue of quantifying “learning” has vexed researchers for decades. Benjamin Bloom’s (1956) pioneering work, *Taxonomy of Educational Objectives: the Classification of Educational Goals* is widely cited as the basis for defining and classifying learning objectives in the classroom. Bloom describes three different types of learning – the Affective, Psychomotor, and Cognitive domains. Affective learning refers to the attitude with which students react to learning or the emotional interaction between student and material. Bloom’s study identifies five different levels of affective learning. From the most basic to the most complex, these levels are: Receiving, Responding, Valuing, Organizing, and Characterizing. Whereas in the “Receiving” domain a student merely pays minimal attention and does not learn anything, in “Characterizing” the student is so influenced by the material that he or she demonstrates this new knowledge as a personal characteristic. Bloom’s second category is the Behavioral, or Psychomotor domain, which explains the ability of humans to learn a physical skill, such as manipulating a tool or using their hands to accomplish a task.

Last, and most critical to this study, is the third and final domain, cognitive learning. Bloom (1956) described cognitive learning as the retention and understanding of a subject as well as critical thinking and application of the learned material. The six levels of cognitive learning, ranged again from basic to complex were: Knowledge,

Comprehension, Application, Analysis, Synthesis, and Evaluation. A student displays knowledge and comprehension by simple retention and memorization of data, while in synthesis and evaluation the student displays a greater ability to apply the knowledge learned in the lower levels and think critically about the material (Bloom, 1956).

One important aspect of cognitive learning, which communication and education researchers have studied at length, is its relationship with affective learning. A higher level of teacher immediacy, behaviors that decrease the “distance” between communicators (discussed at greater length below), has been shown to have a significant effect on students’ affective learning but only a slight one on cognitive learning. Allen, Witt, and Wheelless (2006) conducted a meta-analysis of teacher immediacy studies to see whether a link between affective and cognitive learning exists. The research concludes that there is indeed a link between teacher immediacy, affective learning, and cognitive learning. Higher teacher immediacy levels caused higher affective learning levels, which, in turn, induced an increase in cognitive learning. This study will also attempt to discover a link between teacher immediacy levels and cognitive learning, but in the online realm.

In order to test cognitive learning levels in students, an instructor must assess aptitude in all six categories of Bloom’s taxonomy. These evaluations have traditionally been accomplished by written or oral examinations asking students to recall and analyze subject material (Kelley & Gorham, 1988; Witt & Wheelless, 2001). Recent studies in the field of distance learning, however, have overwhelmingly utilized a different method of measuring cognitive learning—the learning loss scale. The learning loss scale asks students to report 1) how much they learned in the class with their own instructor and 2)

how much they would have learned with an ideal instructor (Richmond, Gorham, & McCroskey, 1987). This scale is widely used in studies because it allows students to self-report scores across a variety of disciplines and has been corroborated as a viable way of measuring cognitive learning, though recent research has questioned its effectiveness (King & Witt, 2009). At best, the learning-loss scale appears to be a backup plan for traditional means of measuring cognitive learning, such as a written examination, but nevertheless the scale is useful for a multitude of studies. Witt and Wheelless (2009) championed Kelly and Gorham's (1988) study of the relationship between nonverbal immediacy and short-term recall because they "manipulated specific immediacy behaviors in a controlled setting, rather than merely surveying students about their perceptions of learning" (25).

Our study is most similar to Kelly and Gorham's, conducted in a highly experimental and controlled setting in which cognitive learning was measured by the traditional means of a written examination rather than relying on the learning-loss scale. It should be noted that our test did not measure all aspects of cognitive learning. The tests were administered only two days after the experiment, so they only revealed students' learning in the immediate short-term. The tests also only measured the beginning categories of Bloom's taxonomy: Knowledge, Comprehension, and Analysis. The CCJS105 exam only tested Knowledge and Comprehension, while the ECON200 and CHEM135 exams added the element of Analysis. As discussed above, there are many different components of cognitive learning. Due to the constraints of this study, we were able to measure immediate recall and application.

**Perceived Learning.** Perceived learning signifies how much subject material students think they have learned. It is an important part of the education process that can suffer in an online education environment (Richardson & Swan, 2003). If students do not feel that they are learning adequately, they will not want to enroll in an online course, regardless of how much they actually learn. Therefore, for an online class to be successful, it is essential that educators find a way to ensure a high standard of perceived learning in various class formats.

Studies are mixed on the issue of perceived learning in an online environment, with the majority suggesting that while cognitive learning does not suffer in an online classroom, the level of perceived learning does. Swan (2003) used a correlational design to test the relationship between social presence and perceived learning among 97 students in a semester-long online learning course. Swan found that the three main factors affecting student satisfaction are: (1) clarity of instruction, (2) interaction with professors, and (3) active discussion among students. Swan concluded that there is a strong relationship between social interaction and perceived learning, which could hamper the success of an online distance course. Rovai (2009) tested 221 students enrolled in either a traditional course or an online course, and used post-class surveys to determine cognitive learning and perceived learning. Rovai concluded that perceived learning levels were lower in an online course. Caspi and Blau (2008) distributed a web-based questionnaire to 50 course websites, asking 659 students to evaluate the importance of social presence in an online discussion group. They reported that an increased social presence resulted in a higher perceived learning score. O'Malley (1999) distributed a survey to 128 university students across a variety of classes. He found that, although

while students did agree that online courses offered some benefits not related to education, a traditional classroom still offered a better learning environment, and fostered an experience in which they learned more material. Last, Swan (2000) administered a post-semester survey to 1,406 students to determine student satisfaction, perceived learning, and interaction with teachers and peers in both online and face-to-face classes. Swan concluded that these factors were stronger in a traditional classroom, which offered students the educational stability that an online curriculum lacked.

However, newer research shows a shift in this data. Davies et al (2010) found that between 1998 and 2007, student satisfaction with online courses increased significantly. This seems to suggest that as technology improves, the historical divisions between traditional and online lecture formats may be lessening. Wu et al. (2005) found that students actually reported higher levels of perceived learning in an online discussion than in an in-class discussion. Hong, et al. (2003) reported that students in an online course were more motivated to do well, and enjoyed the technological advantages the online section offered, finding them to make the online course more advantageous than the traditional class. Stein (2003) split students in a winter course into online and face-to-face groups, giving them an option. He then asked students to evaluate their perceived learning, and compared the responses. Stein found no significant difference in perceived learning satisfaction between online and face-to-face learning environments. Hannay (2006) reported the strongest data, saying that the majority of 217 students preferred online education, as reported in a survey. Recent data complicate the traditional view that perceived learning is higher in a classroom, making our study a significant research project.

**Teacher Immediacy.** Teacher immediacy has been found to be an integral element of education that can impact the effectiveness of an online class. While teacher immediacy is not an independent variable of this experiment, it has the potential to change as a result of our varying levels of social presence between experimental groups (Richardson & Swan, 2003). Student performance has been shown to be independent of class size based on a comparison of the world's countries by the Organisation for Economic Co-operation and Development (Goldstein, 2011). This suggests that teaching methods are more important than the student-to-teacher ratio. Other studies support this position. Eom and Wen (2006) tested a variety of variables and their impacts on student perceived learning and satisfaction. Variables included course structure, instructor feedback, self-motivation, learning style, interaction, and instructor facilitation. Of these, the only variables significantly correlated with satisfaction were learning style and teacher feedback, with feedback having the strongest correlation. Baker (2004) surveyed 145 online learners and determined that students who rated their instructors as more verbally immediate expressed greater cognitive and perceived learning than students taught by less immediate instructors. Shea (2005) found that teacher presence and online learning shared a direct correlation, with both variables scoring higher levels in a survey of students in the face-to-face environment.

Arbaugh (2001) investigated and discovered that immediacy behaviors such as using humor, being open with students, and using a student's first name factored significantly in higher levels of cognitive learning and course satisfaction. Russo (2005) also found that student perception of the instructor's presence was significantly correlated

with both cognitive learning and student satisfaction, more so than with the presence of other students.

Allen et al. (2007) conducted a meta-analysis to determine the impact of teacher immediacy on learning outcomes in the classroom. Allen used pre-established verbal and nonverbal cues by the professor to define teacher immediacy, and compared the existence of these cues with student scores. By examining the correlation between measures of teacher immediacy and cognitive and affective learning, Allen concluded that higher levels of immediacy increase a student's motivation to learn the material, and thus have a significant impact on student learning behaviors. According to Allen, the research proves that immediacy behaviors bridge the "psychological distance" between educators and students in an online course.

King and Witt (2009) tested the relationship between perceived teacher immediacy behaviors and perceived and performed learning. Seventy-two underclass students evaluated their professor's nonverbal immediacy behaviors. Eight weeks after the course ended, the same students completed an online questionnaire to measure perceived learning, and a course grade was used to judge the cognitive learning score. King and Witt (2009) concluded that nonverbal immediacy scores strongly correlated with both perceived and cognitive learning scores.

After illuminating the importance of teacher immediacy, the question remains how to best maintain that immediacy in an online lecture. Several studies concluded that the success of an online course depended on the effectiveness of the teacher in creating an interactive environment, regardless of learning method. Webster and Hackley (1997) found that in distance learning settings, students were more likely to express a positive

attitude toward the experience when teachers took questions from students throughout the lecture. Schrum (2004) concluded that the best way to overcome the distance factor is to increase interactivity. Aragon (2003) laid out methods to increase user interaction, including answering emails promptly and providing frequent feedback. Conaway et al. (2005) divided students into groups, with some students posting in a monitored message board and others exchanging emails and talking in chat rooms. By analyzing the content of the message boards and emails, they determined that students did not automatically exchange information, but were more likely to communicate if the instructor worked to foster an atmosphere of interactivity and discussion. These results all indicate that the success of an online course depends largely on how effectively the professor can implement a measure of interactivity and immediacy.

### **Methodological Approaches to Distance Learning Research**

There are many different educational research methods that researchers use to establish trends and evaluate successful learning outcomes in different areas of education. Case studies, correlations and quasi-experiments are the main tools used to examine education practices.

Qualitative studies in online education are usually case studies of one specific online class. Peterson (2009) detailed the account of her first time teaching an online graduate course. In this case study, she assessed her pedagogical methods and overall increased accessibility to students. Cross-course case studies or case studies that review different repetitions of the same online class can also reveal information about the characteristics of online classes. Clark (2009) looked at the results of all the online

classes from the autumn quarter of 2008 at the University of Cincinnati to see how many students successfully completed the online classes.

Researchers have used a few different quantitative approaches to study correlations and causal factors that optimize student learning and satisfaction with online classes. Many studies used a convenience sample and distributed surveys to students already enrolled in semester-long online classes (Baker, 2010; Baker, 2004; Larson, 2009; Shoenfeld-Tacher, 2001). These studies then used descriptive statistics to show attitudes of students towards the online classes that they took and the people they encounter in the class.

Some studies used the professors' point of view to assess online classes. Berge (1998) sent surveys to college professors who had previously taught online classes and asked them about barriers to online education. This approach also has been employed in secondary schools to survey online teaching practices (Crippen, Archambault, & Kern, 2012). The Department of Education has done an annual meta-analysis of online learning in the United States (Means, et al., 2007). Additionally, the Babson Research group recently released its tenth annual survey of online education (Allen & Seaman, 2012).

Another type of methodology used in online education is in the correlational or causal-comparative studies. These studies have been used to describe differences between demographics and performance or opinion of online classes (Tallent-Runnels, et al., 2006). There was no manipulation of an independent variable, and experimental groups were based on pre-existing characteristics. These studies suggest a relationship between variables, but they did not show causation.

Next, some studies used a quasi-experimental study. In this kind of study, experimenters manipulated some aspect of the online class, and then collected information about performance or satisfaction. Survey responses were correlated with test and assignment scores in the class. However, this approach did not account for the fact that independent learners were more likely to enroll in online classes (Diaz & Cartnell, 1999); therefore, their learning style was suited to better perform in and enjoy these classes.

Another approach was a randomized controlled trial. In this type of study, researchers randomly assigned participants to either an online class or an in-person class. However, this experimental design was typically only used for short-term classes such as a one-time training (Benjamin, 2008; Bello, 2005; Chou, 2012). These trainings were usually very specific, such as “Principles and Practice of Airway Management” (Bello, 2005) or “Nutrition and Physical Activity Principles Important for the Promotion of a Child Healthy Weight” (Benjamin, 2007). Additionally, they only served a narrow audience such as anesthesiology students (Bello, 2005) or Child Care Health Consultants (Benjamin, 2007). Chou (2012) randomly assigned electronic engineering students to take a one-hour web-based anatomy course, and then measured their cognitive learning by a test.

Randomized controlled trials have been used in long-term classes; however, researchers had to recruit the participants. Mentzer (2007) randomly assigned students to an online section or in-person section, but had previously screened participants who would be amenable to possibly taking an online class. Students who did not agree were registered for a traditional class. Similarly, Jang (2005) explained their semester-long

study to undergraduate nursing students in Korea who had to verbally consent to participating before being randomly assigned.

In order to address our chosen variables, we needed to use a randomized controlled trial. However, a semester-long randomized controlled trial would not be feasible for our study because we, as undergraduates, did not have the means or expertise to develop an entirely online class. We also did not have the authority to randomly assign them to an online or in-person class for a course for which they paid tuition. Therefore, we chose a short-term randomized controlled trial with a sample of convenience using already intact introductory courses at the University of Maryland.

### **CHAPTER THREE: METHODOLOGY**

Our methodology was carefully planned and executed in conjunction with IRB standards. We recruited professors and classes to work with, then operationalized our independent variables and developed our measures to test our dependent variable. To ensure that our methodology was sound, we performed a pilot study in our first semester of data collection. Then, we performed our three experiments and analyzed the data collected.

#### **Sample Selection and Recruitment**

Our target population was college students in large introductory courses. Our first population, the students in ECON200: Principles of Micro-economics, was rather diverse in major and academic background. About 33% of University of Maryland graduates will have taken this class before graduating (Schwab, personal communication, 2010). All Business students and Government and Politics students are required to take ECON200, and many other students take it as a general education class. Therefore, the student demographic for ECON200 contributes a diverse sample of the population consisting of different humanities and science majors. Similarly, many students take CCJS105: Introduction to Criminology as both a degree requirement for Criminology and Criminal Justice and as a general education elective class, so the student major demographic was also diverse. CHEM135: Chemistry for Engineers, on the other hand, was a required prerequisite chemistry class for all engineering students in the A. James Clark School of Engineering. These engineering students were less diverse in majors, and they had strong math and science backgrounds. All of these class descriptions are available on the University of Maryland's scheduling website [www.testudo.umd.edu](http://www.testudo.umd.edu).

After choosing the types of courses we wanted recruit participants from, we connected with professors teaching these classes who would also be interested in our proposed research. Dr. Bonnie Dixon has conducted educational research in her Organic Chemistry classes, and consistently taught the CHEM135 class. Former Gemstone members who proposed this project previously had spoken about the topic with Dr. Robert Schwab, who at the time taught ECON200 for the University of Maryland. This class sometimes had up to 900 students enrolled, so Dr. Schwab expressed interest in our research and moving the class entirely online. Dr. Schwab enlisted the help of Dr. Cindy Clement, who was the chair of the Economics Department. Dr. Brendan Dooley taught Introduction to Criminology (CCJS105), and we thought he would be a good fit for the experiment on learner control given his class size, diverse class make-up, and his lecture style of teaching. We recruited his participation via email.

The lecture that we selected for our experiment was chosen in consultation with the professors. We aimed for topics that tested different skills and which fell on favorable dates for the students' testing in a way that would avoid interference with students' grades on the next test. All experimental lecture dates allowed the students time for reviewing material they did not understand after our experimental lectures and before any examination affecting their grades in the class. The CHEM135 unit we tested was "Reaction Kinetics," which was heavily based on fundamentals of math and science. The ECON200 lecture that we tested was "Public Goods and Common Resources," which included some math concepts, but also general economic principles. The CCJS105 lecture that we tested was "Contemporary Anomie/Strain Theory," which included criminology principles and some history of criminology.

## **Experimental Design**

We chose to use a randomized controlled experiment. This method would control for error variables in our random sample by randomly assigning students to the experimental lecture formats (Johnson, 2006). Using an online random number generator, we randomly assigned consenting students to one of the groups in each experiment. The students were required to attend or watch their assigned types of lecture for only one class period. The individual methodology for each experiment was unique in some way, but the basic methodological design remained the same for all three. The University of Maryland Institutional Review Board (IRB) approved all of the protocols, surveys, tests, and email scripts. The IRB is an institution that affirms that all research protocols involving humans are ethical and sound.

## **Operationalization of Independent Variables**

Social presence was operationalized into three different lecture formats according to Social Presence Theory (Short, Williams, & Christie, 1976). In our first experiment, we had three levels of social presence. The traditional face-to-face lecture was the highest level of social presence. The middle level of social presence was a video lecture, and the lowest level of social presence was an audio presentation. In our second experiment, we only had two levels of social presence to test a new lecture format. The traditional lecture was again the highest level of social presence. The next lowest level of social presence was an Interactive Whiteboard lecture with dynamic graphics (example in Appendix D). These formats will be explained in more detail later.

In our final experiment, we operationalized the pacing aspect of learner control as pause and rewind capabilities in the online lecture. The traditional lecture format did not

have pause and rewind capabilities and served as our control. For our online formats, one lecture was a live stream video that did not have pause and rewind capabilities – an equal to the traditional lecture, but in a video format. Our highest level of learner control was a video lecture that you could pause and rewind like a Youtube © video.

### Development of Dependent Measures

Recall was assessed by a test created by each professor to test the appropriate material from the experimental lecture. The ECON200 and CHEM135 tests included recall questions as well as questions requiring application of the material; however, the CCJS105 test only had recall questions because those are the types of questions that the material in the experimental lecture was best suited for. The ECON200 test included ten multiple-choice questions; the CHEM135 test included six multiple-choice questions and two true-or-false questions; and the CCJS105 test included eight multiple-choice questions. Table 1 shows sample questions from each test. To view the full tests, see Appendix A.

Table 1: Sample Questions from Test Used in Each Experiment

Experiment	Example Question
CHEM135	<p>5. Write the rate law expression for a third order reaction with respect to A and a second order reaction with respect to B.</p> <p>a) <math>\text{rate} = k[A]^3 [B]^2</math>            b) <math>\text{rate} = k[A]^3 [B]^2</math>            c) <math>\text{rate} = k^3[A]^2[B]</math>            d) <math>\text{rate} = K^3[A]^2[B]</math></p>
ECON200	<p>7. Private decisions about consumption of common resources and production of public goods usually lead to an</p> <p>a) efficient allocation of resources and external effects            b) efficient allocation of resources and no external effects            c) inefficient allocation of resources and external effects            d) inefficient allocation of resources and no external effects</p>

- CCJS105 1. A few attributes of those most likely to address strain by acting out criminally were mentioned during lecture. Which of the following was among them?
- Those with an established criminal history
  - Psychopaths
  - Those who have learned criminal behavior
  - Those experiencing low social control
- 

Teacher immediacy and perceived learning were measured by a survey adapted from The Teacher Immediacy Scale (Gorham, 1988). Each survey had 15 questions using a 5-point Likert scale that ranged from strongly disagree to strongly agree. Four of the questions measured perceived learning, while the other 11 focused on teacher immediacy. Four of the 11 teacher immediacy questions asked about nonverbal immediacy behaviors from the professor, while the rest assessed the verbal immediacy behaviors from the teacher. The same survey was used for every experiment, though the dates of the experiment and the name of the class was altered to reflect the correct information. In the CCJS105 experiment, three questions were added to the survey to assess learner control and how often students paused or rewound the video for reinforcement of the material. Table 2 shows sample survey questions in each category. To view the full surveys, see Appendix B.

Table 2: Sample Questions from Surveys Used in Each Experiment

Variable Measured	Sample Question
Nonverbal Teacher Immediacy	Smiles while talking.
Verbal Teacher Immediacy	Uses personal examples or talks about experiences outside of class.
Perceived Learning	I feel as though I learned the material effectively.
Learner Control	I re-watched parts of the lecture.

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## Procedures

**Pilot Study.** Our Pilot study was performed during the Spring 2011 semester with Dr. Bonnie Dixon's CHEM135 class. Lectures were typically 50 minutes in length. The students in this class received an email describing our study with the consent form attached on April 5, 2011. They were given a deadline of April 11, 2011 to hand in a signed consent form to Dr. Dixon in order to participate. Dr. Dixon posted a document to Blackboard ©, the class communication website, which displayed the random group assignments of the students. The class then received another email instructing them to check the uploaded document to find their group assignment on April 11, 2011.

There were three groups: Group A, Group B, and Group C. Group A was the control group that attended the traditional in-person lecture as they had been doing all semester. Group B received a video of the lecture that Group A had attended in person. This video had been recorded with a digital video camera and uploaded to our team's page on blogspot.com. Group C received a video of Dr. Dixon teaching that class's material without an audience, but in the same lecture hall. We recorded the Group C lecture in the same lecture hall with the same high-definition camera at another time when there was no audience watching Dr. Dixon. It was also uploaded to blogspot.com. The links to each video on blogspot.com were separately emailed to the students assigned to that group.

Group A attended lecture on April 13, 2011. Groups B and C received their email with the link to the videos on that same day around 5 p.m. Each group watched its assigned lecture, and then they returned to the lecture hall the next class period on April 15, 2011 to take the survey and test, which were proctored and collected by team

members. The students were given 10 minutes to complete these documents. Students were rewarded for their participation by receiving five bonus points towards their final grade in CHEM135. According to IRB policies, if a student chose not to participate, they still had to have an opportunity to earn the extra credit points, so if they completed the test students were awarded the five bonus points, even if they did not want their test score used for experimental purposes.

The tests were graded based on answer keys provided by the professor. The survey responses were coded by a numerical system based on the Likert scale responses. However, we did not use these data because we had to revise the test and survey based on some student response and confusion. The test originally included some open-ended questions, which we revised to all multiple choice or true or false for consistency with all other experiments. Additionally, some students answered the questions in different ways and giving partial credit introduced a confounding variable because different graders would give different amounts of partial credit.

Another change that we made in our data collection was how we labeled the Likert scale on the survey questions. Originally, the students denoted numbers that corresponded to their level of agreement with the statement. To ensure that students did not mix up the numbers with the corresponding statements, we changed the survey so that the students would circle initials representing the agreement. For example, originally “1” meant strongly agree and “5” meant strongly disagree. After these revisions, “SA” meant strongly agree and “SD” meant strongly disagree. These changes can be seen in Appendix C.

## Experiments

**ECON 200.** We performed our study in ECON200 during the Fall 2011 semester with Dr. Cindy Clement's class. Lectures were typically 75 minutes in length. The procedure was entirely the same as the Pilot Study with the CHEM135 class; however, the Group C video had a different format. The Group C video consisted of a slideshow with a voiceover by Dr. Clement explaining each slide in the same way she would have explained in class. Dr. Clement was not visible on this recording. Dr. Clement recorded this video in her office without an audience using Camtasia © software (see Appendix C for example). The change in Group C format was required because Dr. Clement used a slideshow to present concepts and did not write on a blackboard.

The class received an email with a consent form attached explaining our study and its procedures on October 2, 2011. They were asked to sign the attached consent form and hand it in to Dr. Clement in class on October 4, 2011 in order to participate. Students who chose to participate and complete the study were awarded five bonus points towards the final grade in the class. If students chose not to participate in the study, they were still able to earn five bonus points by taking the test as a quiz, a practice of IRB policies. Then, the class received an email on October 11, 2011 assigning them to either Group A, B, or C for the study.

Group A attended the in-person lecture on October 13, 2011. Group B watched the recorded lecture that Group A viewed in person on Blackboard © by using Panopto © software. Panopto © is in partnership with Blackboard ©, the class website. Using Panopto ©, the camera in the back of the classroom can record the lecture and post it directly to the Blackboard © site. Group C viewed the slideshow lecture by downloading

an MP4 file from the Blackboard © class site. Panopto © and the MP4 file were used in this experiment for ease of use for the professor. Then, participants in all groups returned to the lecture hall on October 18, 2011 to complete the survey and test, which were proctored and collected by team members. The students were given ten minutes to complete these measures.

**CCJS105.** The CCJS105 lectures were typically 50 minutes in length. The CCJS105 experiment again followed similar IRB procedures, but we conducted different recording procedures. Additionally, we added the dependent variable of learner control, while focusing less on the social presence variable. Therefore, we changed our experimental groups. Group A still attended the in-person lecture. Group B watched a live stream of the lecture on a website called Justin.tv via a webcam streaming. We used Justin.tv instead of blogspot.com or Blackboard © because it had relatively simple streaming procedures. Also, the live stream did not allow the users to rewind the lecture. They were able to pause, but when they chose to play the lecture again, the lecture would skip ahead to real time, and the student would have missed any material during the pause. This change in Group B reduced the learner control by removing the opportunity for students to pace themselves and/or repeat material. Group C watched an embedded recording of that same lecture through Panopto © capabilities in that lecture hall that had both pause and rewind capabilities. Both of these online lectures then had the same level of social presence.

Students in the class received an email detailing the experiment on April 13, 2012. They were asked to sign the attached consent form and return it to Dr. Dooley by April 19, 2012 in class. If students chose to participate, they were awarded five bonus

points towards the final grade in the class. If students chose not to participate in the study, they were still able to earn five bonus points by taking the test as a quiz according to IRB policies. Then, the class received an email on April 17, 2012 telling them the groups to which they were assigned.

On April 19, 2012, Group A attended the lecture in-person. Group B watched the lecture synchronously in a location of their choosing. Group C was emailed a link to the embedded lecture later that day to view at a time of their convenience before the test and survey were administered. On April 21, 2012, all groups returned to the lecture hall to complete the survey and test, which were proctored and collected by team members. The students were given ten minutes to complete these documents.

**CHEM135.** The CHEM135 experiment took place during the Fall 2012 semester. Lectures were typically 50 minutes in length. The CHEM135 class again followed approved IRB procedures, but it tested different lecture formats. In this study, we only had two experimental groups. Group A attended the in-person lecture, and Group B watched a “Khan Academy” style lecture video. This video format allows the professor to write onscreen as they explain the concepts, but the professor is not visible. Dr. Dixon recorded this lecture using the Docrer Interactive Whiteboard © on an iPad (see Appendix C for example). Then, the video was uploaded to YouTube.com, so that students could view it.

We also made a change to our consent form procedures in this study with IRB approval. On November 6, 2012, the students were sent the preliminary email explaining our study. The email included a statement of consent to participate, and they signed the consent form on the day that they filled out the survey and test. The students received the

email assigning them to either Group A or B on November 11, 2012. Students who chose to participate were awarded five bonus points towards the final grade in the class. If students chose not to participate in the study, they were still able to earn five bonus points by taking the test as a quiz according to IRB policies.

On November 14, 2012, Group A attended the in-person lecture. Group B received an email with the link to the YouTube © video for them to watch at any time before the test and survey were completed. Then, on November 16, 2012, all students returned to the lecture hall to complete the consent form, survey, and test, which were proctored and collected by team members. The students were given ten minutes to complete these documents. Table 3 shows some of the differences in our experiments.

Table 3: Comparison of Experimental Procedures

Experiment	Participating Students	Percent of Total Students	Independent Variable Tested	Number of Experimental Groups
ECON200	315	83.3%	Social Presence	3
CHEM135	236	78.6%	Social Presence	2
CCJS105	108	36.0 %	Learner Control	3

Experiment	Test Questions	Extra Credit Offered	Dependent Variables Measured
ECON200	Recall & Application	5 pts	Perceived Learning, Teacher Immediacy, Recall
CHEM135	Recall & Application	5 pts	Perceived Learning, Teacher Immediacy, Recall
CCJS105	Recall	5 pts	Perceived Learning, Teacher Immediacy, Recall

### Data Analysis

Our data analysis involved comparing the average test score for each group and the average survey responses for each group. First, we needed to score all the tests and

surveys. Each test was graded for correctness based on answer keys provided by the professors who created the tests. There was only one correct answer for each question. The surveys were numerically coded based on Likert scale responses. As explained in the methodology section, this code represented different responses for perceived learning and teacher immediacy. For perceived learning, the code was 0 – strongly disagree, 1 – disagree, 2 – neutral, 3 – agree, and 4 – strongly agree. For teacher immediacy, the code was 0 – never, 1 – rarely, 2 – sometimes, 3 – often, 4 – always. The data was input into a Google spreadsheet that only team members could access with their Gmail passwords. Then, the data for perceived learning, teacher immediacy, and recall (test scores) were tested by ANOVA to see if the differences among groups were significant. Only the data from students who completed the consent form, test, and survey were included in the data set to analyze.

The ANOVA test we used was a one-way between subjects Analysis of Variance statistical test. This test allows us to compare the measurements of more than two sample groups (Johnson, 2006). Therefore, we can see if one mean out of the three means of our dependent variables is significantly different than the rest. We used the one-way ANOVA because each of our experiments only had one independent variable. The independent variable in both ECON200 and CHEM135 was social presence, and the independent variable in CCJS105 was learner control. However, for our CHEM135 experiment that only had two experimental groups, we used a t-test, which is designed specifically for assessing the mean difference between two samples (Johnson, 2006).

In addition to the ANOVA test for ECON200 and CCJS105, we used separate t-tests between each pairing of groups. This approach allowed us to determine any

statistical significance between two individual groups based on the variables of cognitive learning, perceived learning and teacher immediacy. We chose the implementation of the t-test with the ANOVA test as an additional method of data analysis to examine the statistical relationships between pairs of groups rather than focusing on just the relationship between the three groups as a whole. The ANOVA test allows us to use the t-test with less chance of encountering a Type I Error in our data analysis (Johnson, 2006). While using the t-test by itself may pose a higher risk of encountering such an error, we believed that our data analysis benefitted from its inclusion as an additional measure to more closely examine relationships between different experimental groups. For example, we were able to explore the differences between the two online formats (those who watched the lecture remotely with and without an instructor) and the differences between traditional lectures and individual levels of social presence. Because the University of Maryland offers many classes with a lecture format of an instructor's audio over a slideshow, we felt that comparing that type of format with a control group as well as a different variable would help create a better representation of what we had hoped to discover through our testing.

After conducting the ANOVA and t-tests, we calculated the effect size of our samples using Cohen's *d*. Effect size measures how large the effect of your intervention is. In other words, effect size shows how the dependent variable changed based on the independent variable. This statistic is calculated by dividing the difference of the population means by the standard deviation (Johnson, 2006). The effect size is a standardized measure to compare our findings to other research in the field.

Our use of an IRB-approved, randomized controlled experiment of a convenience sample allowed us to empirically measure differences in our chosen dependent variables among different lecture formats. We performed three experiments across a range of academic disciplines in order to increase the external validity for our results to be meaningful for different kinds of introductory courses. Using ANOVA and Cohen's *d* statistical tests, this methodology yielded the results as seen in Chapter Four.

### **Limitations**

Due to the nature of our research using human subjects, there were numerous confounding variables and limitations that we acknowledged and tried to control. Because we used an experimental setup with random assignment to one of the lecture formats, we could not implement our intervention for an entire semester. Students pay tuition to take these classes, and we could not force them to be randomly assigned to a lecture format that may not suit their individual learning style. With permission from the professors, we chose to administer the intervention for one unit. For CHEM135 and CCJS105, one unit was one 50-minute lecture. For ECON200, one unit was one 75-minute lecture. Because our intervention was only for one unit, we are careful with our generalization to entire semester online classes. However, we will try to combat this limitation by administering our experiment over multiple semesters. We felt that students would be more likely to participate if the intervention was one unit rather than a complete semester because it poses a lesser threat to their success in the class. Therefore, this approach will yield larger sample sizes for analysis.

For our statistical analysis, we are assuming that our test populations will meet the requirements for both ANOVA and t-test analyses, namely the normal population

requirement. While other statistical tests may offer more power in nonparametric cases, our statistical analysis proceeds on the assumption that our data is parametric. We also chose to use a two-sided t-test for our analysis to better detect significance in either direction between each pairing of groups as opposed to testing only whether online groups report significantly lower scores.

We also collected our survey responses as quantitative data in order to offer students a more clear choice in rating each question and to fit our findings into a more manageable data set for statistical analysis. In doing this, we are assuming that there is an equal difference between each 0 to 5 response choice and that we can, in fact, use those responses quantitatively.

Another threat to external validity is that, although we have chosen a variety of lecture formats, there are still other options that we did not test such as entirely print-based classes or a class with hybrid formats. We chose our lecture formats based on literature as described in the literature review section.

Because we could not randomly sample for our experiment, selection played a part in the formation of our groups. The subjects in the introductory courses that we tested were a majority freshmen, so there was no way to establish a measure of equal groups. The students that chose to participate agreed to be randomly assigned to one of the three experimental groups. We assume that we created samples that were roughly equivalent in previous knowledge of the subject and had a variety of learning preferences.

The largest confounding variables and limitations in our study will be attrition and attendance. Attrition could have caused an inflation or deflation of our mean or skewed

our statistical analysis. Additionally, attrition could have made our sample less representative in either one of two ways. First, our participants could have been the students who needed the extra credit because they had lower grades in the class. Second, our participants could have been the better students who are more likely to participate in optional assignments. However, we did not have access to the students' academic records. We had demographic information on our survey and did ask for GPA. However, many participants left it blank since they were freshmen and did not have an established GPA yet.

As an introductory course, many students from all majors take ECON200 as a prerequisite or a general education curriculum fulfillment allowing for a representative sample. In respect to the CHEM135 class, the results will not be as externally valid. However, the class still provides a valid sample in that it is the physical science class, which differs from the social science ECON200 class. Unfortunately, attendance is an issue mainly for the ECON200 class. Both students and the professors know that students do not always attend lecture. We hoped to combat the problems of attrition and attendance by providing an incentive to the students. The students who completed our study by attending the assigned lectures and completing the test and survey received participation points toward their final grade in the class. However, there was no way for us to ensure that the online groups had actually viewed their assigned lecture. During administration of the survey and tests, we asked participants to only fill out the test and survey if they had actually completed the study.

## **CHAPTER FOUR: RESULTS**

Our initial experiment in ECON200 focused mostly on varying levels of social presence in the learning experience as represented by the visual of a teacher or lack thereof, as well as the visual of other students. As previously stated, a single lecture was presented to three separate groups of students through different mediums. The first group attending the lecture in person as they normally would was intended to represent a controlled sample to compare to the online formats (Group A). The other two groups viewing the lecture remotely were designed to represent two different levels of social presence. We hypothesized that these three groups would have significantly different levels of teacher immediacy, cognitive learning, and perceived learning in the test and survey responses.

### **ECON200 Fall 2011 - (Research Questions 1 & 2)**

307 students participated out of a class of 420 students, so 73.5% of the class participated. Group A had 103 students; Group B had 107 students; Group C had 97 students. In our ECON200 experiment, we found no statistical significance between the three groups in cognitive learning as determined by performance on a test based on material presented in the single lecture (see Table 4). Therefore, there is no evidence to support any difference between the amount of information retained between the traditional in-class lecture, the video of the traditional lecture, and the video featuring just the instructor's voice over a slideshow. This finding was supported by individual t-tests between each pairing of the three groups that also found no statistical significance. This suggests that social presence has a negligible effect on the amount that students actually learn from an instruction period. As stated, we must reiterate that these data are limited

by the parameter of a single lecture and different results might be obtained through longer observations, but within the context of our experimental design we have found no reason to believe that there is any difference.

Table 4: ANOVA Results for Cognitive Learning in ECON200

Group	M	SD	n
A (traditional)	5.68	1.28	103
B (video of traditional)	5.51	1.27	107
C (audio slideshow)	5.56	1.47	97

Note: Tests were scored from 0 to 8.

M=Mean, SD=Standard Deviation

$F(2, 306) = 0.40, p < 0.05$

Although there was no significance in cognitive learning, we were able to find a significant difference in perceived learning based on both the ANOVA test and the t-test at the 0.05 alpha level between the traditional in-class group and the group watching the audio slideshow without the visual representation of the instructor and students (Group C). Table 5 shows the ANOVA statistics describing the significance. The effect size for the analysis between Groups A and B and Groups A and C happened to be the same ( $d=0.35$ ) and was in between Cohen's convention for small ( $d=0.2$ ) and medium ( $d=0.5$ ) effect (Johnson, 2006). This significance in perceived suggests that there is a difference in how much students perceive they learn in a certain lecture format based on social presence. The students' default format uses both the physical image and voice of the instructor as a complement to the slideshow material, rather than only the auditory presence of an instructor. Thus, the online lecture of Group B was designed to more closely emulate a traditional lecture, and therefore, may have yielded higher perceived learning scores because it allowed the students to learn from a more familiar environment. This result is especially interesting to note given the previous findings of no

statistical significance between our measured performances through the test. After watching the slideshow with instructor audio and no visual presence of an instructor, Group C reported the lowest perceived learning scores. Our results suggest that although students in the online formats were able to perform just as well as students in the traditional lecture, they did not believe that they had learned as much through that particular format.

Table 5: ANOVA Results for Perceived Learning in ECON200

Group	M	SD	n
A (traditional)	2.91	0.92	103
B (video of traditional)	2.62	0.73	107
C (audio slideshow)	2.62	0.75	99

Note: Survey responses were scored from 0 to 4.

M=Mean, SD=Standard Deviation, n=sample size

$F(2, 306) = 4.47, p > 0.05$

We also found statistical significance in verbal teacher immediacy between based only on the ANOVA test. Table 6 shows the ANOVA statistics to illustrate the significance. While we did not find significance between any pair of groups using a t-test, we found that the effect size ( $d=1.04$ ) between the traditional class (Group A) and the class watching an audio slideshow (Group C) was more than Cohen's standard for a large effect size ( $d=0.8$ ). Therefore, we believe that a difference exists between the traditional lecture and the two online formats with lower levels of social presence. We chose to exclude total Teacher Immediacy from this test because without the visual presence of the instructor, students would not be able to adequately respond the survey questions designed to target certain visual cues. However, we did perform a t-test between the traditional in-class lecture group and Group B that watched a video of that lecture, in which we found no significance. The overall significant result in verbal immediacy

suggests that the instructor had more verbal interactions such as using humor and answering student questions throughout the traditional lecture. Both Groups A and B watched that lecture, so they would have similar levels of verbal teacher immediacy. However, Group C watched the pre-recorded slideshow lecture, which did not allow for these verbal immediacy behaviors from the instructor. The significant result in verbal immediacy between the traditional lecture format and the slideshow format of Group C supports that audio files are less socially present than either videos or in-person interactions.

Table 6: ANOVA Results for Verbal Teacher Immediacy in ECON200

Group	M	SD	n
A (traditional)	2.49	0.71	103
B (video of traditional)	2.14	0.61	107
C (audio slideshow)	1.70	0.81	99

Note: The verbal teacher immediacy scores are on a scale of 0-4

M=Mean, SD=Standard Deviation, n=sample size

$F(2, 306) = 31.04, p > 0.05$

We are confident that the randomized samples used in all of our experimentations are large enough to account for any bias in the results and provide an accurate representation of the class as a whole. We will assume no outside variables have influenced the results of this experimentation or distorted our findings, and because of the diverse array of students participating in this class we believe we can generalize these results to a larger population of University of Maryland students.

### **CCJS105 Spring 2012 - (Research Questions 3 & 4)**

For this experiment, 108 students participated out of 300 students in the population. This ratio means that only 36% of the students participated in our trial. Unfortunately, many students had technical difficulties with the online videos, so their

data were not used. This sample size is smaller than we had hoped for and could lead to unrepresentative data.

Dr. Dooley's CCJS105 class included the introduction of learner control as an additional variable. The addition of learner control allowed us to determine whether the ability to pause or rewind a lecture video had any effect on perceived learning, teacher immediacy or cognitive learning on a test. Because we employed three groups here as well, we relied on a One-Way ANOVA test to find any statistical significance across the three groups and then additionally used a two-tail t-test between group pairs to support any statistical difference between any two groups for each measure, as done in the experimentation with ECON200. While the variable tested changed from levels of social presence to levels of learner control, we kept the same methods of analyzing data because the experimental design was based on our work with ECON200.

As with ECON200, we found no statistical significance in either the ANOVA or t-tests of the cognitive learning as seen in Table 6. This lack of significance suggests that there is no evidence to support the claim of a difference in cognitive learning measured by a test based on a single lecture across the three groups. These findings also suggest that students are able to perform as well on a test based on a single lecture even with decreased levels of learner control. Students with the benefit of pausing and rewinding a video did not appear to gain any statistically significant advantage on the test. We hypothesized that students with higher learner control would have different test scores for recall because they had pacing abilities unavailable to students in the other groups. They could pause and rewind the video to reinforce concepts that they did not fully understand the first time. Our data suggest that hypothesis is incorrect, as students did not show any

significantly different scores despite their advantages or disadvantages. Because this result was only based on a single lecture, students may not have taken full advantage of the ability to rewind or pause the video, whereas if they were enrolled in a full course based on this method they might be more inclined to do so in the long-term. However, based on just a single lecture, students were able to perform just as well regardless of whether or not they could pause or rewind the video.

Table 7: ANOVA Results for Cognitive Learning in CCJS105

Group	M	SD	n
A (traditional)	5.83	1.72	35
B (live stream)	5.30	1.90	47
C (video with self-pacing)	5.65	2.31	26

Note: Tests were scored from 0 to 10

M=Mean, SD=Standard Deviation, n=sample size

$F(2, 105) = 0.78, p < 0.05$

Although we found no statistical significance in cognitive learning, we did find a statistical significance in perceived learning based on both the ANOVA and t-test at a 0.05 alpha level between the traditional in-class lecture and the lecture that watched the video without the ability to pause or rewind (Group B). Table 8 shows the ANOVA statistics demonstrating the significance. We found a strong effect size between groups A and B ( $d=0.97$ ) and a medium effect size between groups A and C ( $d=0.49$ ).

Table 8: ANOVA Results for Perceived Learning in CCJS105

Group	M	SD	n
A (traditional)	2.62	0.72	35
B (live stream)	1.86	0.82	47
C (video with self-pacing)	2.19	1.00	26

Note: Survey responses were scored from 0 to 4

M=Mean, SD=Standard Deviation, n=sample size

$F(2, 105) = 5.79, p > 0.05$

These results follow logically in that students may have felt disadvantaged without the ability to pause or rewind a video that is a common feature in similar online videos. Because students did not have the option to ask questions, anything they missed during the viewing of the lecture they could not regain. Therefore, students who did not fully understand a portion of the lecture may have felt disadvantaged as well. Students who could ask questions in Group A or pause the video in Group C had the option to review the material and students in class were aware of the opportunity to ask questions if they did not understand any of the material. The lack of those options for Group B may have influenced survey responses enough to yield a statistically significant difference between the groups.

As we saw in ECON200, there is a continuing pattern of online groups reporting lower perceived learning scores while performing equally well on the test. The students in the group with the lowest level of learner control reported the lowest perceived learning scores. While we do not have the data to declare that a relationship always exists between perceived learning, learner control and teacher immediacy, our experiment supports such a trend in this particular instance, which could warrant further research.

We found no statistical significance in teacher immediacy between the three groups based on both the ANOVA and t-tests. Unlike the ECON200 experiment, each group was presented a visual representation of the instructor during the exact same lecture. Therefore, students in each group should have noticed the same verbal and tonal cues from the instructor, which was reflected in the survey responses. This lack of significance suggests, that when some visual element of the instructor complements their

voice, students still feel close to the instructor and feel engaged despite variations in learner control.

Overall, this experiment showed that while learner control may play a role in students' perceived learning over a single lecture, there is a negligible impact on cognitive learning as measured by the test. There is also no evidence to suggest students without the ability to pause or rewind the video feel any less close to the instructor than those attending the lecture in person or watching a video of the lecture with the ability to pause or rewind. However, because this experimentation relied on smaller sample sizes, we must cautiously accept our results and assume that randomization would account for any bias in the data. Moreover, past experimentation in the field has successfully utilized similar samples sizes.

#### **CHEM135 Fall 2012 - (Research Questions 1 & 2, Adjusted)**

For this experiment, 236 students participated out of a total 300 students, so 78.6% of the class participated. Group A had 124 students, and Group B had 112 students. The experimentation for CHEM135 was simplified to include just two groups. This change created larger sample sizes and allowed us to rely solely on a two-tail t-test to determine whether there was any statistical significance between the two groups. By eliminating the need to perform an ANOVA analysis in addition to individual t-tests, we accept that there may be a greater risk of encountering a Type II error during data analysis since we are not using the second test as additional support for the data. However, simplifying the experiment to only two groups would provide a larger sample size for data analysis.

When analyzing cognitive learning based on test performance, there appeared to be no statistical significance between the two groups as seen in Table 9 and consistent with our other trials. Students in both lecture formats were able to perform at the same level on the test, regardless of the level of social presence. This trend suggests that there may not be a difference between cognitive learning during one lecture period for classes in an online environment versus traditional lecture environments based on social presence levels. Therefore, we find no evidence to support that an online class using video lectures without the visual presence of an instructor – as offered at the University of Maryland –offer less academic value when examined on a single lecture-to-lecture basis.

Table 9: t-Test Results for Cognitive Learning in CHEM135

Group	M	SD	n
A (traditional)	6.22	1.33	124
B (whiteboard video)	6.10	1.37	112

Note: Tests were scored from 0 to 8

M=Mean, SD=Standard Deviation, n=sample size

t = 0.37, p < 0.05

Unlike previous experimentation, we found no statistical significance in perceived learning between the two groups. This difference could be derived from a variety of responses to the change in lecture format with the implementation of a chalkboard-like software. First, the course material may lend itself more to a problem-solving approach that allows students to feel as though they gained more from the visualization of problems, as they saw when Dr. Dixon wrote out formulas. Secondly, because Dr. Dixon bases her lecture format on writing on the board, the online group that watched her write the same material electronically may have felt closer to the traditional lecture format than students in the online groups for CCJS105 and ECON200, which did not have the same level of visualization. The overarching idea is that students relate how much they believe

they have learned in part by comparing their environment to their psychologically conditioned idea of a classroom, or a learning environment. This hypothesis would explain why students in experimental groups designed to more closely resemble a traditional classroom environment reported higher perceived learning and teacher immediacy scores than the groups that faced a different design. However, there was no evidence to suggest that students who participated in the online lecture for CHEM135 felt as though they learned any more or less than students who attended the in-person lecture.

We also found no statistical significance in both total and verbal teacher immediacy. The category was separated as such because students perceived different levels of teacher immediacy based on whether the behavior was expressed verbally (through words), or nonverbally (through tone and physical gestures). Since nonverbal indicators are more subtle, it is possible that students did not pick up on the differences in these indicators among groups. Using this same measure for CCJS105 we were able to see a significant difference between groups. Once again, because the format of Dr. Dixon's lectures are based more on visualization of the material on the board than Dr. Dooley's CCJS105 class, students in the CHEM135 class may be less concerned with having a visualized instructor as students in the CCJS105 class and more concerned with having visual and dynamic material.

The CHEM135 experiment showed no statistical significance between the traditional and online groups across the three measures, indicating that there is no evidence to support any difference between the two formats based on our measures. We assume our randomized samples are large enough to eliminate any bias in the data, and therefore provide reliable results based on the two-tail t-tests employed.

Our most interesting finding is that perceived learning was statistically significantly different between groups in ECON200 and CCJS200, and that cognitive learning was not statically significant between groups in any of our experiments. These results imply interesting possibilities as to the impacts of social presence and learner control, as outlined in the discussion in chapter five.

## **CHAPTER FIVE: DISCUSSION**

### **Discussion of Variables**

Technological advancement allows online classes to provide materials unique to that instructional design, as one can see with the development of more interactive features for those types of classes. There are so many different kinds of interactive features that could be studied in all different combinations. For our study, we chose to strip down an online class format to its most basic didactic medium: the lecture. Then, we applied that model to a randomized group of students for a single lecture in order to learn more about initial perception and response to online lectures specifically. This study hopes to provide a better idea of which lecture format online classes should use to benefit the students the most.

**Teacher Immediacy and Social Presence.** Through our research we found most evidence to support a link between social presence and teacher immediacy, which is in line with previous research (Bozkaya & Aydin, 2007). In the experiments with ECON200 and CHEM135, we found that as we decreased the instructor's social presence, students tended to report lower teacher immediacy numbers. This result follows logically as it is harder to feel closer to an instructor you cannot see, as compared to one that is visually and socially present. Lecture designs that feature higher elements of social presence should, therefore, be more effective in practice.

**Teacher Immediacy and Learner Control.** Our experiments in CCJS105 manipulated the pacing capabilities of learner control for the students. These experiments showed no significance in teacher immediacy between the three groups. This result makes sense in that the pacing capabilities of a lecture should not

affect the perceived distance between the instructor and the student. Pause and rewind capabilities would not affect verbal and nonverbal immediacy behaviors.

**Cognitive Learning and Social Presence.** When discussing a collegiate course, the most general measure for the value of a learning experience is cognitive learning, which is often expressed in terms of academic performance. There is no purpose in designing and funding a course if it does not provide the same academic value as a traditional class. However, through our findings we found no evidence in any experimentation to suggest that online lectures that vary in degrees of social presence negatively affect cognitive learning based on a single lecture. This finding justifies the development of online classes as a substitute for traditional classes based purely on what students can learn from the class.

If online classes truly offer the same cognitive learning value as traditional classrooms, an entirely new branch of higher education would break through as an alternative for students whose learning preferences more closely align with taking online classes. This new learning paradigm would offer students more flexibility in schedule adjustment and allow more university resources to be allocated to other endeavors rather than entry-level classes.

**Cognitive Learning and Learner Control.** Learner control capabilities have been shown to increase cognitive learning (Chou & Liu, 2004; Chang & Ho, 2009). However, our experimentation in CCJS105, which manipulated the learner control capabilities of the online lectures, showed that learner control did not affect cognitive learning. These contradictory results are somewhat common in educational research due to samples

differing both in kind and number. Learner control pacing techniques should be further researched with many different samples, both of convenience and randomly assigned.

**Perceived Learning and Social Presence.** Simply put, if students do not think they are learning as much in a certain course, they will most likely seek an alternative option. Thus, when designing an online course, instructors should attempt to maximize perceived learning if they intend to maximize enrollment.

According to our study and in agreement with Mackey and Freyberg (2010), social presence may not be essential to cognitive learning, but it may influence whether or not students choose to participate in a particular course as seen in perceived learning levels. Despite their primary functions of providing education, universities have a financial obligation to provide students with courses that satisfy their expectations in order to maintain enrollment numbers. The only significant result found in our experiment in terms of perceived learning was between the traditional ECON200 classroom lecture and the online ECON200 lecture that only saw a slideshow with the instructor's audio. All other groups in our experimentation found no statistical significance between lecture formats, suggesting that they did not feel any differently about the instructor. We believe that the difference between the ECON200 students and the other experimental groups lies in the presence of the instructor. In each CCJS105 group, students were able to see the instructor at all times and thus had higher levels of social presence than the slideshow lecture of Group C in ECON200. Group B in CHEM135 did not see the instructor herself, but they were able to watch the instructor draw on the screen as she lectured, just like she would have on the blackboard in class. While students did not actually see the instructor, they still felt as though the teacher was interacting with them because it was

visually represented in the instructor's writing. While the CHEM135 professor was able to mimic a significant part of her own classroom behaviors with the use of a tablet, the ECON200 teacher was less able to mimic her own behaviors such as pointing to the slides, walking around the classroom, and using body language. This difference suggests that there is an element of visualization that determines how much a student perceives that they learned. Whether the visualization is the actual instructor or simply a representation of the instructor's usual behaviors, the absence of such a visual appears to negatively impact reported perceived learning levels.

It is important to note that the majority of online ECON200 classes at the University of Maryland follow the slideshow model and do not provide visualization of an instructor during online versions of lectures. Students never see the instructor on screen or writing, and must rely only on verbal cues to remain engaged with the lecturer. This course design may negatively impact students' perception of the course as a whole, and thus create a less attractive option for prospective students. If the instructor added some kind of visualization to the lecture video besides the slideshow, students may feel more engaged while watching the video and report closer connections with the instructor. While there are other aspects that can affect students' cognitive and perceived learning in a particular course, we feel as though the effects of social presence on students should be an important consideration when designing an online lecture, and that those effects also present ideas warranting future experimentation.

**Perceived Learning and Learner Control.** Learner control is also an important tool to consider when designing an online course. While our experimentation only examined the pacing aspect of learner control, learner control also encompasses the

sequential order of the material and the stress each student places on each section of material. The basis of learner control is the opportunity for students to interact with the material in a more customized manner, which can help them to be more satisfied with the learning experience (Rose, 2009).

We found through our experimentation with CCJS105 that students with a lower level of learner control reported lower levels of perceived learning through that lecture design than students who were afforded basic pacing abilities in their lecture video (i.e. pause and rewind functions). Therefore, the self-pacing aspect of learner control can directly affect students' perceived learning in the course.

The CCJS105 results can be explained by the decreased level of learner control given to students in the live streaming group. Because students could not pause or rewind the video, they were more likely to miss or not understand key information than the group watching the video with more pacing ability. If they felt disadvantaged by watching a live video, they may have felt as though they did not learn as much even though there was no evidence to support that claim with cognitive learning results. We believe that live video formats for online classes can cause similar feelings in students, and thus do not provide an ideal course design. If possible, instructors should avoid forcing students to watch lecture videos remotely without the capabilities to pause and rewind.

### **The Future and Future Study of Online Education**

In reviewing our findings, it became apparent that institutions of higher learning must aim not only for optimum cognitive learning in online classes, but for optimum perceived learning as well. As demonstrated by student responses in ECON200 and

CCJS105, the amount of actual material learned and the amount that students think they have learned can differ. However, for the future of online education, the methods used in the online section CHEM135 are promising, as they yielded similar perceived learning levels to the traditional class. The experimentation with CHEM135 utilized an increasingly popular lecture delivery method using computer software and tablet hardware to create a virtual blackboard for writing out definitions, problems, and solutions to those problems. This medium allowed the instructor to physically write instructional material on the board as she would normally do in class, which could have helped students feel as though they are in an environment more closely related to the traditional forum to which they are accustomed. This method is especially effective in classes teaching subjects such as chemistry and math, in which lecture material is based more on concrete formulas that can be used to suit a variety of applications. In this type of class, a visual of the instructor is not necessary to keep the student engaged, because the material on the screen is dynamic – changing by the second as the instructor verbally works through the problem and illustrated.

In contrast, fact-based classes like CCJS105 rely more on definitions, theory and abstract concepts. In those types of classes, the slideshow method better suits the needs of the instructor for transference of material in a traditional classroom, because the visual serves more as an outline for reference than an actual illustration of the material. In the traditional classroom, this format will suffice, as students are able to use visual cues from the teacher's body language and ask questions to stay engaged. However, in the online realm, a collection of slides proves to be a far more static visual than that of illustrated problem-solving. This distinction is something that warrants further research especially

since these dynamic writing-focused lecture videos are becoming more popular with the explosion of sites like YouTube and Khan Academy. Most importantly, instructors must recognize that simply recording and digitizing the instructional methods used in a traditional lecture hall may leave students unsatisfied, with lower levels of perceived learning.

As enrollment numbers in classes like ECON200 continue to grow, having an online option that provides the same academic value would theoretically alleviate the stress brought on the department by the massive number of students and allow more students to enroll in those classes than was previously possible. This also means that educational videos with the same academic value as a college lecture could be dispersed to a widespread population at minimal cost, thus offering cheaper opportunities for higher learning for those who cannot afford to attend traditional universities. In the long run, this change could transform the entire landscape and design of collegiate institutes and place more of an emphasis on trade education and other academic ventures that would require a more hands-on approach than just a lecture. Lower-level, basic introductory classes could be replaced by online courses and eliminate the massive lecture halls that those classes now rely on. If online education can be developed into a viable option, it could completely change higher education. However, this does not necessarily make the brick-and-mortar institution obsolete. The hands-on experiences and collaborative abilities provided by in-person interaction can be invaluable in the educational process. Perhaps by utilizing online methods, much like Daphne Koller of Coursera hoped, educational institutions will be better able to facilitate more valuable and unique learning experiences at the brick-and-mortar school. In this way, the efficiency of MOOCs can be

combined with the infamous “college experience” to create the ideal higher learning format of the future.

However, in order to spark this revolution, students must also be in favor of using online techniques. Our findings reflect a disparity between what students actually learn and what students think they learn. Despite the fact that students performed just as well on a specific test no matter the lecture delivery method, they tended to have a general feeling that online lectures do not provide the same quality of education as traditional in-class lectures. That rationale signifies that other variables like social presence and learner control might contribute to lower perceived learning. While our experimentation only manipulated those variables, there is a vast array of others to consider when designing an online course. However, based on short-term results from single-lecture experimentation, we believe that the key to developing more successful and desirable online courses lies in visualization and immediacy, as demonstrated by the CHEM135 lecture in which students perceived learning levels were not significantly different among online and traditional groups.

The question of online education in higher learning is far too complex to be answered through a single set of experiments. While our design handles different responses to changing levels of learner control and social presence based on a single-lecture, the next step would be to attempt to recreate an entire semester’s worth of experimentation to measure how students would react in situations more closely related to real options available to them. Perhaps once students have become accustomed to the online learning environment, they are more likely to have higher perceived learning levels, but this matter remains unclear and requires further research.

Another question we encountered through our research was the effects of teaching through different media on the instructors themselves. In discussions with the professors we worked with, they expressed concern that they were not delivering the lecture material as completely to the online groups because they were taken out of an environment in which they were comfortable and were forced to cope with a different set of circumstances. We feel as though this topic has not widely been addressed in previous research and could warrant significant thought for future experimentation. If instructors are uncomfortable teaching through a certain environment, they could be presenting the material inefficiently and thus provide a lesser academic value to students engaging with that material and thus would not provide an education equal to that specific class' traditional counterpart.

If instructors were uncomfortable in a certain environment, students may feel that same discomfort which could be represented through decreased reported teacher immediacy and perceived learning. There may be nothing wrong with the online format itself, but the psychological responses to the change by both the instructors and students could affect the delivery and reception of the material, which would in turn decrease the value of the class. While students appear to receive the majority of attention when dealing with research on online learning, instructors should warrant much thought, especially when they are placed in environments where they have direct control over the delivery and are therefore most affected by changes in delivery method.

Additionally, the technological capabilities available today warrant further research into more innovative methods of online learning. Just like the CHEM135 lecture used a recording tablet to create more interactive online videos, a variety of online

tools could be used to enhance cognitive learning, perceived learning, and teacher immediacy. This could include anything from basic discussion boards to interactive games and quizzes during the lecture. Future researchers would be wise to examine which of these tools, if any, are equipped to engage students in a more valuable learning experience. Another alley for further research is the use of blended formats – a combination of online and traditional education methods. Blended formats have been found to increase the amount of time students can dedicate to learning in some instances, ultimately leading to greater student success (Means et. al., 2009). As a follow-up to our experiment, it would be ideal to factor the findings on perceived learning and teacher immediacy into a blended environment.

#### **Team ONLINE's Recommendations for Implementation**

Since we began the work for our study in 2010, the world of online education has seen a great transformation. Despite its detractors, more than half of students surveyed in 2011 think that online education offers student satisfaction that is about the same as that of a traditional class, and more than half of academic leaders think that students can learn just as much or more in an online class (Allen & Seaman, 2011). Companies and programs like Coursera, Khan Academy and the University of Phoenix have only grown in recognition and popularity. After collecting our data, we are able to make a few recommendations.

As Internet technology gives rise to the unprecedented proliferation of online courses, it is worth noting that this technology is experiencing growing pains just as much as any other. Technological difficulties, many of which we encountered while conducting our experiment, should be taken into account when discussing and

implementing the transition from a traditional classroom to a virtual one. A crucial aspect of online courses is the quality of the video. During practice runs, we tested the in-house camera for the CHEM135 lecture hall, but decided to not use it for the actual experiment as it shot a blurry video. Students would not be able to discern what Dr. Dixon wrote on the board and would suffer a distinct disadvantage compared to the students in Group A who had attended the actual lecture. Therefore, it is crucial for an instructor or institution that offers online courses to ensure the highest video quality, requiring the most modern cameras and video technology. High quality audio should complement the clear video, as often it is just as important for the students to hear what the instructor has to say as it is to see what they write down. From our difficulties with emerging technologies in our own experiment, we must stress that faculty and administrators become well acquainted with the technology of online courses.

There seems to be an underlying belief that online education cannot offer the same academic value as a traditional classroom, but through our experimentation we have found no evidence to support that claim. We believe that in order for online classes to be truly successful, a discussion must start about the way online education is perceived and how to change that perception to reflect the true value of online education as an instructional format in higher education. Because universities have existed in a traditional classroom environment for so long, any movement towards online education could be met with resistance because of that prevailing notion that it could not offer the same value. Through additional research, that idea could evolve and help usher in a new age of collegiate education through technology, changing the landscape of higher learning as it exists today.

Overall, we believe that one should consider both the instructor and the student when designing an online class for higher learning. The goal should be to provide instructors with the training and knowledge necessary to present the material at the same level as they would to a traditional classroom. This could help to prevent any confounding effects of discomfort that instructors may experience. Likewise, students should be provided with a medium through which to obtain lecture material that is presented clearly while at the same time keeping the student engaged in the material.

The future of higher education lies in the development of online courses designed in a way to provide large student populations with general information and concepts in order to prepare them for real-world application of that material. Instructors should be wary of merely “digitizing” their traditional lectures like the ones seen in ECON200 and CCJS105. The low perceived learning scores in the virtual classroom show that methods used in brick-and-mortar classrooms, such as slideshows, do not translate well to the online realm. Our experiment illustrates the need for teachers to be willing to adapt their lectures for a virtual environment. They must increase levels of social presence by creating spaces for conversation like discussion boards and offer instant feedback to student questions. As our results show, students have better attitudes toward the material if they feel as though the instructor is more real. In addition to social presence, our data also revealed learner control as the other significant variable in designing an online course. Students feel as though they learn more when they have greater control of their learning. Pacing – having the ability to pause and rewind – is a crucial element to learner control but certainly not its only component. Instructors can make their classes more accessible to students through small changes such as creating audio files of their lectures

so students can listen at their own leisure. The more access students have to the material, the more control they have over it.

### **Conclusion**

The advent of the Internet has taken distance learning from an inconvenient last resort to a viable alternative in education and a major topic of conversation and study in the field. When the education is free, such as the Khan Academy and MIT Courseware, instruction online is a no-brainer. However, institutions like University of Phoenix have demonstrated that people are willing to pay for an online learning experience resulting in a degree. As this reality became clear, traditional brick-and-mortar universities gained the opportunity to rework certain curriculums into an online format, serving larger and more diverse audiences. To serve these audience members well, it is important to know the best versions of online lectures, and how students are best satisfied with their learning experiences.

Our findings represent a small contribution to the development of online learning, among research on interactivity, learner preference, new technology, and more. However, we found that students truly can learn an equal amount of information from various online formats. When it comes to the memorization of facts and the interaction with methods, the lecture format with which students learn, traditional and online, may be negligible. Additionally, learning these facts and methods is neither significantly affected by the presence or absence of the image of the teacher, nor by the ability to pace one's own learning experience.

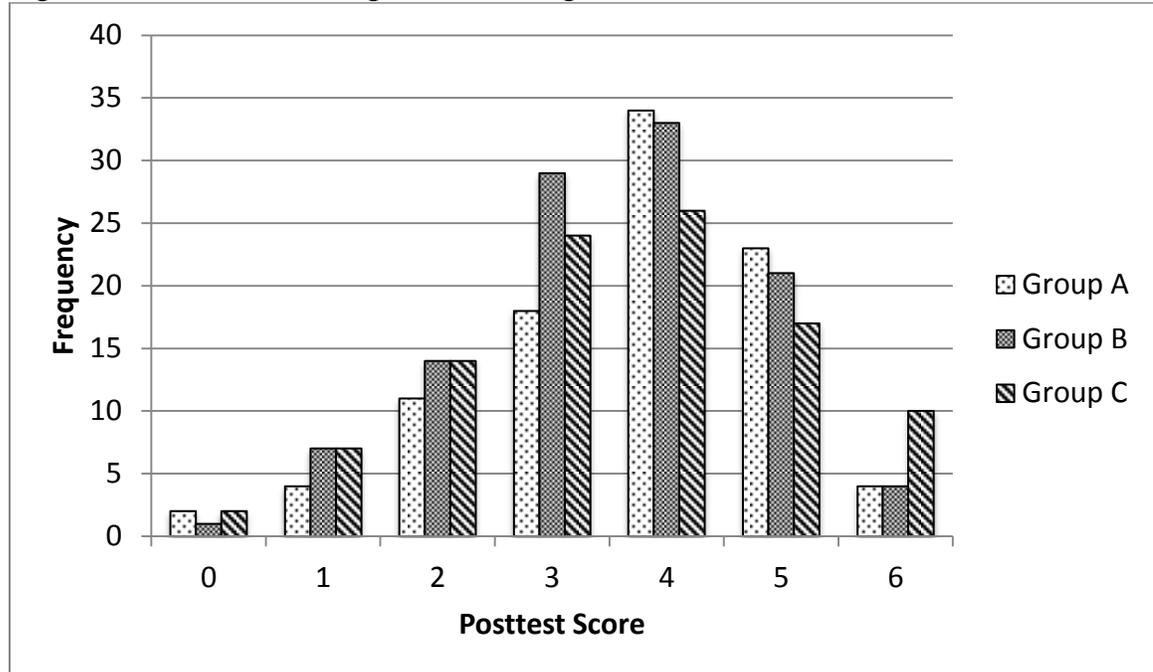
However, these features of social presence and learner control can have a significant effect on the student's perception of how much he or she has learned.

According to the results of our study, viewing a slideshow with audio commentary without view of the teacher can make students think they are learning less, and lacking the ability to self-pace in an online format can have the same effect. In contrast, lacking the image of an instructor is not detrimental if the visual is active and dynamic, like a motion picture of writing notes and solutions mimicking a traditional blackboard.

The question that remains for educators is how far they want to go for student satisfaction. The factors that we examined are relatively equal in terms of the amount of effort and cost they require from the educational institution. However, as online features progress, more methods have arisen and will arise that allow for further student satisfaction, higher perceived learning, and perhaps even higher levels of cognitive learning. Exploring these avenues and implementing interactive online features, blended courses, and other advances may require some change in how educational institutions function, but could help them to reach more students more effectively. Although these changes may seem intimidating at the outset, they could result in a more educated world.

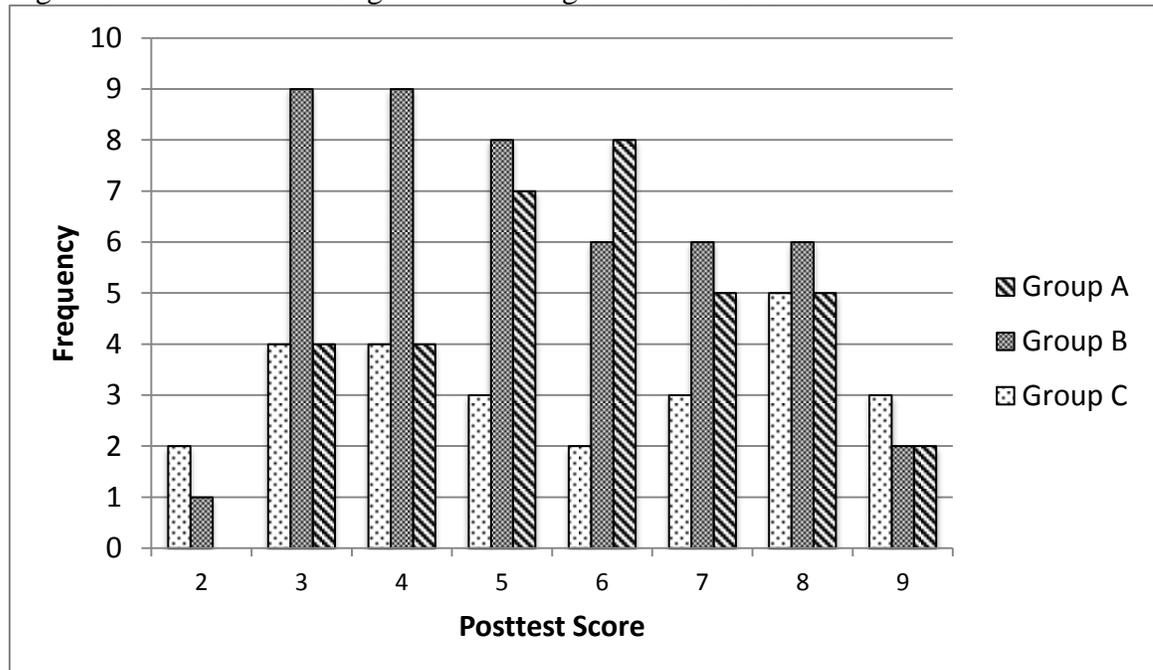
### APPENDIX A: SUPPLEMENTAL ANALYSIS

Figure 2: Distribution of Cognitive Learning Scores in ECON200



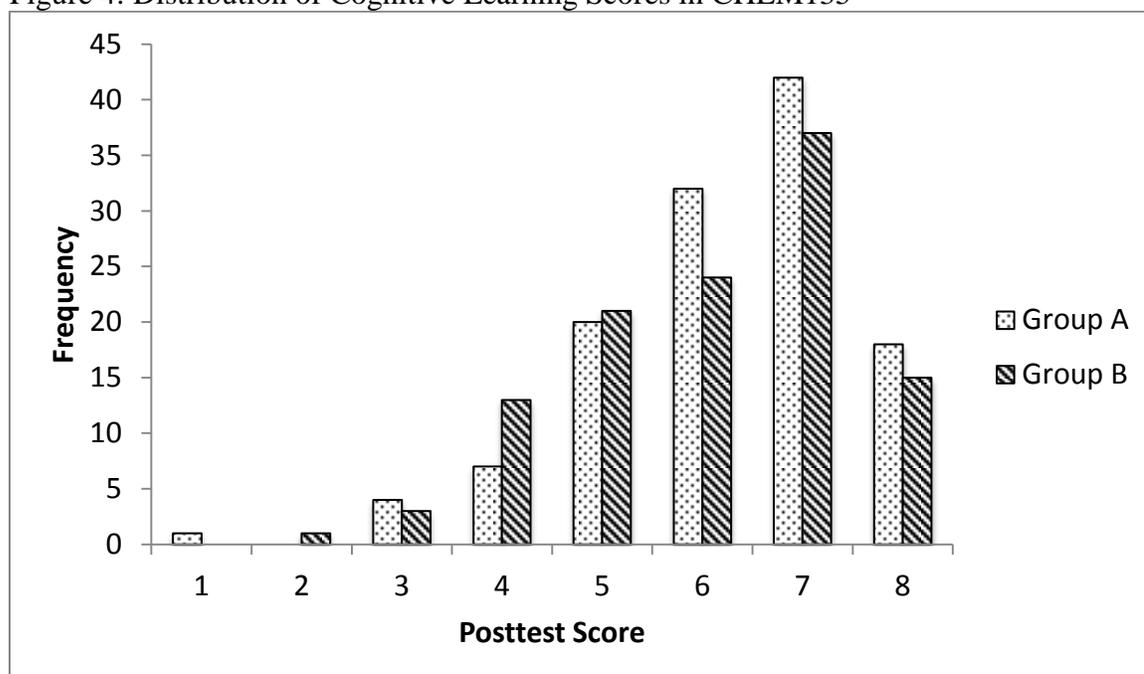
Frequencies of cognitive learning scores in ECON200 based on the posttest in Groups A, B, and C.

Figure 3: Distribution of Cognitive Learning Scores in CCJS105



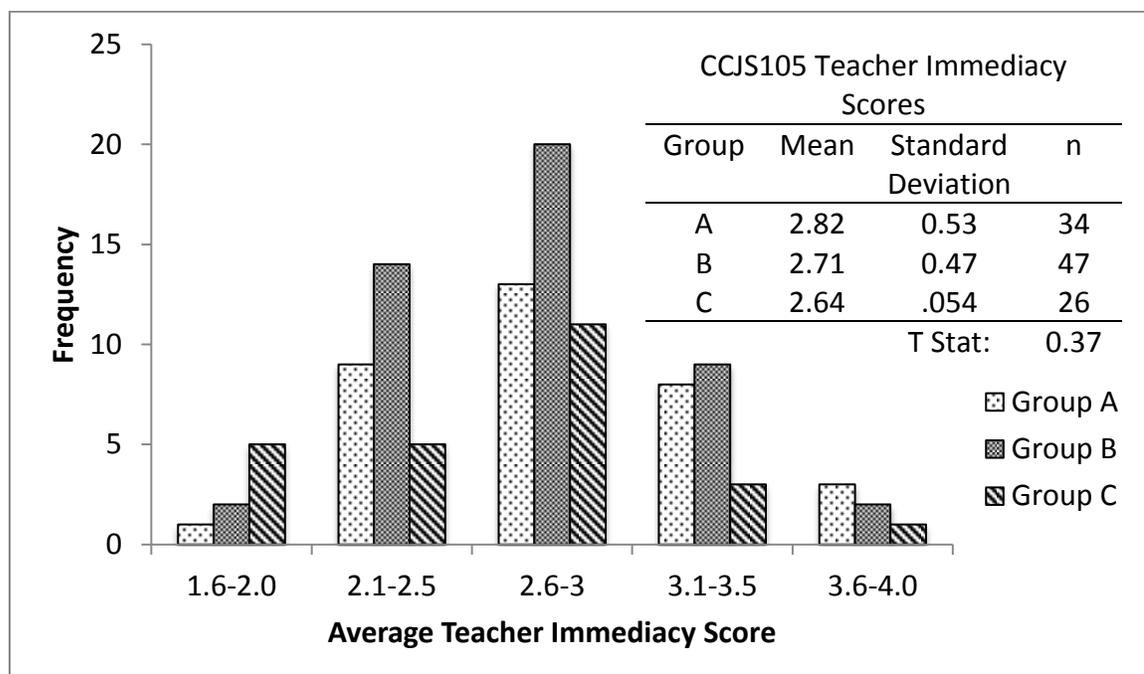
Frequencies of cognitive learning scores in CCJS105 based on the posttest in Groups A, B, and C.

Figure 4: Distribution of Cognitive Learning Scores in CHEM135



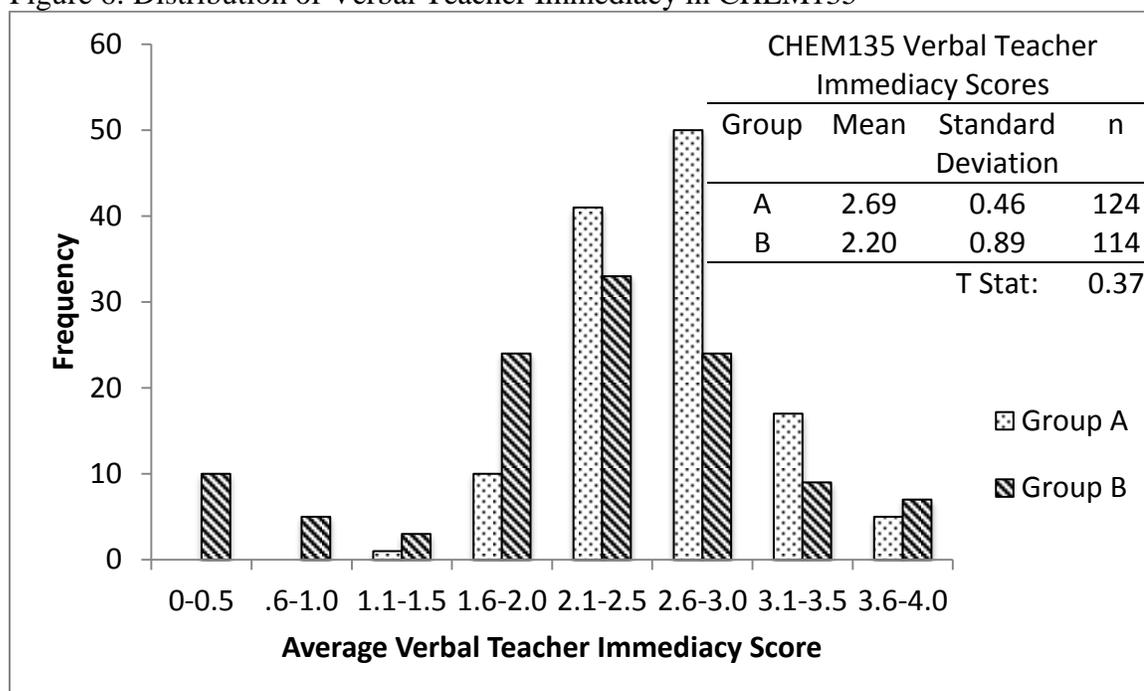
Frequencies of cognitive learning scores in CHEM135 based on the posttest in Groups A and B.

Figure 5: Distribution of Verbal Teacher Immediacy in CCJS105



Frequencies of teacher immediacy scores in CCJS105 based on the survey of Groups A, B, and C and a summary of the ANOVA test for the CCJS105 teacher immediacy survey results.

Figure 6: Distribution of Verbal Teacher Immediacy in CHEM135



Frequencies of verbal teacher immediacy scores in CHEM135 based on the survey of Groups A and B and a summary of the ANOVA test for the CHEM135 verbal teacher immediacy survey results.

**APPENDIX B: TESTS USED IN EACH STUDY****CHEM135 Pilot Test**

Assigned #

Name \_\_\_\_\_

Age \_\_\_\_\_ Gender \_\_\_\_\_ I was in Group \_\_\_\_\_ (A,B,C)

Approximate number of college credits completed (as of the end of last semester) \_\_\_\_\_

GPA \_\_\_\_\_

Online Experience:

 I have never taken an online course I have taken one online course I have taken two or more online courses I am not sure if I have taken an online course (If so, please explain below)

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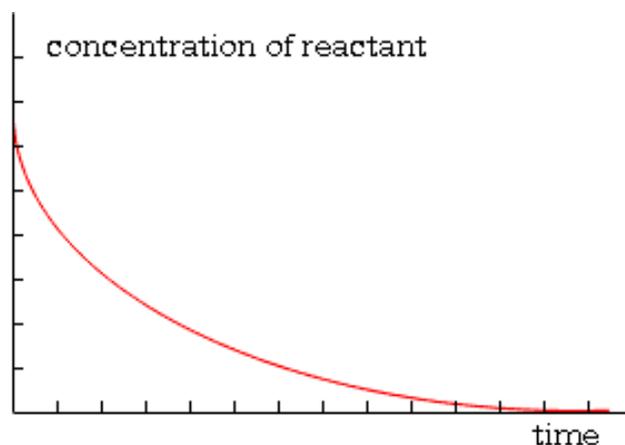
Carefully read each question and answer to the best of your knowledge.

1. Which is not a key aspect of the kinetic profile of a reaction?

- a) reactants need to meet
- b) reactants need to meet with a certain energy
- c) reactants need to meet with a certain orientation
- d) reactants need to meet spontaneously

2. How is the speed of the reaction measured?

- a) reaction rate
- b) reaction rate constant
- c) order of the reaction
- d) the rate law



2. Give an approximate initial rate of the reaction with respect to the reactants
3. TRUE/FALSE The generic rate is always given as a positive value.
4. TRUE / FALSE The rate constant is temperature dependent.
- 5 a) Write the rate law expression for a third order reaction with respect to A and a second order reaction with respect to B.
- b) What are the units for the reaction rate?
- c) With respect to the rate law expression in part a, what would be the units for k?
6. For the reaction  $\text{OCI}^- + \text{I}^- \rightarrow \text{OI}^- + \text{Cl}^-$ , determine the overall rate law.

$[\text{OCI}^-], \text{M}$	$[\text{I}^-], \text{M}$	$[\text{OI}^-], \text{M}$	Rate constant ( $\text{OI}^- \text{ m/s}$ )
0.0040	0.0020	1.000	$4.8 \times 10^{-4}$
0.0020	0.0040	1.000	$5.0 \times 10^{-4}$
0.0020	0.0020	1.000	$2.4 \times 10^{-4}$
0.0020	0.0020	0.500	$4.6 \times 10^{-4}$
0.0020	0.0020	0.250	$9.4 \times 10^{-4}$

**ECON 200 Test**

Name \_\_\_\_\_

Age \_\_\_\_\_ Gender \_\_\_\_\_

 I was in Group A (live lecture) I was in Group B (online lecture with an audience) I was in Group C (online lecture without an audience) I chose not to participate

Approximate number of college semesters completed \_\_\_\_\_

GPA \_\_\_\_\_

**Online Experience:** I have never taken an online course I have taken one online course I have taken two or more online courses I am not sure if I have taken an online course (If so, please explain below)

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1. The Ogallala aquifer is a huge underground pool of fresh water lying underneath several western states in the U.S. Any farmer with land above the aquifer can legally pump water out of it without paying for the use of the water, only the cost of pumping.

Which statement is the best economic analysis of the situation?

- a. Over time, the aquifer is likely to be overused.
- b. Each farmer has a sufficient incentive to conserve the water.
- c. State governments have an incentive to insure that farmers within their boundaries do not overuse the water.
- d. Resources would be used more efficiently if the government paid for the pumps farmers use to get the water.

2. When a good is excludable,

- a. one person's use of the good diminishes another person's ability to use it.
- b. people can be prevented from using the good.
- c. no more than one person can use the good at the same time.
- d. everyone will be excluded from using the good.

3. An FM radio signal is an example of a good that is

- a. private.
- b. nonrival in consumption.

- c. social.
  - d. nonexcludable in production.
4. Tom is a non-union employee at General Power. The majority of the employees at General Power are unionized. The union at General Power has negotiated very good benefits. Even though he is not a union member and he does not have to pay union dues, Tom receives all the benefits that the union has negotiated. Tom's behavior is an example of
- a. rivalry.
  - b. a barrier to entry.
  - c. free riding.
  - d. Taft-Hartley opposition.
5. A toll collected from each car traveling during rush hour on a congested road is an effective correction to the Tragedy of the Commons for all of the following reasons *except*
- a. The toll provides an incentive for commuters to drive at times other than rush hour.
  - b. The toll provides an incentive for commuters to use public transit rather than driving.
  - c. The toll provides an incentive for commuters to drive more fuel-efficient cars.
  - d. The toll provides an incentive for commuters to car-pool.
6. The provision of a public good generates a
- a. positive externality, as does the use of a common resource.
  - b. positive externality and the use of a common resource generates a negative externality.
  - c. negative externality, as does the use of a common resource.
  - d. negative externality and the use of a common resource generates a positive externality.
7. Private decisions about consumption of common resources and production of public goods usually lead to an
- a. efficient allocation of resources and external effects.
  - b. efficient allocation of resources and no external effects.
  - c. inefficient allocation of resources and external effects.
  - d. inefficient allocation of resources and no external effects.
8. Which of the following is a *disadvantage* of government provision of a public good such as national defense?
- (i) The government does not know the exact willingness of consumers to pay

for the public good.

- (ii) The free-rider problem is more likely to occur when the government provides a public good than when the private sector provides a public good.
- (iii) Taxpayers do not agree on the optimal quantity of the public good that the government should provide.

- a. (i) only
- b. (i) and (ii) only
- c. (i) and (iii) only
- d. (i), (ii), and (iii)

**CCJS105 Test**

Name \_\_\_\_\_

Throughout, IAT refers to Institutional Anomie Theory and GST refers to General Strain Theory.

1. IAT was formulated by which scholar(s)?
  - a. Shaw & McKay
  - b. Travis Hirschi
  - c. Robert K. Merton
  - d. Messner & Rosenfeld
  
2. IAT states that the societal mandate to keep earning money stops when?
  - a. It doesn't
  - b. There is no cultural imperative to earn
  - c. When you are content with your earnings
  - d. Upon reaching a median income
  
3. The fundamental proposition that IAT is that \_\_\_\_\_.
  - a. Institutions corrupt individuals
  - b. There is an institutional imbalance of power
  - c. People who fail to earn inevitably turn to crime
  - d. The criminal justice system should apply law with more certainty
  
4. IAT is a \_\_\_\_\_ level theory and GST is a \_\_\_\_\_ level theory.
  - a. Macro/micro
  - b. Micro/Micro
  - c. Macro/macro
  - d. Micro/macro
  
5. This was mentioned as one of the traditionally important institutions responsible for regulating behavior that has been corrupted by the exclusive focus on drive to earn money.
  - a. Prisons
  - b. Religion
  - c. Family
  - d. ALL of the above
  
6. GST suggests that criminal behavior serves what purpose?
  - a. Making people feel worse is pleasing to some
  - b. It attempts to explain conformity, not deviance
  - c. Crime serves as a "solution" that alleviates frustration
  - d. Mental states lead individuals to delinquent behavior
  
7. GST mentions this as the primary source of strain?
  - a. Prevent or threaten to prevent the achievement of positively valued goals
  - b. Present or threaten to present negatively valued stimuli
  - c. Remove or threaten to remove the achievement of positively valued goals
  - d. ALL of the above

8. Several types of strain were mentioned. This was the variety in which others' suffering affects your experience with stress.
  - a. Vicarious
  - b. Objective
  - c. Subjective
  - d. Empathetic
  
9. A few attributes of those most likely to address strain by acting out criminally were mentioned during lecture. Which of the following was among them?
  - a. Those with an established criminal history
  - b. Psychopaths
  - c. Those who have learned criminal behavior
  - d. Those experiencing low social control
  
10. Three ways in which the economy comes to diminish the importance of other institutions according to IAT is this, indicated by the idea that "it is the homeowner not the homemaker" that is the important distinction in today's world.
  - a. Accommodation
  - b. Devaluation
  - c. Denigration
  - d. Primacy

**CHEM 135 Test (differs from CHEM135 pilot test)**

Name \_\_\_\_\_

Age \_\_\_\_\_ Gender \_\_\_\_\_ I was in Group \_\_\_\_\_ (A or B)

Carefully read each question and answer to the best of your knowledge.

1. Which is not a key aspect of the kinetic profile of a reaction?
  - a) reactants need to meet
  - b) reactants need to meet with a certain energy
  - c) reactants need to meet with a certain orientation
  - d) reactants need to meet spontaneously
2. How is the speed of the reaction measured?
  - a) reaction rate
  - b) reaction rate constant
  - c) order of the reaction
  - d) the rate law
3. TRUE/FALSE The generic rate is always given as a positive value.
4. TRUE / FALSE The rate constant is temperature dependent.
5. Write the rate law expression for a third order reaction with respect to A and a second order reaction with respect to B.
  - a)  $\text{rate} = K[A]^3 [B]^2$
  - b)  $\text{rate} = k[A]^3 [B]^2$
  - c)  $\text{rate} = k^3[A]^2[B]$
  - d)  $\text{rate} = K^3[A]^2[B]$
6. What would be correct units for the reaction rate?
  - a) moles/sec
  - b) M/sec
  - c) volume/sec
  - d) M/volume
7. With respect to the rate law expression in #5, what would be the units for k?
  - a) M/sec
  - b)  $M^4/\text{sec}$
  - c)  $M^{-4}/\text{sec}$
  - d)  $M^{-3}/\text{sec}$

8. For the reaction  $\text{OCl}^- + \text{I}^- \rightarrow \text{OI}^- + \text{Cl}^-$ , which two sets of experimental data would you use to calculate the order of the reaction with respect to  $[\text{I}^-]$ .

	<u><math>[\text{OCl}^-], \text{M}</math></u>	<u><math>[\text{I}^-], \text{M}</math></u>	<u><math>[\text{OI}^-], \text{M}</math></u>	<u>Rate (<math>\text{OI}^-</math> m/s)</u>
i)	0.0040	0.0020	1.000	$4.8 \times 10^{-4}$
ii)	0.0020	0.0040	1.000	$5.0 \times 10^{-4}$
iii)	0.0020	0.0020	1.000	$2.4 \times 10^{-4}$
iv)	0.0020	0.0020	0.500	$4.6 \times 10^{-4}$
v)	0.0020	0.0020	0.250	$9.4 \times 10^{-4}$

- a) i and ii
- b) ii and iii
- c) i and iii
- d) i and v

## APPENDIX C: SURVEYS USED IN EACH STUDY

### Survey CHEM135 Spring 2011 (Pilot study)

Name \_\_\_\_\_

Age \_\_\_\_\_ Gender \_\_\_\_\_ I was in Group \_\_\_\_\_ (A, B, or C)

Approximate number of college credits completed (as of the end of last semester) \_\_\_\_\_

GPA \_\_\_\_\_

Online Experience:

I have never taken an online course

I have taken one online course

I have taken two or more online courses

I am not sure if I have taken an online course (If so, please explain below)

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Your responses to the following questions should reflect your experience for the CHEM135 lecture you attended or viewed online on April 13. For the following questions please circle the number which best reflects your opinion in the answer column to the right of the question.

(1=strongly agree, 2=agree, 3=neutral, 4=disagree, 5=strongly disagree, N/A=non-applicable)

Teacher asks students for feedback.	1	2	3	4	5	N/A
I was satisfied with how the material was taught for this unit.	1	2	3	4	5	N/A
My level of learning that took place in this course was of the highest quality.	1	2	3	4	5	N/A
My teacher will occasionally engage in small talk during the lecture.	1	2	3	4	5	N/A
My teacher used terms like we and us to refer to the class.	1	2	3	4	5	N/A
The teacher looks at the class while talking.	1	2	3	4	5	N/A
Teacher is non-monotone when speaking to the class.	1	2	3	4	5	N/A
I feel as though I learned the course material effectively.	1	2	3	4	5	N/A
The teacher smiles at the class while talking.	1	2	3	4	5	N/A
The teacher has a relaxed body posture.	1	2	3	4	5	N/A
Teacher uses gestures while talking to the class.	1	2	3	4	5	N/A
I felt comfortable conversing through my selected class medium.	1	2	3	4	5	N/A
The teacher moves around the classroom while talking.	1	2	3	4	5	N/A
The teacher rarely looks at notes/chalkboard/PowerPoint slides while speaking.	1	2	3	4	5	N/A
My goals and expectations for this unit were met.	1	2	3	4	5	N/A

What features of the class did you find most engaging?

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If you were in an online class (groups B and C) , how did your experience differ from a traditional classroom setting? How was your education experience affected by the quality of the video technology?

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## Survey ECON200 Fall 2011

Name \_\_\_\_\_

Age \_\_\_\_\_ Gender \_\_\_\_\_

I was in Group A (live lecture)

I was in Group B (online lecture with an audience)

I was in Group C (online lecture without an audience)

I chose not to participate

Number of semesters completed at a college or university \_\_\_\_\_

GPA \_\_\_\_\_

Online Experience:

I have never taken an online course

I have taken one online course

I have taken two or more online courses

I am not sure if I have taken an online course (If so, please explain below)

our responses to the following questions should reflect your experience for the ECON200 lectures you attended or viewed online on October 13, 2011.

	N=Never	R=Rarely	S=Sometimes	O=Often	A=Always			
The teacher:								
1. Uses personal examples or talks about experiences she has had outside of class.				N	R	S	O	A
2. Asks questions or encourages students to talk.				N	R	S	O	A
3. Uses humor in class.				N	R	S	O	A
4. Asks how students feel about assignments, due dates, or discussion topics.				N	R	S	O	A
5. Invites students to meet with her outside of class if they have a question or want to discuss something.				N	R	S	O	A
6. Asks questions that solicit viewpoints or opinions.				N	R	S	O	A
7. Will have discussions about things unrelated to class with individual students or the class as a whole.				N	R	S	O	A
8. Gestures while talking to the class.				N	R	S	O	A
9. Smiles at the class while talking.				N	R	S	O	A
10. Moves around the classroom while talking				N	R	S	O	A
11. Uses a variety of vocal expressions while talking to the class.				N	R	S	O	A

	SD=Strongly Disagree	D=Disagree	N=Neutral	A=Agree	SA= Strongly Agree
1. I was satisfied with how the material was taught for this class.	SD	D	N	A	SA
2. My level of learning that took place was of the highest quality.	SD	D	N	A	SA
3. I feel as though I learned the material effectively.	SD	D	N	A	SA
4. My goals and expectations for this unit were met.	SD	D	N	A	SA

Answer the following questions only if you were in Group B or C:

Did you pause the video to take notes? \_\_\_\_\_

Estimate about how many times you paused the video. \_\_\_\_\_

Did you rewind the video to reinforce concepts? \_\_\_\_\_

Estimate about how many times you re-winded the video. \_\_\_\_\_

Revised 09/26/11

## Survey CCJS105 Spring 2012

Name \_\_\_\_\_  
 Age \_\_\_\_\_ Gender \_\_\_\_\_  
 I was in Group A (live lecture)  
 I was in Group B (live streaming)  
 I was in Group C (embedded video)  
 I chose not to participate  
 Number of semesters completed at a college or university \_\_\_\_\_  
 GPA \_\_\_\_\_

### Online Experience:

I have never taken an online course  
 I have taken one online course  
 I have taken two or more online courses  
 I am not sure if I have taken an online course (If so, please explain below)

Your responses to the following questions should reflect your experience for the CCJS105 lectures you attended or viewed online on **April 19, 2012 ONLY**.

SD=Strongly Disagree    D=Disagree    N=Neutral    A=Agree    SA= Strongly Agree

- |   |    |   |   |   |    |
|---|----|---|---|---|----|
| 1. I was satisfied with how the material was taught for this class. | SD | D | N | A | SA |
| 2. My level of learning that took place was of the highest quality. | SD | D | N | A | SA |
| 3. I feel as though I learned the material effectively.             | SD | D | N | A | SA |
| 4. My goals and expectations for this unit were met.                | SD | D | N | A | SA |

N=Never    R=Rarely    S=Sometimes    O=Often    A=Always

### The teacher:

- |   |   |   |   |   |   |
|---|---|---|---|---|---|
| 4. Uses personal examples or talks about experiences she has had outside of class.                          | N | R | S | O | A |
| 5. Asks questions or encourages students to talk.   | N | R | S | O | A |
| 6. Uses humor.  | N | R | S | O | A |
| 7. Asks how students feel about assignments, due dates, or discussion topics.                               | N | R | S | O | A |
| 8. Invites students to meet with her if they have a question or want to discuss something.                  | N | R | S | O | A |
| 9. Asks questions that solicit viewpoints or opinions.  | N | R | S | O | A |
| 10. Will have discussions about things unrelated to class with individual students or the class as a whole. | N | R | S | O | A |
| 11. Uses a variety of vocal expressions while talking.  | N | R | S | O | A |
| 12. Gestures while talking.   | N | R | S | O | A |
| 13. Smiles while talking.   | N | R | S | O | A |
| 14. Moves around the classroom while talking.   | N | R | S | O | A |

N=Never (0 times)    R=Rarely(1-3times)    S=Sometimes (4-7times)    O=Often (8-10 times)    A=Always (more than 10 times)

The following questions are for **Group C only**. If you don't remember exactly, please estimate.

- |  |   |   |   |   |   |
|--|---|---|---|---|---|
| 1. I paused the lecture video to take notes.         | N | R | S | O | A |
| 2. I paused the lecture video to take a study break. | N | R | S | O | A |
| 3. I re-watched parts of the lecture.                | N | R | S | O | A |

Revised 2/20/2012

## Survey CHEM135 Fall 2012

Name \_\_\_\_\_

Age \_\_\_\_\_ Gender \_\_\_\_\_

I was in Group A (live lecture)

I was in Group B (online lecture)

I chose not to participate

Number of semesters completed at a college or university \_\_\_\_\_

GPA \_\_\_\_\_

Online Experience:

I have never taken an online course

I have taken one online course

I have taken two or more online courses

I am not sure if I have taken an online course (If so, please explain below)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Your responses to the following questions should reflect your experience for the CHEM135 lectures you attended or viewed online on **November 14, 2012 ONLY**.

SD=Strongly Disagree    D=Disagree    N=Neutral    A=Agree    SA= Strongly Agree

- |   |    |   |   |   |    |
|---|----|---|---|---|----|
| 5. I was satisfied with how the material was taught for this class. | SD | D | N | A | SA |
| 6. My level of learning that took place was of the highest quality. | SD | D | N | A | SA |
| 7. I feel as though I learned the material effectively.             | SD | D | N | A | SA |
| 8. My goals and expectations for this unit were met.                | SD | D | N | A | SA |

N=Never    R=Rarely    S=Sometimes    O=Often    A=Always

The teacher:

- |   |   |   |   |   |   |
|---|---|---|---|---|---|
| 15. Uses personal examples or talks about experiences she has had outside of class.                         | N | R | S | O | A |
| 16. Asks questions or encourages students to talk.  | N | R | S | O | A |
| 17. Uses humor.   | N | R | S | O | A |
| 18. Asks how students feel about assignments, due dates, or discussion topics.                              | N | R | S | O | A |
| 19. Invites students to meet with her if they have a question or want to discuss something.                 | N | R | S | O | A |
| 20. Asks questions that solicit viewpoints or opinions.   | N | R | S | O | A |
| 21. Will have discussions about things unrelated to class with individual students or the class as a whole. | N | R | S | O | A |
| 22. Uses a variety of vocal expressions while talking.  | N | R | S | O | A |
| 23. Gestures while talking.   | N | R | S | O | A |
| 24. Smiles while talking.   | N | R | S | O | A |
| 25. Moves around the classroom while talking.   | N | R | S | O | A |

## APPENDIX D: VISUAL EXAMPLES OF ONLINE VIDEO LECTURES

Figure 7: Example of Slideshow with Audio Lecture Format

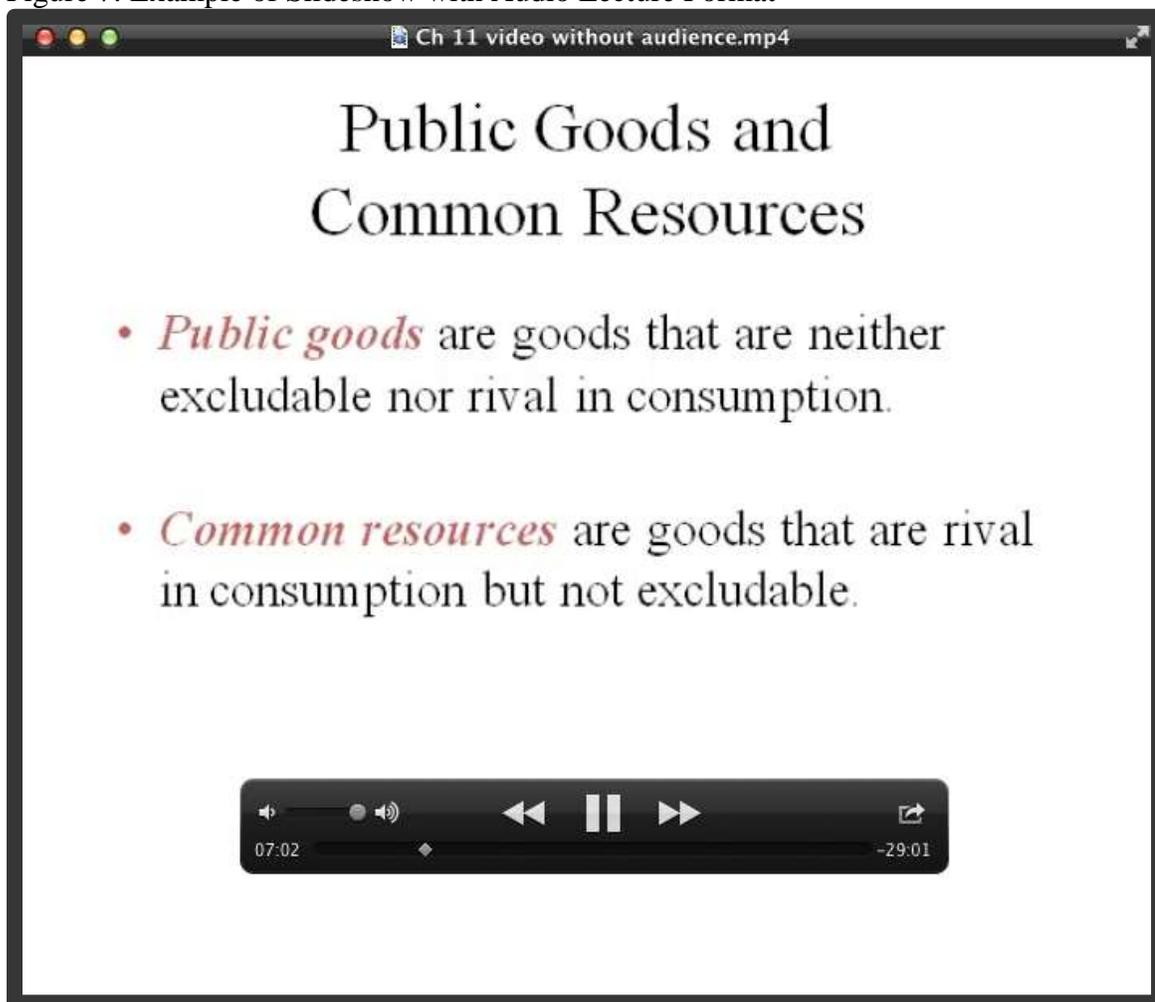


Figure 10: This slideshow style lecture with audio voiceover was used in the ECON200 trials for Group C.

Figure 8: Example of Video with an Audience Lecture Format

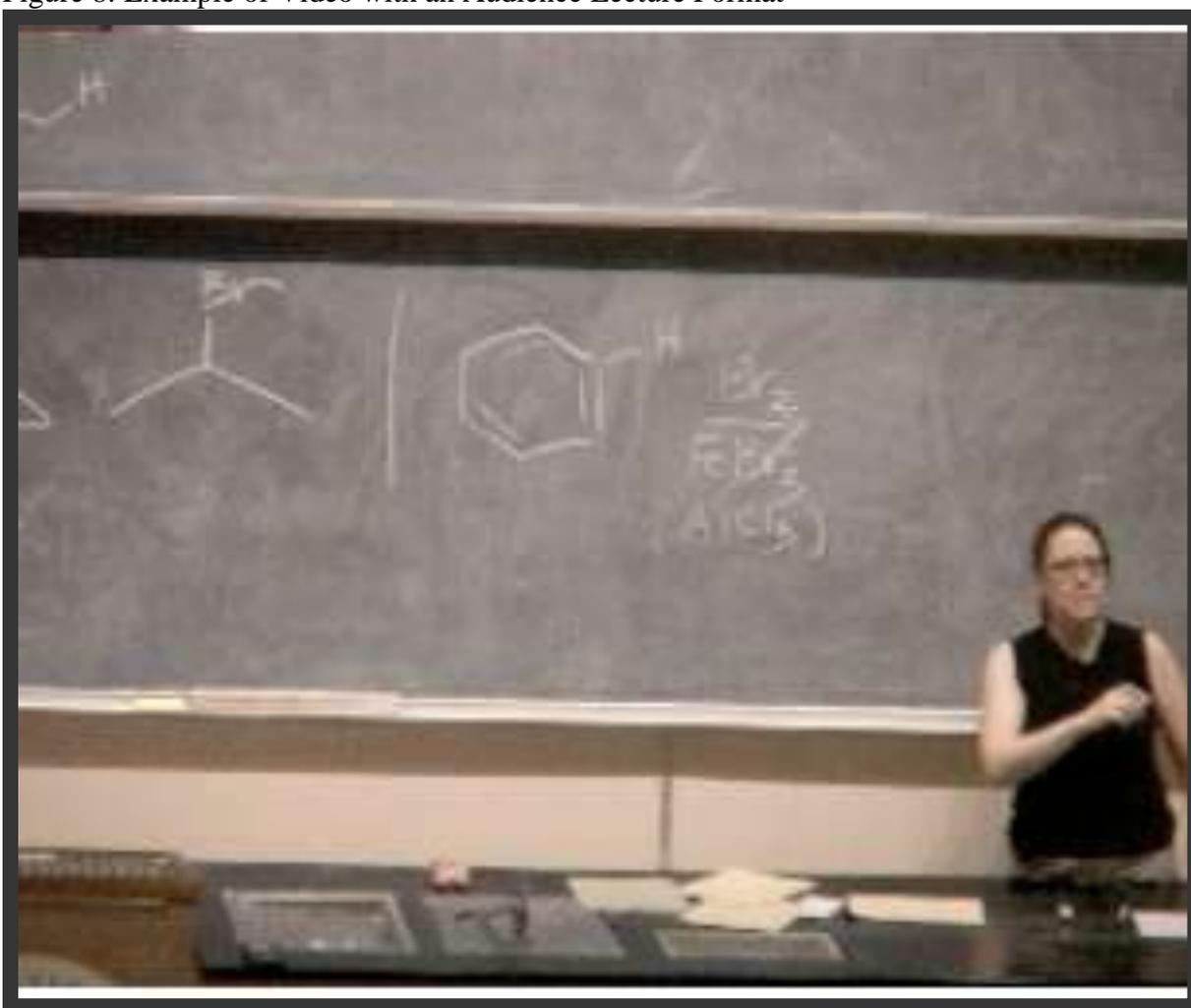


Figure 11: This lecture was recorded while Dr. Dixon was teaching the class. Her student audience comprised the Group A participants. This style of lecture was also used for Group B of ECON200, Groups B and C of CCJS105.

Figure 9: Example of Video without an Audience Lecture Format

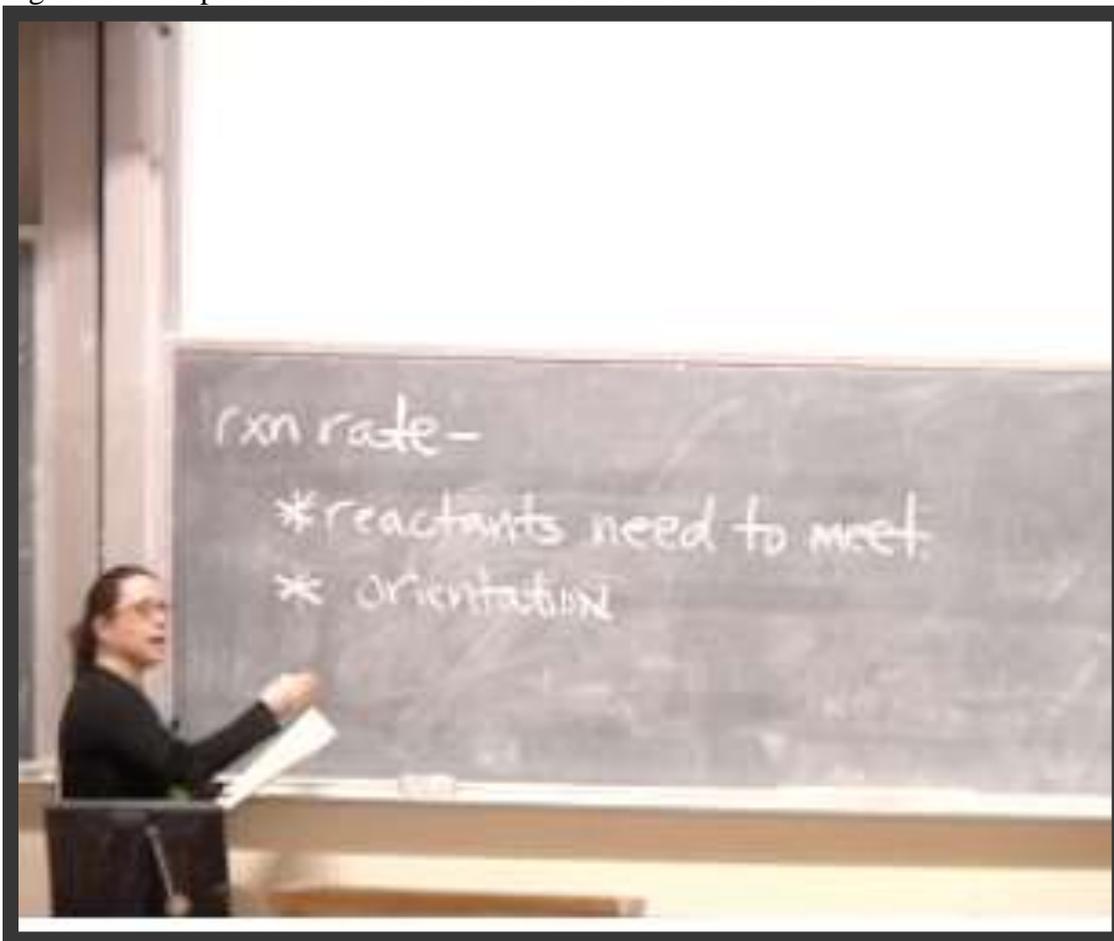


Figure 12: This video of Dr. Dixon's lecture was recorded outside of class. She is teaching to an empty lecture hall without an audience. This style of lecture was used in the pilot CHEM135 study.

Figure 10: Example of Dynamic Writing Whiteboard Lecture Format

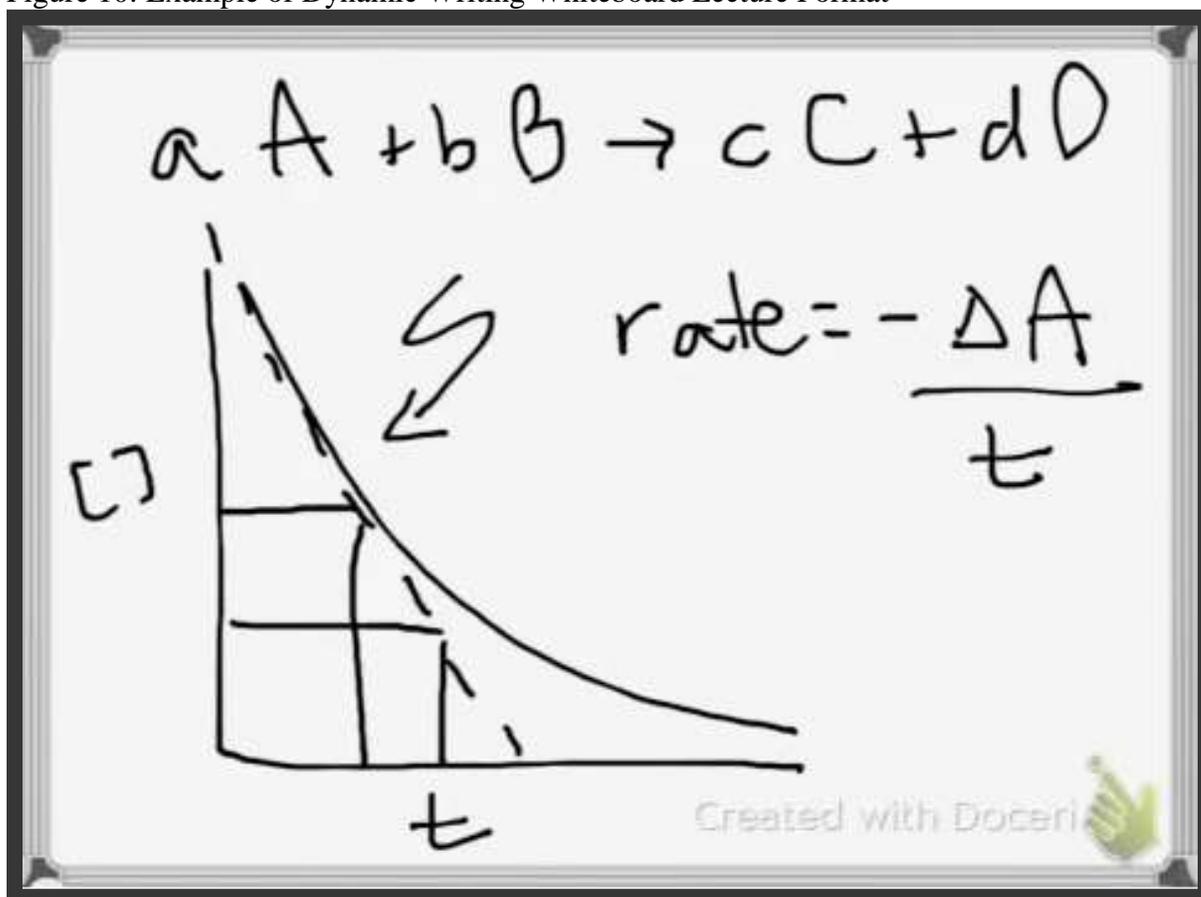


Figure 13: This lecture style was used during the CHEM135 Fall 2012 trial for Group B. Students could view the professor writing on the whiteboard electronically and could hear her voice explaining the concepts as she wrote.

## APPENDIX E: GLOSSARY

Asynchronous—a learning environment in which there is “a lag time between presentation of instructional stimuli and student responses” (Means, Toyama, Murphy, Bakia, & Jones, 2009)

Blended Learning – term used to describe educational formats that mix both an online element and a traditional face-to-face format (“The online learning,” 2011)

Cognitive learning—the retention and understanding of a subject as well as critical thinking and application of the learned material as seen in test scores for our study (Bloom, 1956)

Distance Education – Term used to describe educational formats that involve the students and professors being separated by space (“The online learning,” 2011)

Online Learning – term used to describe educational formats that are administered primarily over the Internet not including print correspondence, television broadcasts, or videotapes (“The online learning,” 2011) Also known as cyber learning, e-learning, virtual learning.

Learner control - Learner control refers to the ability of students to choose topics, assignments, project format or communication strategies according to their own interests and preferences (Milheim & Martin, 1991)

Learning outcomes - Learning outcomes are statements that specify what learners will know or be able to do as a result of a learning activity. Outcomes are usually expressed as knowledge, skills, or attitudes

Lecture format – what kind of lecture the student will be viewing (either traditional or one of the various online types)

Perceived learning – how much subject material a student thinks that they have learned from the lecture (Richardson & Swan, 2003)

Social Presence - the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships (Short, Williams & Christie, 1976).

Synchronous—a learning environment in which instruction occurs in real time either in a physical or virtual place (Means, Toyama, Murphy, Bakia, & Jones, 2009)

Teacher Immediacy—the level of perceived closeness between teacher and student(s) (Richardson & Swan, 2003).

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