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How do Millennial Engineering and Technology Students Experience Learning Through Traditional Teaching Methods Employed in the University Setting?

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How do Millennial Engineering and Technology Students Experience Learning Through
Traditional Teaching Methods Employed in the University Setting?

For the degree of Master of Science

Is approved by the final examining committee:

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HOW DO MILLENNIAL ENGINEERING AND TECHNOLOGY STUDENTS
EXPERIENCE LEARNING THROUGH TRADITIONAL TEACHING METHODS
EMPLOYED IN THE UNIVERSITY SETTING?

A Thesis

Submitted to the Faculty

of

Purdue University

by

Elizabeth Ann Howard

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science

May 2011

Purdue University

West Lafayette, Indiana

To my parents and family – thank you for your love and support throughout this endeavor.

ACKNOWLEDGMENTS

There are many I would like to thank for helping me achieve this goal. First, I would like to thank my chair, Dr. Patrick Connolly, for his support and mentoring throughout my time at Purdue University. His expertise and guidance helped me to persevere through my experience. I would also like to thank my committee members, Professor Clark Cory, Dr. Craig Miller, and Dr. Mihaela Vorvoreanu. Each provided me with their own unique expertise without which my thesis would not have been complete.

Thank you, also, to the Computer Graphics Technology departmental staff whose encouragement and support was both needed and appreciated. Finally, I would like to thank my family for their care, patience, and understanding throughout the duration of this study.

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GLOSSARY

Millennial – This study will use the term Millennial to refer to individuals born after 1980. These individuals are said to be born into a digital age where the advances and availability of technology exceed that of previous generations (Gasser & Palfrey, 2008; Shaw & Fairhurst, 2008).

Traditional teaching methods – Traditional instructivist methods of teaching focusing on textbook and lecture format as defined by Felder, Woods, Stice, and Rugarcia (2000), Foreman (2003), and Rugarcia, Felder, Woods, and Stice (2000).

ABSTRACT

Howard, Elizabeth. M.S., Purdue University, May 2011. How do Millennial Engineering and Technology Students Experience Learning Through Traditional Teaching Methods Employed in the University Setting? Major Professor: Dr. Patrick Connolly.

The purpose of the study was to document and analyze how Millennial engineering and technology students experience learning in large lecture classrooms. To help achieve this purpose, perceptions Millennials have toward traditional teaching methods employed in large lecture classes were analyzed and discussed. Additionally, this study documented how Millennials experienced technology within large lecture classrooms. A learning model depicting how Millennials experience learning within the large lecture classroom was created based on the results of this study. This model employed three separate tools utilized within the large lecture classroom. These tools: Lecture, Technology, and Homework, work together to synthesize learning for the students.

The findings from this study were analyzed to help identify whether change is needed in the large lecture classroom structure. Recommendations based on the findings of this study were provided.

CHAPTER 1. INTRODUCTION

The purpose of this chapter is to provide an overview of this study. This chapter introduces the research topic and defines its scope and significance. In addition, the assumptions, limitations, and delimitations related to this study are outlined in the following sections.

1.1. Problem Statement

Engineering and technology education is now seeing the impact of a new generation of students known as the Millennial generation. Today's students have grown up in the digital era. For them, technology is a way life (Frاند, 2000). The Millennial generation is unique in the fact that it possesses new and different characteristic from that of previous generations. These characteristics of Millennials not only shape their personas but they also form the distinctive learning preferences of this generation (Shaw & Fairhurst, 2008). Literature suggests these learning preferences clash with traditional teaching methods still employed in engineering and technology education today (Annetta et al., 2006; Foreman, 2003).

The purpose of the study was to document and analyze how Millennial engineering and technology students experience learning in large lecture classrooms. This study also attempted to analyze the perceptions Millennials have toward traditional teaching methods employed in large lecture classes. Additionally, this study documented how Millennials experienced technology within large lecture classrooms. Another goal of this study was to help identify whether change is needed in the large lecture classroom structure to help

engage student attention and learning. Recommendations based on the findings of this study were provided in the analysis chapter.

1.2. Scope

This study focused on engineering and technology students, primarily those currently studying within civil engineering or building construction management. A first/second-year technology class, employing traditional teaching methods defined by Felder, Woods, Stice, and Rugarcia (2000), Foreman (2003), and Rugarcia, Felder, Woods, and Stice (2000) as lecture format, was chosen for the environment of the study. Qualitative study processes and procedures were to observe, collect, and analyze the participants' learning experience. Precise usage of qualitative procedures is further discussed within the methodology section.

1.3. Significance

Millennials learn differently from previous generations. Literature suggests that they process information and learn in a fashion different from previous generations thanks to the advances in and availability of technology (Carr, 2010; Gasser & Palfrey, 2008). While Millennials have almost unlimited access to more information on areas of interest to them, the accumulation of knowledge is seen as less important than the ability to perform a task (Carr, 2010; Frand, 2000). Literature suggests that these learning preferences clash with traditional teaching methods still employed in engineering and technology education today. Though the curriculum is evolving to incorporate the ever increasing volume of data and skills needed to compete in today's environment, traditional teaching styles such as the large lecture have yet to mold to fit today's student (Annetta et al., 2006; Foreman, 2003).

Current literature suggests a change is needed within engineering education. Some educators feel it is critical to change traditional teaching

methods to adapt to today's student (Chubin, Donaldson, Olds, & Fleming, 2008; Felder, Woods, Stice, & Rugarcia, 2000; Rugarcia, Felder, Woods, & Stice, 2000; Wankat, Felder, Smith, & Oreovicz, n.d.). Through the goal of analyzing perceptions Millennial engineering and technology students have towards traditional teaching methods, this study could help to either validate or invalidate the prior concerns of educators. Recommendations were given based on the results of the study in efforts to engage and attract students to engineering studies.

1.4. Assumptions

The following assumptions were inherent to the design of this study:

- There was need to understand how the Millennial student responds to traditional teaching methods in hopes to ensure appropriate teaching methods are employed for this new generation of student.
- This study solely focused on the participants' experience of learning within the large lecture class setting.
- The participants in this study were representative of the Millennial generation as defined by Gasser and Palfrey (2008). The participants selected for this study are born after 1980.
- Participants enrolled in CGT 164 selected for study were either engineering or technology students.
- By using participants from CGT 164, the study recorded the participants' experience of learning in reference to traditional teaching methods employed in CGT 164 and similar large lecture classes.
- CGT 164 employed traditional teaching methods such as the lecture as defined by Felder, Woods, Stice, and Rugarcia (2000), Foreman (2003), and Rugarcia, Felder, Woods, and Stice (2000).
- Participants involved in the study answered all survey and interviews questions honestly and openly and were not influenced in any way.

1.5. Limitations

The following limitations were inherent to the design of this study:

- The participants were limited to the pool of CGT 164, offered at Purdue University, West Lafayette, Indiana in fall 2010.
- The study was limited to the volunteers who completed the initial survey.

1.6. Delimitations

The following delimitations were inherent to the design of this study:

- This study did not focus on any engineering or technology students outside of CGT 164.
- This study did not focus on the effectiveness of the teaching methods employed by the instructor.

1.7. Summary

The intent of this chapter was to provide an overview of the study. This chapter stated the research topic of documenting the Millennial engineering and technology students' experience of learning within the large lecture. This chapter also defined the scope of this study and its significance to the educational community. Additionally, this chapter outlined the assumptions, limitations, and delimitations associated with the study. The following chapter is a review of the literature relevant to the study of the Millennial generation within engineering and technology education.

CHAPTER 2. REVIEW OF RELEVANT LITERATURE

Engineering education is now seeing the impact of a new generation of students known as the Millennial generation. The Millennial generation is unique in the fact that it possesses new and different characteristics from that of previous generations. These characteristics of Millennials not only shape their personas but also form the distinctive learning preferences of this generation. These learning preferences clash with traditional teaching methods still employed in engineering education today. For a change to occur, it is important for educators to know their student audience as well as understand the conflict Millennials encounter when faced with traditional learning methods.

This chapter provides a review of the relevant literature defining the Millennial generation. It explores the attributes and the important role of technology characteristic of this generation. The preferred learning styles and methodologies distinctive of this generation are also discussed. Finally, this chapter provides a history of engineering education as well as current teaching methods employed within engineering education today. Current concerns of engineering educators are discussed as well as a look into the future of engineering education.

2.1. The Millennial Generation

A new generation of students, known as the Millennial Generation, is now entering the age of higher education. This generation, also known throughout literature as the Internet Generation, Digital Natives, Echo Boomers, Boomlets, Nesters, Generation Y, Nintendo Generation and the Digital Generation, refers to individuals born after 1980 (Gasser & Palfrey, 2008; Shaw & Fairhurst, 2008).

Millennials have grown up in a world consumed with technology and their use of technology in daily life exceeds that of previous generations. They are defined as the most diverse generation our country has ever seen and have a strong sense of community and high moral values (Howe, 2003).

2.1.1. Characteristics of the Millennial Student

The Millennial generation is vastly different from previous generations. Millennials possess much generational strength attributed to their constant contact with technology and the era in which they were raised. They are the most connected of all generations (McGlynn, 2008). Millennials are described as social, preferring group activities and teamwork. They strive for accomplishment and have high self-confidence. They are also perceived as open-minded, which may be attributed to them as also being the most ethnically diverse generation. Howe and Strauss (Woodall, 2004, p. 59) identify Millennials as, “special, sheltered, confident, team-oriented, conventional, pressured and achieving.” Millennials grew up in a world where their parents were actively involved in their education. Perhaps this serves for the reason Millennials seek a balance between their schoolwork and personal life (Woodall, 2004).

According to McGlynn (2008), Millennials possess many data processing strengths. They are able to analyze data from multiple perspectives. Their mainstream use of the Internet for activities such as homework and research has aided in their ability to decipher fact from fiction. They also have a good ability to research and discern the validity of information retrieved on the Internet. Millennials also display strength in visualization. This is evident in simulation and role-playing educational tools. Millennials also show a tendency to like math and science (Woodall, 2004). The coupling of powerful visualization skills combined with an interest of math and science is a powerful combination and good fit for engineering. However, Chubin, Donaldson, Olds, and Fleming (2008) reference the growing concern engineering educators have regarding attracting these students to the field and retaining them in the program. Rugarcia, Felder, Woods,

and Stice (2000) and Felder, Woods, Stice, and Rugarcia (2000) also focus on this issue and the need for engineering education to adopt more modern teaching methods to attract and cater to the Millennials' styles of learning.

2.1.2. Technology as a Way of Life

Jason Frand (2000) identifies several traits he defines as the "information-age" mindset that define the Millennial Generation. These attributes relate to new perceptions formed by this generation, problem-solving approaches, and subliminal needs of this generation. For Millennials, computers have become a way of life. TV watching has decreased from that of previous generations as Millennials spend more of their time surfing the Internet. They thrive on multi-tasking and can listen to music and text on their mobile phone while successfully typing papers on the computer. It is essential for Millennials to stay connected to friends, family, news and the Internet via a variety of electronic devices. Constant connection and reliance on computers account for the Millennials' lack of tolerance for delay.

The dependency on technology has left its mark on this generation. As a whole, Millennials tend to be higher caliber students. Being smart is perceived as being popular. Integrating technology appropriately into education is important to Millennials. Immersive learning environments have become popular educational tools for this tech-savvy generation. Constant connectivity to Internet, family and friends has heightened the expectation for instant feedback and communication. The zero-tolerance for delay expectation has also filtered its way into the classroom setting. Extreme socialization and connectivity create a dependency on increased customer service expectations (Frand, 2000; Oblinger, 2003).

The exposure and use of multiple Internet-based media and applications tie into the different learning styles of Millennials (Dede, 2004). This generation is exposed to on-line gaming and other collaborative multi-user applications promoting collaborative learning. Millennials are also familiar with online discussions, also known as threaded discussions, and tend to be comfortable

with this style of communication. According to a study conducted by the Pew Research Center (Taylor & Keeter, 2010), 90% of Millennials use the internet at least occasionally in some capacity. This study also found that 75% of Millennials have created some type of social media profile. The comfort level of Millennials with technology lends to the desire to see these applications in use in the educational setting.

Kvavik (2005) discusses the findings of a study conducted by the EDUCAUSE Center for Applied Research (ECAR) which looks deeply into the use of technology by students, the experience of technology within their undergraduate careers, and the value technology holds for their learning. Among the 4,374 college students who replied to the survey it was found that their number one use of technology was for educational purposes. Communication was the next highest usage of technology devices. Both qualitative and quantitative data support these findings. Additionally, this study found that students preferred a moderate usage of technology in the classroom (41.2%) over extensive use of technology in the classroom (30.8%). Interestingly enough, 22.7% of the students who responded preferred limited use of technology within the classroom while only 2.2% preferred on-line classes.

2.1.3. Learning Styles of Millennial Students

For the Millennial generation, experience speaks more than a thousand words. In the words of Shaw and Fairhurst (2008) the, “Millennial generation also has a preference for doing rather than listening” (p.376). Millennials seek challenging and meaningful experiences in study and career. They thrive on structure and want clear understandings of their roles and responsibilities within the classroom environment and later in their professional careers (Shaw & Fairhurst, 2008).

Frand (2000) describes the learning style of Millennials to more closely resemble Nintendo than traditional logic. Millennials prefer a trial-and-error approach to learning that mimics game logic. Understanding and knowledge is

gained by both winning and losing in a game. This learning preference ties in closely to Millennials preferring experiential activities. Jonas-Dwyer and Pospisil (2004), based on previous literature and research, discuss five key characteristics of Millennials and how they relate to learning and communication styles and possible teaching strategies. First, Millennials are confident in their use of technology. They see computers not as technology but a way of life and Millennials seek the use of technology for interaction and communication in the classroom. Second, Millennials are optimistic. This lends to positive communication styles and a learning preference incorporating exciting learning tools into the classroom such as simulations and experiential learning. Third, Millennials are team oriented. They prefer teamwork and group activities. Fourth, they are achievement-oriented and prefer structure within the classroom. They desire set goals and want constant feedback on progress. A fifth characteristic is that Millennials are civic-minded. This provides an opportunity for community learning through experiential learning.

Incorporating technology into education opens the door for new tools and supplemental learning environments such as multiple media and simulation-based environments. Immersive learning is simulated environment, which allows a student to actively participate in what he or she would perceive as a realistic experience. Dede (2004) describes immersive learning as a “balance among experiential learning, guided mentoring, and collective reflection.” This type of learning environment appeals to today’s Millennial students by speaking to their learning styles and ease in multiple media. Immersive learning promotes active learning and webbed expression. Environments can be personalized for individual learning experiences or utilized in community learning to promote knowledge sharing and collective learning. Interactive learning environments are becoming more popular and offer great alternative methods for reaching today’s Millennial student (Dede, 2004).

2.1.3.1. Situated Learning Theory

Situated learning (Clancey, 1995; Herrington & Oliver, 2000; McLellan, 1994), also referred to as situated cognition, focuses on how everyday learning occurs. It studies how learning develops through physical experience and how individuals interpret and develop understanding of what they are accomplishing.

Traditional learning is often separated from its real world applications. Contradicting this practice, situated learning believes meaningful learning will only take place when embedded in the social and physical situation in which it will be used (Clancey, 1995; Herrington & Oliver, 2000). Equally important to situated learning is the aspect of participation within the situation, interacting with objects and individuals creating a valuable learning experience (Herrington & Oliver, 2000).

Well-designed applications offer the ability to provide simulated situations creating opportunities for learning development. These simulated environments can mimic real life situations typically not available to students in traditional classrooms (Herrington & Oliver, 2000). McLellan (1994) outlines the context for which situated learning can take place. The environments ripe for learning can be the actual physical environment, a highly realistic or virtual replica scenario of the environment, or a video/ multimedia or similar application.

2.1.3.2. Constructivist Theory

Constructivism views learning as a process in which knowledge and meaning are generated from experience (Harper, Squires, & McDougall, 2000; Kirkley & Kirkley, 2005; Savery & Duffy, 1995). Learning is seen as a self-regulated process as individuals evaluate and validate their insights to develop new models of understanding (Kirkley & Kirkley, 2005). Many researchers believe a shift to constructivist learning will result in the creation of better educational software and increased student learning (Harper et al, 2000).

Constructivism, based on Rorty's model (Savery & Duffy, 1995), is comprised of three core principles. The first and primary foundation of

constructivism is that understanding is constructed through our participation and interaction with the environment. As Kirkley and Kirkley (2005, p. 44) state, "... what we understand is a function of the content, the context, the activity of the learner, and the goals of the learner." The second principle of Rorty's model focuses on the need for cognitive conflict or puzzlement as the stimulus for learning and as a result, determines the nature of what is learned. In other words, the goal set forth for the learner is the start of the learning process. The final principle declares that knowledge evolves through social negotiation and through the evaluation of the viability of individual understandings. Social environments provide a testing ground for learners to encounter alternative views weighing them against their own personal understandings. Through social interaction understanding and knowledge is tested, evaluated and possibly molded to create new understanding (Kirkley & Kirkley, 2005).

Blending these principles into the creation of multimedia learning environments and simulation games is becoming more popular. Constructivist applications (Herrington & Standen, 2001) have many advantages over traditional instructivist methods of teaching which mimic the textbook and lecture model. They are able to shine light on the relevance of theory to application and help to provide realistic experiences that are closer to industry scenarios than traditional classroom activities.

2.1.3.3. Achievement Goal Theory: Mastery Goal Orientation

In terms of achievement goal theory, the characteristics of Millennials are synonymous with a mastery goal orientation. Mastery goals place emphasis on task and learning. Importance is placed on gaining understanding and knowledge while increasing competency. According to Shunk, Pintrick, and Meece (2008) mastery goals focus on "mastering the task according to self-set standards or self-improvement" (p. 184). Additionally, value is placed on effort exudes from personal interest. Effort is positively linked with ability (Shunk et al., 2008). This definition of mastery goal orientation is supported by Ames (1992), Kaplan,

Middleton, Urdan, and Midgley (2002), and Midgley, Kaplan, and Middleton (2001).

Kaplan and colleagues (2002) review the positive associations of a mastery orientation. Mastery orientation is linked to students “feeling academically efficacious, preferring challenging tasks, and persisting in the face of difficulties” (p. 26). Ames (1992) discusses the important link between mastery orientation and engagement in learning. Students engage in active learning and are motivated to work on challenging tasks. Also, Ames makes note that research suggests long-term engagement in learning is tied to a mastery orientation.

Millennials prefer to learn by experience. They seek challenge in their learning activities and engage in their tasks with the goal of understanding (Shaw & Fairhurst, 2008). These learning characteristics relate closely with a mastery orientation. Midgley and colleagues (2001) along with Ames (1992) support the use of mastery orientation in the classroom. Students are influenced by the classroom structure and environment. Providing learning environments that promote healthy motivation for learning increases student engagement (Ames, 1992).

Several approaches have been identified to help promote mastery orientation in the classroom. TARGET, an acronym for task, authority, recognition, grouping, evaluation and time, is a model that is geared toward promoting mastery goals (Kaplan et al., 2002; Shunk et al., 2008). In this model, *task* deals with the design of learning activities. Cordova and Lepper (1996) discuss the strategy of involving personalization within learning context and tasks. Associating learning activities with characters and events of interest to students will help increase intrinsic motivation. *Authority* relates to the amount of opportunities students have to assume leadership and independence over their learning activities. Choice over various aspects of learning activities helps to allow students to feel in-control of their learning. Having the authority to make different choices regarding the path of learning helps to motivate students

(Cordova & Lepper, 1996). *Recognition* refers to both the “formal and informal use of rewards, incentives and praise” (Shunk et al., 2008, p. 203). The ability for students to socialize and work well with one another is identified as *grouping*. The methods for assessment and monitoring progress are defined as *evaluation* in this model. Finally, *time* refers to the “appropriateness of workload, the pace of instruction, and the time allotted for completing work” (Shunk et al., 2008, p. 203). This model is successful in the classroom and can be adaptive for use in other areas such as a laboratory setting.

2.2. Engineering and Technology Education

Engineering education has evolved over the years to become more formal in its approach. Once taught by training through apprenticeship, engineering education now focuses on an established curriculum including mathematics, science and critical analysis. Though the curriculum is evolving to incorporate the ever increasing volume of data and skills needed to compete in today’s environment, traditional teaching styles have yet to mold to fit today’s student. Science, Technology, Engineering and Mathematic (STEM) degrees “represented only a third of all U.S. bachelors degrees awarded in 2004” (Chubin et al., 2008, p. 246). It is recognized within engineering education that it is critical to change traditional teaching methods to attract and adapt to today’s student (Chubin et al., 2008; Felder et al., 2000; Rugarcia et al., 2000; Wankat et al., n.d.).

2.2.1. History of Engineering Education in the United States

Formal engineering education was first taught in the early 1800’s at the United States Military Academy at West Point. Throughout the 1800’s little formal education existed elsewhere. Engineers learned skills and training through apprenticeships. Formal engineering education evolved to include drafting, laboratory exercises, and shop classes in addition to the traditional

apprenticeship training in the 1900's. Prior to 1950, most engineering curriculum consisted of lectures and hands-on instruction closely related to industry experience (Wankat et al., n.d.).

The American Society for Engineering Education produced the *Grinter Report* in 1955, which called for an increase of mathematics and science within engineering education. As engineering science gained importance, hands-on instruction fell to the wayside to allow for courses in "scientific analysis and mathematical modeling" (Wankat et al., n.d., p. 2).

Until the 1970s most professional engineers worked in or directly with industry pulling real-world knowledge into their classrooms. The engineering curriculum at that time embodied the data and skills students would need in industry. At that time most tasks required by engineers were routine and students learned required tasks and skills through lab exercises, case studies and work programs (Rugarcia et al., 2000).

2.2.2. Teaching Methods Employed in Today's Engineering and Technology Curriculum

The traditional lecture course is still dominant in engineering education. Not much regarding the structure of the lecture has changed in the past 30 years. The professor delivers the lecture from the front of the classroom while the students sit passively absorbing what information they can (Felder et al., 2000). Traditional instructivist methods of teaching focusing on textbook and lecture format are un-motivating to this generation (Annetta et al., 2006; Foreman, 2003). A study conducted by ECAR finds that engineering students showed the highest percentage, 67.8%, for preferring extensive use of technology in the classroom among all educational disciplines represented in the study.

Foreman (2003) discusses further deficiencies found in large lecture courses. The one-way communication dictated from professor to student leaves little opportunity for asking of questions or clarification a student might needs. Students have to rely on their sense of hearing. Lectures are delivered at one

speed, the speed of the professor. The entire lecture body is expected to follow along, yet this poses problems for some students with varying intellectual abilities.

In addition to the deficiencies Foreman discusses, there is concern for the Millennials' desire to multi-task (Gasser & Palfrey, 2008). This is a concern not unique to engineering educators. With the abundant use of technology there is much opportunity for students' attention to wander when not engaged in the lecture. Parents and educators share concerns for dwindling attention spans. A study conducted by Hembrooke and Gay (2003) of Cornell University, looked at the effects of multi-tasking within the lecture class. They divided a lecture class into two groups allowing one group to freely utilize their laptops. The other group was asked to not open their laptops during the lecture. The researchers logged the activities of those with the laptops to see how they were utilized. They found that while some students looked up topics related to the professor's lecture others used their laptops to surf unrelated sites and check email. After the lecture, the researchers tested each group to see how well they could recall the information presented to them during the lecture. The group without the use of their laptops performed significantly better than the group who utilized their laptops during the lecture. The researchers performed a second study two months later where the groups switched roles regarding the use of the laptop. The results from testing these groups again for memory recall after the lecture provided the same results as the previous study.

It is proven, however, that the lecture is effective for disseminating large quantities of factual data intended for memory and short-term recall. To teach information intended for long-term memory teachers need to employ active learning methods. Active learning has been proven to be more effective than the traditional lecture. Active learning is also the preferred method for motivating students and helping them to develop critical skills (Rugarcia et al., 2000).

More effective teaching methods exist in comparison to the traditional lecture. Examples include cooperative learning, inductive learning, open-ended

questions, multi-disciplinary problems, brainstorming, etc. However, there is resistance to change from the traditional methods. Obstacles to change include a fear of loss of control and worry that new teaching methods would take time away from instructors need to conduct research for university (Felder et al., 2000, Rugarcia et al., 2000).

2.2.3. Concerns of Engineering and Technology Educators

An interesting study conducted by Turns, Eliot, Neal, and Linse (2007) investigates the teaching concern of engineering educators. This study highlights several themes collected over the course of the study. For example, engineering educators have concerns regarding adopting new teaching methods. Reasons for these concerns include lack of support from fellow faculty and department, lack of interest displayed by students, and fear of loss of control over classroom activities. Advancement in many university departments is dependent upon research funds. Many faculty members feel the need to make research their primary focus. When this happens, little time is left for developing new curriculum and teaching methods (Rugarcia et al., 2000).

The fear of loss of control, a concern of many engineering educators, is a valid concern shared by many educators across multiple disciplines. Typically, when the teacher is engaged in a lecture-based environment, he or she remains in full control of the classroom. Moving to a more learner-centered environment moves the control from the teacher to the students. Fear of digression from syllabus and lack of student engagement are among the top issues teachers wrestle with when contemplating learner-centered environments (Rugarcia et al., 2000).

2.3.4 Future of Engineering and Technology Education

Today's environment for practicing engineers is vastly different from earlier times. There is a significant and growing volume of knowledge today's

engineer is expected to know. Critical skills such as critical thinking, team-work, self assessment, global thinking, and change management need to be learned by today's engineering student in addition to the vast volume of multi-disciplinary data (Rugarcia et al., 2000)

In addition to the need to incorporate the critical skills needed by today's engineer, engineering educators also question the traditional teaching methods still used today. The American Society for Engineering Education, ASSE, holds conferences to promote the adoption of new teaching methods within engineering education. Additionally, the U.S. Accreditation Board for Engineering and Technology (ABET) established new standards that will facilitate the change in engineering education moving toward proven teaching methods that promote long-term retention (Rugarcia et al., 2000).

2.3. Summary

With the advent of the Millennial generation entering college, traditional teaching methods may not be sufficient to engage this generation. Engineering education still employs traditional teaching methods. To better engage and attract students, educators need to know and understand their students.

CHAPTER 3. METHODOLOGY

The purpose of the study was to document the experience of how Millennial engineering and technology students experience learning through traditional teaching methods employed in large lecture engineering classes. This study attempted to analyze the perceptions Millennials have toward traditional teaching methods such as the lecture. Another goal of this study was to help identify whether change is needed in traditional teaching methods to help engage student attention and learning and to also provide recommendations for future studies. The following sections look at the framework developed for this study as well as the methodology employed.

This study followed a phenomenological approach adopted from Colaizzi (1978) and Moustakas (1994). Phenomenology, as defined by Patton (2002), “seeks to grasp and elucidate the meaning, structure, and essence of the lived experience of a phenomenon for a person or group of people,” (pg. 482). A quantitative survey was administered to the population of CGT 164 to define its demographics and technological characteristics. Two sources of qualitative data, semi-structured interviews and researcher observations, were used to document the experience of the students. The following sections outline the permissions obtained, site and participant selection, quantitative and qualitative procedures, and data analysis used in this study.

3.1. Permissions

Permission was obtained from the CGT 164 course instructor to observe the students during lecture and recruit volunteers for the study. It was decided by the instructor to offer extra credit to those who volunteered to participate in the

study. In compliance with Human Subjects Guidelines, an additional extra credit opportunity was available for students who chose not to participate in this study.

The researcher sought and was granted Human Subjects approval in the fall of 2010. In compliance with Human Subjects approval (see Appendix A), the researcher did not recruit volunteers from the lab sections in which she taught. Furthermore, the interview participants were given a Participant Information Sheet outlining the purpose, procedures, and risks of the study in accordance with the Human Subjects approval.

3.2. Site Selection

This study focused on first and second year engineering and technology students, specifically those currently studying within the civil engineering and building construction management disciplines. The participants of this study were representative of the Millennial generation based on age criteria. One fall semester core engineering and technology class, Computer Graphics Technology 164 (CGT164), required for all civil engineering and building construction management students, was selected for the setting of the study. The class held two weekly lectures accompanied by an additional weekly laboratory session. The two weekly lectures were divided between theory and laboratory preparation usually in the form of software demonstration.

3.3. Participant Selection

Students from CGT 164 were offered multiple extra credit opportunities. From the choices of extra credit opportunities offered in this class, one opportunity was to participate in an electronic, quantitative survey (see Appendix B) utilized in this study. Students volunteering to participate in this survey were asked basic demographic information such as age, gender, and major. Additionally, these participants were asked multiple choice and ranking questions about the type and usage of technology in their everyday life and education. The

purpose of this survey, in addition to collecting demographic information about the CGT 164 student population, was to identify population characteristics about their technological trends to see how they compared to characteristics generalized across the Millennial generation. Use of technology in everyday life was a key characteristic of this generation as it defines and separates this generation from previous generations (Howe, 2003; Oblinger, 2003; Shaw & Fairhurst, 2008). Therefore it was an important defining factor to observe in this study. Furthermore, the participants from this survey were asked to provide their email contact information for one of questions if they were willing to participate in an interview for this study. Thirty-Eight volunteers provided their email indicating that they were willing to participate further in interviews. Each volunteer was emailed and provided with dates and times in which they could come for interviews. These volunteers, enrolled in CGT 164, representative of the Millennial generation by age, and either engineering or technology majors, met the conditions for criterion sampling. The interviews were conducted on a first-come-first-serve basis. The purpose of multiple interviews from this criterion sample was to maximize the information gathered from the participants. Once no new information was provided from new interviews, also known as redundancy or data saturation (Patton, 2002), no additional interviews were conducted. A total of nine interviews were conducted and transcribed by the researcher. Procedures for these interviews are discussed in the following sections.

3.4. Procedures

Qualitative study processes and procedures were utilized to observe and document the students' experience of learning in a large lecture class structure. Interviews and observations were the two types of data collection used in this study. These methods are discussed in the following sections.

3.4.1. Semi-Structured Interviews

The interviews were conducted over a period of one week. A quiet conference room was selected for the interview setting to shield from outside distractions. Each interview was audio-recorded and transcribed verbatim. The duration of each interview lasted between 7 to 11 minutes. These interviews allowed participants to discuss their experiences of learning through traditional teaching methods used in large lecture classes. The researcher used a question guide to navigate through the interview (see Appendix C). The questions provided for the interview were reviewed by qualitative study experts to insure validity to study. Participants were asked to explain their meanings and feelings related to this phenomenon. The primary researcher conducted all interviews to insure consistency among the questioning.

Each participant was provided with an information sheet (see Appendix A) outlining the study purpose and potential minimal risks prior to beginning the interview. During the interview, they were asked a series of questions focusing on two key areas. The first area probed the participants' personal experience with technology usage among their university experience as a whole. The second area narrowed the focus to the participants' experience of the large lecture class format utilized in some engineering and technology classes. While questioning the participants about their experiences of the large lecture class format, each participant was asked to describe the format of the lecture as well as discuss the use of technology during the class period. Additionally, each participant was asked to describe their feelings about the class; how they felt it helped them learn and what obstacles it presented, if any, to their learning.

The researcher reviewed the data after each new interview searching for redundant data. After nine interviews were conducted, finding no new information the researcher assumed data saturation. The data gathered from these interviews was transcribed verbatim and used by the researcher during analysis. Observations and field notes, discussed in the following section, were analyzed

with the data to insure validity of the information provided by the participants during the interviews.

3.4.2. Classroom Observation

Three classroom observations were conducted during this study. The first observation occurred prior to the interviews conducted with the participants. This observation was for the researcher to observe the setting. The researcher observed the format of the class, the delivery of the content material, and the use of technology during the class period. The second observation occurred during the timeframe of the interviewing process allowing the researcher to observe and record student behavior during the lecture class. The third observation occurred after the completion of the interviews and assessed the validity of the data provided by the participants during the interviewing phase of the study. The analysis of the data recorded in the field notes (see Appendix D) from these observations as well as the transcribed interview data is discussed in the following section.

3.5. Analysis

The data obtained through the interviews will be analyzed using content analysis as outlined by Colaizzi (1978) and Moustakas (1994). The first step of phenomenological analysis, according to Moustakas, was for the researcher to Create an Epoche. Epoche comes from the Greek language and means for one to refrain from judgment. In Epoche, researchers described their experiences, perceptions, and feelings related to the phenomena they are studying in order to set aside any personal judgment. Prior to conducting the interviews for this study, the researcher took time to quietly sit and record all personal experiences and thoughts related to the phenomena. Moustakas (1994) noted that while personal judgments cannot fully be avoided, this process of Epoche provides an attempt for the researcher to focus on the participants' experience instead of their own.

After the interviews were conducted, they were transcribed verbatim. Once this occurred, the transcribed interviews were read and reread several times by the researcher to familiarize herself with the data. As the researcher became more intimate with the data, she developed a list of significant statements, also referred to as textural description, describing in the participants' own words how they experienced the phenomena. This process is referred to as transcendental phenomenological reduction by Moustakas (1994). The researcher then interpreted each significant statement and formulated meanings from them creating structural descriptions. These structural descriptions were grouped into themes identified by the researcher. Once the themes were identified, the researcher created a composite description using both the textural and structural descriptions from the data to create a rich description of the phenomena, which in this study described how the participants experienced learning in the large lecture class.

In addition to the content analysis of the data obtained through the interviews, the field notes recorded during the three observations were reviewed during this phase of the study. Data gathered through the field notes were used to help validate the researcher's findings from the content analysis. Furthermore, the field notes served as a key tool in assisting the researcher to write the structural description of the setting and its context (Moustakas, 1994). The combination of the content analysis of the interviews and the analysis of the field notes were used to help the researcher write an exhaustive account of how Millennials experience learning in the large lecture class.

3.6. Summary

This chapter provided the methodology used for this study. A quantitative survey was conducted on the CGT 164 population to define its demographics and its technological characteristics. From that survey, volunteers were recruited to participate further in the study. These recruits participated in semi-structured interviews. Following a phenomenological approach as outlined by Moustakas

(1994) this study used qualitative methods of data collection and analysis for the interviews. The researcher also participated in classroom observations collecting field notes that were later used to validate the participants' responses and help with writing the composite description of the phenomena. The following chapter shares the results of both the quantitative survey and the qualitative interviews.

CHAPTER 4. RESULTS

The purpose of this study was to document and analyze how Millennial engineering and technology students experience learning in large lecture classrooms. Another goal of this study was to identify and analyze the perceptions Millennials have toward traditional teaching methods used within the same setting. This study also documented how Millennials experienced technology within the large lecture classroom. To address these goals, this chapter first provides the results of the quantitative survey. This survey provided basic demographic information on the CGT 164 population provided basic population characteristics to compare with generational characteristics. Technological trends identified through the survey are also discussed. Second, this chapter focuses on the qualitative results gathered from the participant interviews. Basic participant description is provided followed by an accurate account of their experiences and perceptions of large lecture classrooms. A description of the large lecture environment compiled from their statements and the researcher's observations is followed by participants' perceptions of the presentation of material by their professors. This chapter also describes the participants' experience of technology use in their lab and homework environments. This chapters ends will a summary of the results.

4.1. Survey of Population Characteristics

The classroom setting chosen for this study was CGT 164, Graphics for Civil Engineering and Construction. This course, a service course offered by the Computer Graphics Department, was a required course for disciplines within both engineering and technology. The layout of this course consisted of two weekly

lectures and one weekly lab period. The weekly lectures alternated between theory and laboratory preparation.

A quantitative survey (see Appendix B), as discussed in the methodology section, was administered to students within CGT164. The purpose of this voluntary survey was to collect demographic information on the student population. Additionally, this survey provided an avenue to compare population characteristics to those generalized across the Millennial generation as well as to look at technological trends of the population. A link to the electronic survey was emailed to 158 students. The response rate for the survey was 67%. Of the 106 students who completed the survey, 88% were male and 12% were female. Table 1 displays the breakdown of the survey population by age and major.

Table 1

Survey Population Breakdown by Age and Major

Age	%
18 or under	27%
19-20	68%
21-22	3%
23-24	2%
25 or older	0%
Major	
Construction Engineering Management	3%
Civil Engineering	54%
Computer Graphics Technology	2%
Building Construction Management	36%

Other

5%

To compare the characteristics of the student population to those of the generalized Millennial population, the survey questioned students about their usage and preference of technology. One question asked which communication methods, phone, email, social network, standard mail, and/or other, the students used to stay in contact with friends and family. The students were asked to select all methods that apply. Phone was the most popular method (98%) among the students for staying in contact with friends and family. Email was the second most utilized form of communication with 75% followed by social networking used by 73% of the students. Only 25% of the students responded that they used standard mail for communication while even less (8%) responded that they used other methods. It should be noted that many modern phones incorporate email and social networking capabilities and this may have influenced how students viewed and responded to this question. According to a survey on the Millennial generation conducted by PEW Internet Research (Taylor & Keeter, 2010), 94% of Millennials were found to own cell phones. Additionally, this report also found that 81% of 18 to 24 year-olds created and used social networking applications. These statistics were similarly aligned to the demographics of the engineering and technology students within CGT 164.

Students were also asked how often a day they spent using technology. This included computer, Internet, social media, texting, etc. Over 90% of the respondents selected that they spent more than three hours a day using technology. Taking a closer look at this statistic, 51% responded that they spend 3 to 4 hours daily using technology while 41% spend 5 or more hours a day. Only 1% of the s said that they used technology less than one hour a day. When asked to rank in order their purpose for their technology the top ranking response was communication followed by educational purposes. Entertainment was the third highest usage of technology among the students.

The survey also questioned the students about technology usage in education. Table 2 shows the percentages for what types of technologies were utilized in their classes. The students were also asked how much technology they preferred to see utilized within their classes. They were asked to select extensive usage, moderate usage, limited usage, or on-line classes. A majority of the students, 66%, selected that they preferred a moderate usage of technology in their classes. Extensive usage showed the second highest preference with 29% of the vote. Only 4% of the students preferred limited usage and a mere 2% preferred on-line classes.

Table 2

Technologies Utilized in Respondents' Classes

Type	%
Internet	91%
Software Programs	90%
Blackboard (or similar on-line application)	89%
Textbook	80%
Other	15%

This survey provided a snapshot of the demographics and technological characteristics of the CGT 164 population. Additionally, students were asked to provide contact information if they were willing to contribute further in this study by participating in interviews. The results of participant selection are discussed further in the following section.

4.2. Participant Description

The interview participants for this study were selected from volunteers from the Fall 2010 CGT 164 class. Thirty-eight volunteers provided their email contact information on the demographic survey indicating they were willing to participate in interviews for the study. Each volunteer was emailed dates and times in which they could come for interviews. The interviews were conducted on a first-come-first-serve basis. After each interview, the researcher reviewed the data to see if additional interviews were needed. Finding redundant data with sufficient themes, no additional interviews were conducted after the ninth interview. A breakdown of the nine participants based on age, gender, major, and preference of technology is shown in Table 3. It was interesting to note that the percentage of participants who preferred moderate technology usage in their classes was the same for the CGT 164 population. The percentage of participants preferring an extensive usage of technology in their classes was very close to that of the population as well. The qualitative results of their interviews are discussed in the following section.

Table 3

Interview Participant Breakdown

Participant	Code	Gender	Age	Major	Preference
Participant 1	IP1	F	19-20	BCM	Extensive
Participant 2	IP2	M	18 or under	BCM	Moderate
Participant 3	IP3	M	19-20	BCM	Moderate
Participant 4	IP4	M	19-20	CEM	Moderate
Participant 5	IP5	M	18 or under	BCM	Moderate
Participant 6	IP6	M	19-20	BCM	Extensive

Participant 7	IP7	M	18 or under	CE	Moderate
Participant 8	IP8	M	19-20	CE	Extensive
Participant 9	IP9	M	19-20	Other	Moderate

4.3. Interview Data

This section reviews the qualitative results collected from the semi-structured interviews. Phenomenological methods as outlined by Moustakas (1994) and described in the methodology section were used to analyze and organize the data. This section uses rich description to describe how the participants' experienced learning in large lecture classes. Some participant descriptions are cross-referenced with the researcher's observations to help provide a more vivid picture of the experience. Composite description, a combination of the participants' textural descriptions as well as structural description, is used. Examples of textural descriptions provided by the participants and their structural interpreted meanings are found in Table 4. This section focuses first on the participants' experience of learning in the large lecture setting. Perceptions regarding the presentation of material during lecture, as described by the participants, are also discussed. This section focuses next on the participants' experience of technology in the lab and homework settings. The experiences and perceptions regarding technology are reviewed. This section concludes with a review of the qualitative results.

Table 4

Selected Examples of Textual Descriptions from Participants and their Structural Interpretations

Textural Description	Structural Interpretation
<p>“I feel that the professors do a good job. Like with the PowerPoint it helps show you a visual aid and makes it easier to understand than just them talking cause you might miss something.”</p>	<p>Student feels that the PowerPoint slides compliment what the professor is discussing. The slides have visual information that supplement what is being discussed.</p>
<p>”I rely mostly on homework to study for things. So, I mean, that’s my study time really. But in lecture, yea, if I feel like the lecture offers a lot of information and stuff, I will take notes.”</p>	<p>Participant views homework as a means for studying the material. She will take notes in lecture if she feels it is valuable information.</p>
<p>“And the overheads, make like, you can actually do stuff like right in front of your face and then it goes on the screen for everyone else to see. I think that’s a useful tool.”</p>	<p>Participant likes it when professors utilize overhead projector while walking through processes. Students can see and visualize what the professor is doing.</p>

4.3.1. The Large Lecture Experience

CGT 164 served as the setting for this study. While some of the participants' descriptions and experiences revolved around this particular class, the participants also drew upon other experiences of other large lecture classes from their undergraduate academic career at Purdue University. The description of the large lecture classroom is constructed from the researcher's observations of CGT 164 and the participants' responses. Appendix E contains a reconstructed drawing of the classroom layout by the researcher during one of the observation periods. This section also discusses the participants' large lecture experience and is broken down into two main categories: presentation of content material and the experience of technology within lab and homework. Each category provides detailed descriptions of the participants' experience and perceptions.

4.3.1.1. The Large Lecture Setting

The large lecture classroom was designed so that the front of the room contained a stage-like area with resources available to the professor. Three seating sections fanned out from the front of the room toward the rear like theatre seating. Each row of seats elevated as they moved toward the rear of the classroom. Aisles for walkways flanked each seating section. Exit doors where students entered were located at the front of the classroom on either side of the stage area as well as along the rear wall in the back of the classroom.

Mounted centered along the front wall rested a large, high, projection screen divided so that multiple projections could be cast simultaneously and seen by the entire class. Below the projection screen was a chalkboard that could be utilized by the professor. Directly in front of both the chalkboard and projector screen was a small table that could easily be moved if room was needed. To the right of the table was what looked to be a podium with a computer which the professor used to demonstrate software or show the

PowerPoint projected on the screen. Three overhead projectors were arranged on the stage so that they could also project onto the screen if used by professors.

As noted by the participants, there was a distinct feeling of separation between the professor and the students. IP7 described this arrangement, “there is kinda a separation, the teacher down at the podium, students up in the seats.” He also described the lecture setting as “distant.”

Students poured into the classroom, some with head phones on, cell phones out, talking with one-another. IP9 described how his typical lecture period would start:

I’m going to walk with my headphones; I’m going to sit down. And usually it won’t get started for a couple minutes. And we’ll go over things that are due or things or things that you need to review, which is good because it reminds me of what I need do. And then he’ll start going into the lecture and which I’ll usually take notes unless it’s on something that we already went over or something like that.

Other participants described how lecture started with announcements. IP5 described how one of his professors started off with some ice-breakers to “kinda just loosen up the mood” before starting.

Once the lecture began, usually a few minutes after class time officially started, the participants described what they noticed around them while the professor was lecturing. IP9 shared what he experienced during lecture:

Well, definitely there’s quite a few people sleeping. There’s people on their phones. There’s people on their computers doing other homework which I sometimes do if I have something due at the end of the day and I want to work on it... But, I would say about half the class is paying attention and taking notes and the other half is just doing different things.

IP5 shared a similar experience, “They’ll be like using cell phones, going off in just like a low constant chatter. But I don’t know if they are not paying attention or talking about the lecture maybe.” Other participants shared similar accounts of hearing a low constant chatter or squeaking chairs. These were noises they had to tune-out to try to hear their professors. Most students described these noises and the behaviors of students around them as “distractions.” They also listed

these specific instances when asked what about lecture caused obstacles to their learning. IP8 described that he tried to pay attention to the professor during the entire lecture yet he felt distracted about 15% of the time:

But then, I don't know, minus 15% because of... people talking and I get distracted or people do something and I get distracted or... maybe miss something and you need to ask somebody a question so that takes away a little bit too.

IP6 shared his frustration with the distractions around him during lecture:

... It wasn't so bad in my other classes last year, but in physics 218 now... there's a lot of talking going on while the professor is trying to teach. And that's like a class where you want to understand and it's really hard and distracting for me to try to listen to the teacher and then hear something in the background sometimes.

During lecture, when not battling the distractions the participants mentioned, they seemed to agree that they spent their time following along with the lecture when new content was delivered. "I take notes and try to learn as much as possible," remarked IP2. IP1 described spending her time taking notes while watching and listening to the professor. IP4 described his behavior as, "Listening... I take notes sometimes but I find its better to just listen and remember than to write stuff down. So, I do some of both." The rest of the participants shared similar behavior experiences during lecture for new material.

When professors presented material the participants felt there were familiar with, the participants' attention seemed to wander. "In lecture, I spend my time taking that stuff that I don't know like seriously. And then if I already know something then I'll probably look at my phone for just boredom purposes," was how IP6 described spending his time. IP9 expressed, "And, if it's something I already know or I've already reviewed or I did homework on, I tend to dream off or do something else, but usually I'm attentive in class."

Overall, the participants seemed to agree that lecture provided a good overview to the content material. In the words of IP7:

The lecture does a good job of introducing the material. And then like the small recitations, the lab helps do a good job cementing it, resolving any

problems or questions... If there is one person who has a question you just don't stop the whole thing. You keep going. Introduce all the new material as planned. It's not stop and go.

IP1 described how lecture provided an overview of the material to help prepare her for homework and studying:

I think homework is most effective tool for me. I don't really find lecture that helpful. Um, maybe in some classes, like chemistry, I thought lecture was helpful because I would get a brief overview of what we were talking about and then I would go home and really get into what I was learning with homework and stuff. So I would have kind of a brief overview and then get into my homework.

IP9 also described how the professors break down the material into smaller modules making it a little easier for students to digest:

Well definitely chapters are going to help you learn, because it's just a small base of material. You aren't having to learn so much, so. And the way that they go over it in lecture is actually pretty well laid out. They have different slides and different explanations for things. And, so, they have it pretty well... done.

IP9 described how PowerPoint slides are used to help compliment the content material. The visual presentation of material as experienced by the participants is described in the following section.

This section described what the participants experienced in terms of the setting and personal behaviors during the lecture period. The participants expressed that lecture provided a good overview of content material. The following section describes the experiences as well as the perceptions they shared regarding the presentation of the content material, both visual and verbal.

4.3.1.2. Presentation of Content Material

The participants shared that most of their lecture professors lectured for about 90% of the period. During this time, the participants would try to tune out the distractions they described to focus on the professors and their delivery of the content. This section focuses on the participants' experiences of this delivery as

well as their feelings and perceptions on the delivery. The participants shared distinctive feelings regarding the visual and verbal communication of the material. This section focuses on each form of communication individually as described by the participants.

4.3.1.2.1. Visual Presentation of Material

Seven of the nine interview participants shared strong feelings and perceptions regarding the visual presentation of material during lecture. In discussion with the participants, PowerPoint was found to be the most utilized form of visual communication by their lecture professors. Some participants described the use of overhead projectors as another avenue for providing visual material. However, the participants shared similar feelings about how PowerPoint was a tool for communication. The first perception made by the participants described it as a useful visual aid to supplement the content discussed by the professor during lecture. The second perception defined PowerPoint as a critical tool for capturing important notes and details about the lecture content. The following composite description describes these perceptions made by the participants.

PowerPoint was defined by the participants as an important visual communication tool. Participants described themselves sitting in lecture listening to the professor and looking at the PowerPoint for key points to highlight. IP1 described her typical lecture experience with PowerPoint:

I would say, typically, you are going to have a PowerPoint and, yea, mostly just a PowerPoint and the teacher will have visual aid and will have problems up on the board. And they'll compliment that with extra problems later on, and dry erase board or something... I know in Physics we had clicker quizzes, we would have those on the PowerPoint and they use that technology to get quiz points.

During his interview, IP5 discussed how PowerPoint slides complimented what the professor discussed during lecture. "I feel that the professors do a good job. Like with the PowerPoint, it helps show you a visual aid and makes it easier to understand than just them talking, 'cause you might miss something." The slides

were a tool for him to cross-reference what the professor was talking about. The participant felt the slides had visual information that helped supplement the material discussed. For IP5, he felt the content provided on the PowerPoint helped with understanding the concepts. This perception was shared by IP7 who also found PowerPoint to be a useful tool to help convey content material. He found the use of PowerPoint especially helpful when the professor used it in conjunction with walking students through problems, "... and he has PowerPoints on the screen, and sometimes he brings out other demonstrations. But... the PowerPoint is good to get the idea across and walk through an explanation."

When asked about his feelings of how content was delivered in the lecture setting, IP2 said, "It's very thorough. I do like PowerPoint presentations, they do have notes and to be able to read it and write in down myself as well as have a professor explain the material." IP3 also responded similarly, "I think they're good. They help a lot and they are very informative and full of everything you need." These participants shared that they liked the ability to visually view content material on the screen and takes notes while the professor discussed the material.

While participants IP2, IP3, IP5, and IP7 noted that material conveyed on the PowerPoint was "good" or "very thorough", IP4 described an example of what he felt was an unsuccessful use of PowerPoint:

And I just came out of physics lecture, his slideshow is awful. He put like tons of equations and tons of words that were like completely filled it with all different reds and blues and different colors and it was just so confusing. So, I don't know, that was bad.

According to IP4, for slideshow presentations to be effective for learning they need to be well organized. He found slides packed with information and poorly organized difficult to read and understand. As he stated this was "confusing" to him and not conducive to his understanding.

The second perception shared among participants revolved around the use of PowerPoint slides as a tool for obtaining notes and studying. During lecture, it was observed by the researcher how students took notes. Each time a

new slide appeared on the screen, students would rush to copy down the points before it was replaced with the next slide. It was like a mad-rush to copy down the information. Several participants described that many of their classes posted the PowerPoint lecture presentations online. For the participants, this was a preferred method of obtaining lecture and study materials. IP9 shared his feelings about posted lecture material:

I think it's also good that most of the teachers put the lectures online so if you miss or aren't feeling well or something like that you can also go back and take notes on your computer, which is nice. But, definitely going to lecture is important and you need to do it.

IP2 shared similar feelings about professors posting PowerPoint presentations online, "... one class, OLS, the notes are online. I do prefer that but students would skip more class. I would like if there was another way to get that material besides just that lecture." His concern centered around obtaining lecture material in other forms than just taking notes during lecture. IP7 discussed that his Physics and Engineering classes were "good" at posting PowerPoint notes online. When asked how he used the posted information he responded, "When reviewing for a test." In her interview, IP1 discussed how she used PowerPoint lecture presentations posted online as a method of studying:

PowerPoint is helpful especially if they put it online cause then you can use that to study for a test. I have found that really helpful for chemistry cause they would have a lot of test questions from the PowerPoint slides in class.

The participants viewed the visual presentation of material as key to their learning. PowerPoint was described as a tool to both facilitate communication and aid in understanding the content of the lecture. It gave the students another focus point to assist them in following along with the discussion. These ideas expressed by the participants are further discussed in the analysis section of this study. The following section looks at the participants' experiences and perceptions regarding the verbal presentation of material by their professors.

4.3.1.2.2. Verbal Presentation of Material

The participants described their experience of sitting and listening to their professors deliver the content of the lecture material. Throughout their descriptions three reoccurring perceptions emerged. These perceptions included speed of delivery, irrelevant content material, and engagement of the audience. This section focuses on these experiences and perceptions shared by the participants.

The first reoccurring perception described by the participants regarded a concern for the speed of delivery by the professor. This was important to the students who “sit and listen” to the professor deliver the content. The lecture was described as one-way communication, the professor at the front of the room delivering to the students facing him/her. Little or no interaction occurred during lecture unless there were questions. Even that, according to the participants, was a rare occasion. Low constant chatter and squeaky chairs made it slightly difficult for the participants to pay full attention to the professor throughout the duration of the lecture time. Other distractions from students around them would take their attention from time to time. When the participants were engaged in the lecture, they took notes on key points and recorded examples to be used for studying later on. Several participants described their experiences of when professors went through the material too quickly not allowing them time to record the information. As the participants described, this was a source of frustration for them.

In the words of IP3, “sometimes they go a little too quick going over things... and they don’t cover things enough as they should or don’t clarify if they need to.” This sentiment is shared by IP1, “in CGT I wish, maybe, he would take more time explaining how to do the drawings ‘cause I feel like he does it very fast. And maybe spending more time explaining different commands and what they do or something.” These participants felt that their professors ran through examples and/or demonstrations too quickly not spending the time needed to make explanations for the students. IP1 described how she wanted the professor to

take more time with demonstrating and explaining different key commands used in the programs demonstrated. She felt she was not absorbing all of what the professor was doing, more like she was catching highlights of what was actually being completed.

Both IP2 and IP8 expanded upon this perception about the delivery of content material. In addition to sharing their feelings that the speed of delivery by some professors was too fast, they elaborated on how it hindered them. “Sometimes the professors do go a little bit fast and I may not have time to write down all the notes,” described IP2 when sharing his experience. IP8 also experienced difficulty following along with the lecture when professors moved too quickly through material:

It depends on who is teaching it, really. I mean, sometimes in, um, chemistry... or even math; I just didn't get the stuff. 'Cause they're flying through the stuff that, you know, 'cause they want to throw out a lot of information at once, and I just didn't get it. Delivery could have been good, but I just... didn't see it too much cause I was trying to write it down.

IP8 referred back to this point later during the interview when asked what about the lecture posed obstacles to his learning. In his words, “I guess it would only be if I was, just if there was so many notes that I had to write that I can't really learn because I have to write it all down.” IP8 felt that it is an obstacle to learning when the professor crammed so much information into one lecture. He felt he was not learning because his time was spent trying to capture and write down all the notes from the lecture. He was missing some of what was being discussed, perhaps important information.

The second reoccurring perception described by the participants was that some professors introduced irrelevant content into their lecture. Several participants shared their feelings that sometimes it was hard to pay attention when the instructor went off on a tangent. Often, when attention wandered then the participant missed something important as IP1 described:

Um, sometimes if the teacher goes off on a tangent then I do too. It's hard to get back. Um, so yea, if they are talking about a bunch of stuff I don't

find that I need to know and then I might not pay attention. And when they do say something I need to know then that's an obstacle.

IP4 discussed how he did not pay attention to the lecture portion of class when the professor covered theory because he knew he would not be tested on the material. He felt that since he would not be tested on that material, it was information he did not need, and therefore, irrelevant. He gave the sense that it was a waste of this time when his professors did this. In the words of IP6, "I would feel that I could mainly summarize most of the stuff in about half of the class time." IP3 described that he sometimes paid attention to the stories shared by the professor, yet most of the time he felt he was just copying information from the PowerPoint. In his words, "sometimes you get listening and to their stories and stuff. And most of the time I feel like I'm just reading off the slide and writing it down." IP8 described what he felt was a positive to his professor sharing some irrelevant information during lecture:

For others though, like my dynamics teacher, he kinda goes slower and kinda makes lots of jokes in-between... I mean, when he does teach the material it's good. But, I don't think he uses his time as efficient as possible. I guess that's one good thing about the dynamics teacher, even though he doesn't use his time efficiently, he's a little slower so I can, like, kinda see the stuff as it comes. He's not like trying to crank through it so fast.

IP8 felt that even though the professor did not use his time efficiently by making jokes in-between information he was relieved that this allowed him time to follow along with the material.

The third reoccurring perception that was discussed by the participants involved engaging the audience. This perception mostly regarded the professors' ability to engage the participants during lecture. IP3 described his experience of lecture professors engaging students, "I've had a couple professors that were fun, like they told stories and stuff. And other ones just literally read it and it's just really boring and you don't even want to go in the mornings." The participant enjoyed professors who are more animated and could relate to students. Professors who read straight from their notes or presentations were boring to the

participant. He did not want to attend lecture where professors read straight from their PowerPoint presentations. This feeling was shared by other participants. They described how they would tune-out the professor and focus solely on the content of the PowerPoint trying to capture all the notes before the professor clicked to the next slide. "You almost don't need to listen as long as you take a look at the PowerPoint," described IP3. His description of the lecture experience, "you go in, you sit there, you watch a slide show, listen to the professor say the same thing," conveyed his dislike for professors who just repeated the PowerPoint. IP9 shared his feelings about how the delivery of content material could better relate to students:

I think that it could be a little more geared toward students and not towards what the professor wants to do. Just, as in like, he doesn't have to sit there and talk about just one topic for 20 minutes. He can move on and go through the notes and try to explain other things that we don't know. Instead of just staying on one thing forever and having us go and read the book later, and just not know what's happening.

The participants estimated that most professor lecture for between 90-100% of the lecture period. This made the perceptions of the students regarding delivery of content material, whether visual or verbal, critical to their experience of learning. The professors, viewed by the participants, had the ability to alter the effectiveness of the lecture in the eyes of the students. Those professors who took more time walking students through the content material were praised by the participants. Professors who tried to relate to the students engaged their students in their lectures. These topics are reviewed further in the analysis chapter.

4.3.2. The Experience of Technology in Lab and Homework

In addition to the technologies utilized in the large lecture classes, the participants experienced different technologies within their lab settings and outside assignments. The participants described the types of technologies they were exposed to as computers, Internet, on-line applications, software, articles,

magazines, and textbooks. Among the most frequently described software and programming application mentioned by the participants were Matlab, AutoCAD, and Python. The purpose for these applications, as described by the participants, was for use in solving lab problems and assisting with homework assignments. The most frequently mentioned on-line applications included Blackboard and WebAssign. This section describes the participants' experiences with these technologies as well as their perceptions regarding their exposure to these technologies.

4.3.2.1. Use of Technology in the Lab Environment

The participants listed many types of technology they encountered within their lab environments. Programs like AutoCAD and Python used in CGT and physics were among the most popular applications described by the participants. The participants conveyed using these programs to help with lab assignments by constructing 3D models or creating simulations to help find solutions. The participants also expressed how these programs helped to compliment the material reviewed during lecture. IP7 described how helpful Python was for him, "I really like the Python in physics because it's taking the material that we are learning in class, like the gravity and the springs, and we are actually being able to see and model that without doing calculations tediously."

The common essence of these experiences shared by the participants was that the use of technology provided visualization. The participants seemed to agree that visualization was key in helping them understand complex concepts. In the example IP7 provided about using Python in physics, he was able to visualize changing affects gravity had on springs. The participant was able to see the visual explanation of the math and physics he learned in lecture. IP1 expressed how Python provided an avenue for her to test solutions:

Python helped you visualize, to view what is going on and enter in different code and different information to make objects do different things.

So it was a way to experiment without actually experimenting with objects. I think that was pretty cool.

IP1 also described how visualization with other technologies was important to her learning:

I like PowerPoint 'cause I am very visual. So, in physics we had a lot of demonstrations and that helped a lot... Like whenever a teacher draws something out instead of just saying it with words, I understand it. Or, like with math when they write the whole problem out and then they show you step by step what's going on instead of just saying 'ok, then you would do this.'

IP2 similarly described himself as a visual learner, "I'm a visual learner so I like to see things in front of me." IP6 expressed how he enjoyed being able to see a final product after working in a program. IP9 felt 3D visualization was good for helping to view models since it provided the ability to move objects around and view different perspectives:

I mean I like AutoCAD and all. It's kinda a hard program for me seeing as how I never really used it before this... I think it's a good program and once we start getting to like 3D models and stuff like that, I'm sure it's a lot easier to visualize than if I was to like draw a 3D shape model on piece of paper. Cause you are able to move it around and see all the different points and areas and stuff.

Similarly, IP5 described how AutoCAD provided a hands-on experience that was helpful to him, "I feel that it does help me learn. I think that, more with AutoCAD that its hands-on experience and that's how I learn better I guess." IP7 shared how he felt it was important they were exposed to such technology, "I don't want to abandon the textbook. But, at the same time, we should be introduced to those [software] because that's what we will be using more in the real world."

The participants expressed how important these visual and hands-on experiences were for their learning. These concepts are further reviewed in the analysis chapter. The following section describes the participants' experiences of technology for used homework and studying.

4.3.2.2. Use of Technology in the Homework Environment

The participants shared that most of their large lecture classes, including CGT 164, were accompanied by a class website or on-line application. These on-line locations, such as Blackboard, offered access to course resources. The participants described on-line applications as tools to find information about their classes. In CGT 164, the participants had a website that provided them with a syllabus, weekly class schedule with assignments, and quick links to additional resources. “The online stuff is mostly information about the class, like the syllabus and schedule, and then submitting homework online,” described IP7. He further described the use of on-line applications such as Blackboard as, “mostly just receiving information. Whether about exams or homeworks, exams, and labs. And actually, I think, what technologies to use for labs and for homeworks, whatever.” IP1 described her experience of explain to her father how convenient Blackboard was for her to look up grades:

Especially, I think it’s useful for when you are trying to find your grade and stuff to. Cause I know I was telling my dad, you know, I would go online and check and see what my test grade was. And he would say, “I remember when I was young and at Purdue back in the day and we had to go and check on the sheet, and you would get so nervous trying to find your grade on there and whatever.” Now you just go online and check it out, though, which is cool.

In addition to providing course information, several participants discussed how they used on-line resources to study and practice key concepts and problems. IP9 expressed:

They have different resources for different courses. So, like, if I were to take a Spanish test this week, they have Spanish exercises on top of the homework I have already completed. And the same for math. They have past exams and stuff on the website.

The participants used these additional on-line resources to aid them with their studies. IP1 described taking practice quizzes to help study for exams even though she would not receive credit for them.

Some applications described by participants provided sample problems with walk-thru explanations. Students could check answers and application would show them where they were incorrect. IP1 described how she felt this was helpful to her:

Cause, especially in math classes and science courses in engineering you could answer questions and then they would tell you if you were wrong or not. And then they would tell you how to fix it or they would tell you what you did wrong and you could try it again and multiple submissions instead of using a textbook where you don't know if the answer is right or not. That was helpful for me, especially Owl in Chemistry that was really helpful.

IP3 preferred the use of software to help with his studies. He felt the use of software programs showed more in-depth examples and how to structure formulas to help solve problems. "Yea, I think it's a lot better than just going out of a book because out of a book there is one or two examples. And with this it's like you can almost use their formula their structure exactly how they did."

Similarly, IP6 preferred on-line homework applications over traditional methods:

...the online homework, those programs, I, personally... like doing homework better on the internet than I do writing it out on paper and turning it in cause its easier for me to keep all my notes and then not have to turn them into the teacher.

Organization was described as a key to the success of on-line applications. Several participants described on-line applications such as Blackboard as "easy to use" and "convenient." IP7 was new to the concept of on-line applications, "Purdue, it's a lot more online course stuff than I have been use to... It's easy to adapt to, hasn't been a difficult transition." IP5 described how some professors would show students how to navigate their on-line resources, "the professors, if they have, like, their online resources they'll go onto it and show you where they are at. And so that way you have a full understanding of how to find it when you get there." Other participants expressed frustration with some of their on-line application experiences. "For my geometrics class, maybe it's just the teacher himself, but, like, on Blackboard it's kinda everywhere. So it can kinda, all these different links and whatnot. And it kinda gets... time

consuming,” described IP8. He felt Blackboard could be better organized to be more efficient. While expressing how much he liked using Blackboard, IP9 also expressed some downfalls, “I think Blackboard is very good except the teachers don’t really update it that often. Um, and usually, I only get one or two grades on blackboard.”

This section reviewed the experiences and feelings the participants shared toward the use of technology within their lab and homework environments. Some participants, such as IP9, expressed a preference for technology over the traditional textbook and handouts:

I prefer using a computer over a book, but that’s just my opinion. Um, I do think both are very reliable sources. But, in my opinion, I think that we should just switch to technology and computers ‘cause it’s easier to use. And you just walk around with one little laptop instead of, like, books and papers and stuff.

This preference for technology ties closely with the defined characteristics of the Millennial generation. The following section provides an analysis of participants’ experiences as well recommendations based on the findings of this study.

4.4. Summary

This chapter reviewed the results of both the quantitative survey and qualitative interviews and observations. The quantitative survey, as discussed in this chapter, served to describe the population of CGT 164. It provided a method of obtaining the class demographics as well as important technological trends and characteristics which were compared to those associated with the general Millennial population. The qualitative results, obtained through the interviews and researcher observations, were presented in rich description. Composite description, combining both the participants’ textual statements and their structural meanings were weaved into a narrative describing the phenomena of how they experienced learning in the large lecture classroom. This same method was used to describe the participants’ experience of technology both within the

laboratory setting as well as the homework setting. The following chapter analyzes and discusses the meanings of these results. It also addresses the research question: How do Millennial engineering and technology students experience learning in the large lecture classroom?

CHAPTER 5. ANALYSIS AND SUMMARY

Addressing the purpose of this study, this chapter attempts to answer the question of how the participants experienced learning in the large lecture class setting. From the analysis of the data, the participants expressed that learning is a synthesis of three fundamental tools that large lecture classes employ. This chapter looks at the model, Figure 1, created based upon the data collected from the participants' experiences. The model depicts three separate tools employed in the large lecture class that together synthesize learning for the participants. The first tool, the lecture, provides an overview of the content material for the class. Technology utilized in lab, lecture, and homework environments is the second tool which fosters communication and visualization. Homework and study, the final tool, provides practice and application of the material concepts presented by the other tools. Each tool is reviewed in this section for its individual contribution as well as its influence on the other elements. Recommendations based on the results of the interviews and the analyses of the data are also provided within this chapter followed by a summary of the study.

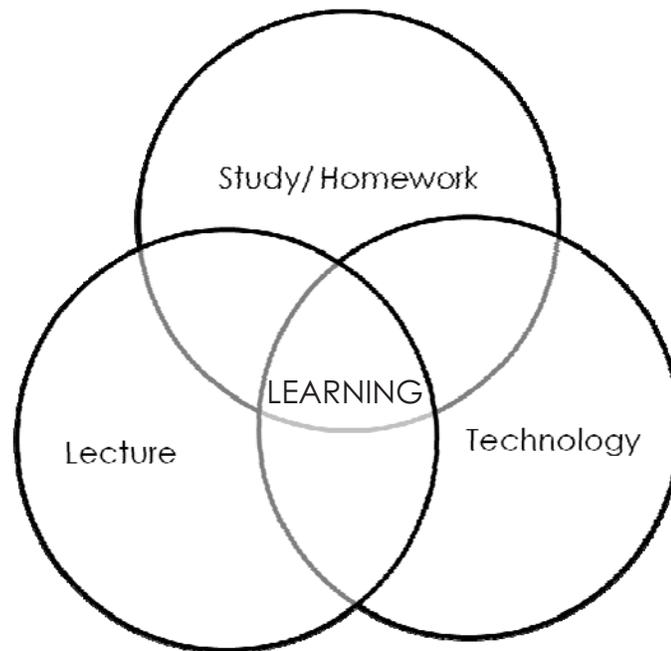


Figure 1. Tools employed in large lecture classes as experienced by the participants. Learning is a synthesis of all three tools.

5.1. Lecture as a Tool

The primary perception of lecture expressed by the participants was that it was a tool used to introduce new material to the class. IP1 expressed how lecture is not the most effective learning tool for her, yet it did introduce her to the relevant material, “for the most part, I don’t lecture is as helpful for me. But it is good for just like generally getting the idea of what we are learning.” In contrast, IP9 described lecture differently:

I think they are effective. It’s the only way to learn. Cause if you are paying attention to lecture then you are obviously wanting to learn. And if you are not paying attention then you are not going to learn. You are going to put it off till later. So, if you are paying attention during lecture you are going to learn.

Additionally, it was described that professors outlined key concepts and set expectations for what was expected be learned. IP2 described how he felt lecture helped him learn, "...just going over the material, and sometimes you have to teach it to yourself, but having a professor there who know what they are talking about, to tell you this is that for that reason." The participants expressed that they used lecture to take notes on important material outlined by the professor. IP5 describes his feelings about lecture as a tool:

I'll sit there and, um, pay attention to the professor and try to watch and see what they are doing so I can learn the material if we are going to have a quiz or go through the homework... I like to write down notes during the lecture and try to like copy things that stand out to me that will make me remember.

The words of IP7 appeared to summarize the overall opinion the participants' shared of lecture serving as a tool for introducing material:

The lecture does a good job of introducing the material. And then like the small recitations, the lab helps do a good job cementing it, resolving any problems or questions... If there is one person who has a question you just don't stop the whole thing. You keep going. Introduce all the new material as planned. It's not stop and go.

Lecture was also described as a tool for preparing students for labs, homework assignments, and examinations. IP2 described how he used his lecture notes for further study; "I highlight my notes a lot and go back through them later. And study them basically." The participants described some of their professors writing out problems and walking the students through them step-by-step.

The professors delivered the content material in modules. This action by the professors was favorable viewed by the participants. IP9 expressed this feeling:

Well definitely chapters are going to help you learn, because it's just a small base of material. You aren't having to learn so much, so. And the way that they go over it in lecture is actually pretty well laid out. They have different slides and different explanations for things. And, so, they have it pretty well... done.

The lecture also provided students with exposure to technology through communication tools and application software. The presentation of material, whether PowerPoint, overhead, or other applications provided a tool for communication. This communication was important to convey ideas when lecturing to a big classroom so important material was seen by all. These tools offered visual communication to go along with the verbal communication by the professor. As discussed in the results chapter, the participants thought highly of the use of PowerPoint in the lecture.

Learning resources, whether videos, internet sites, software, etc. shared by professor through use of technology also conveyed concepts to students. These were other resources to help transfer of knowledge. The use of i-clickers for quizzes as described by two participants made it easy for students to receive quiz points during the lecture. Demonstrations by the professors helped the participants learn techniques they would utilize in lab settings. "I learn a lot from CGT. Just 'cause, watching him with AutoCAD is really good," expressed IP1.

The lecture provided a means for the participants to gain the information and skills they needed to successfully complete lab and homework assignments. As discussed in the results chapter it also helped to prepare them for examinations. While only one participant expressed that he felt the lecture was a strong learning tool, it was agreed upon by all participants that it was helpful in conveying information. The lecture overlaps with study/homework and technology tools as seen in Figure 2. Technology as a tool for learning is discussed in detail in the following section.

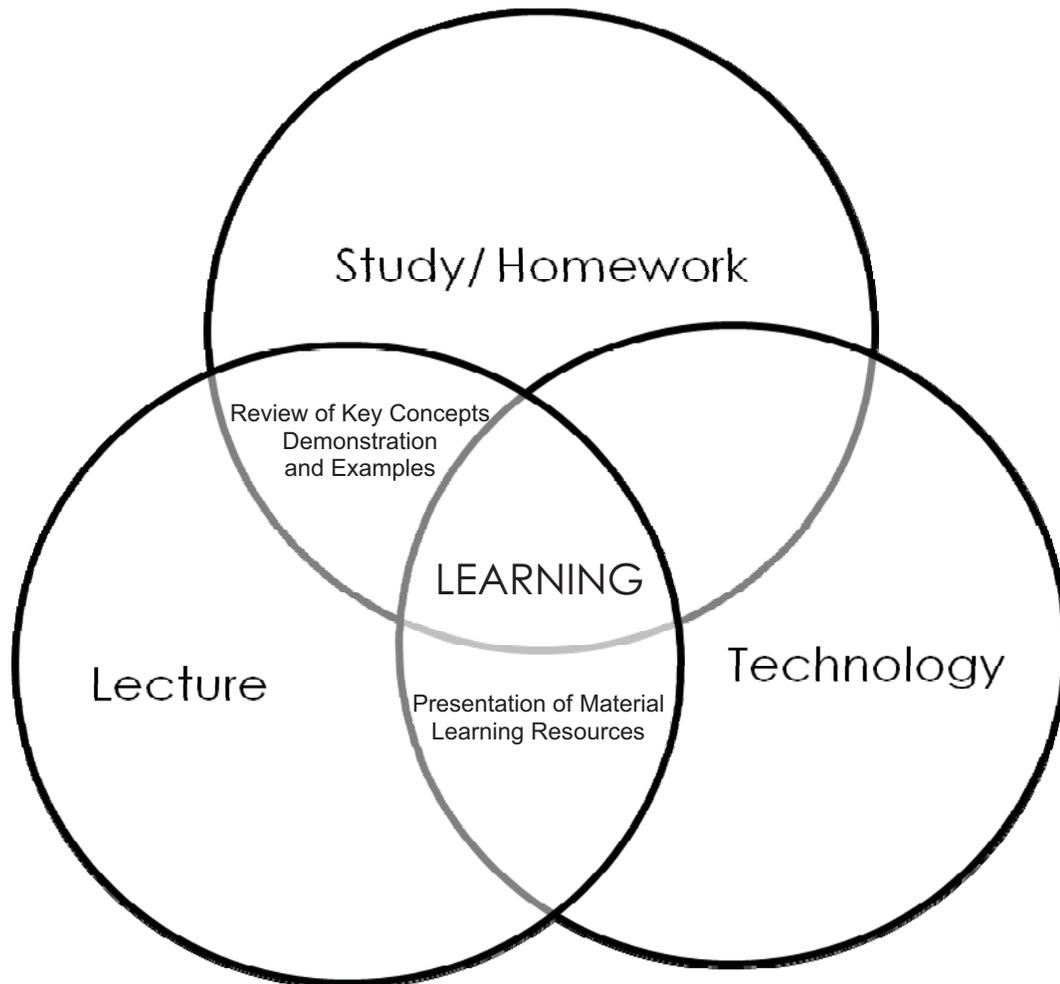


Figure 2. Lecture as tool influences both Study/Homework and Technology.

5.2. Technology as a Tool

Technology is the second tool utilized by the large lecture class. Technology was described as both a communication tool as well as a visual learning tool. The use of technology touched all modules of the class, the lecture, lab, and homework. This section looks at how the participants experienced technology as a tool for learning.

The participants shared some of their experiences and perceptions of on-line technologies used in their classes. Web sites and on-line applications such as Blackboard provided the participants with a connection to the class outside of the classroom. These sites and applications provided resources readily available to the participants. When designed well, as described by the participants, these applications provided a one-stop shop for all their needs. The participants expressed a preference for these applications. They discussed using extra tools and sample quizzes to help study from even when they were not required to use them. Having access to past exams and links to other resources was appreciated by the participants. They liked the ease of use and breadth of resources these applications afforded them.

Another application of technology, associated with lab assignments, was as a tool to help the participants apply their knowledge. As described in the results chapter, the participants expressed that some programs offered visualization to aid in learning. Several of the large lecture classes discussed by the participants involve lab portions where they worked on lab assignments that showed application of concepts introduced during lecture. It was in these lab environments that the participants experienced many the software and programming applications.

Course software as described by the participants provided visualization for clarification and understanding of concepts. It offered hand-on application of concepts introduced during the lecture. The use of software to create “experiences” has been defined as a learning preference of this generation. When asked about how technology helped him learn, IP5 expressed, “I feel that it does help me learn. I think that, more with AutoCAD, that it’s a hands-on experience and that’s how I learn better, I guess.” IP2 described himself as a visual learner, “I’m a visual learner so I like to see things in front of me.” IP8 also described his preference for visualization, “I like pictures. Pictures or visualizations.”

Both IP1 and IP7 described how they liked Python used in their physics class to help visualize solutions. As IP7 expressed it, “I really like the Python in physics because it’s taking the material that we are learning in class, like the gravity and the springs, and we are actually being able to see and model that without doing calculations tediously.” IP1 described Python:

Python helped you visualize, to view what is going on and enter in different code and different information to make objects do different things. So it was a way to experiment without actually experimenting with objects. I think that was pretty cool.

Similarly, IP9 described how he felt AutoCAD and Revit offered visualization that would help him:

I think it’s a good program and once we start getting to like 3D models and stuff like that, I’m sure it’s a lot easier to visualize than if I was to like draw a 3D shape model on piece of paper. Cause you are able to move it around and see all the different points and areas and stuff.

IP6 described the visual aspect of using software appealing. He enjoyed seeing a completed product after solving a problem. He felt it offered a sense of completion.

The combination of technology experienced during the lab portion as well as those they experienced completing homework assignments was a positive experience as expressed by the participants. IP5 felt that technology was the key to his learning. “I think technology is pretty much what helps me learn. Just overall, 'cause it gives you another source where you have the teacher teaching you and it just adds on to help you process the stuff even more.” Technology, described as both a tool for communication as well as visualization, influenced the lecture and study/homework tools as seen in Figure 3. The third and final tool, study/homework, is discussed in the following section.

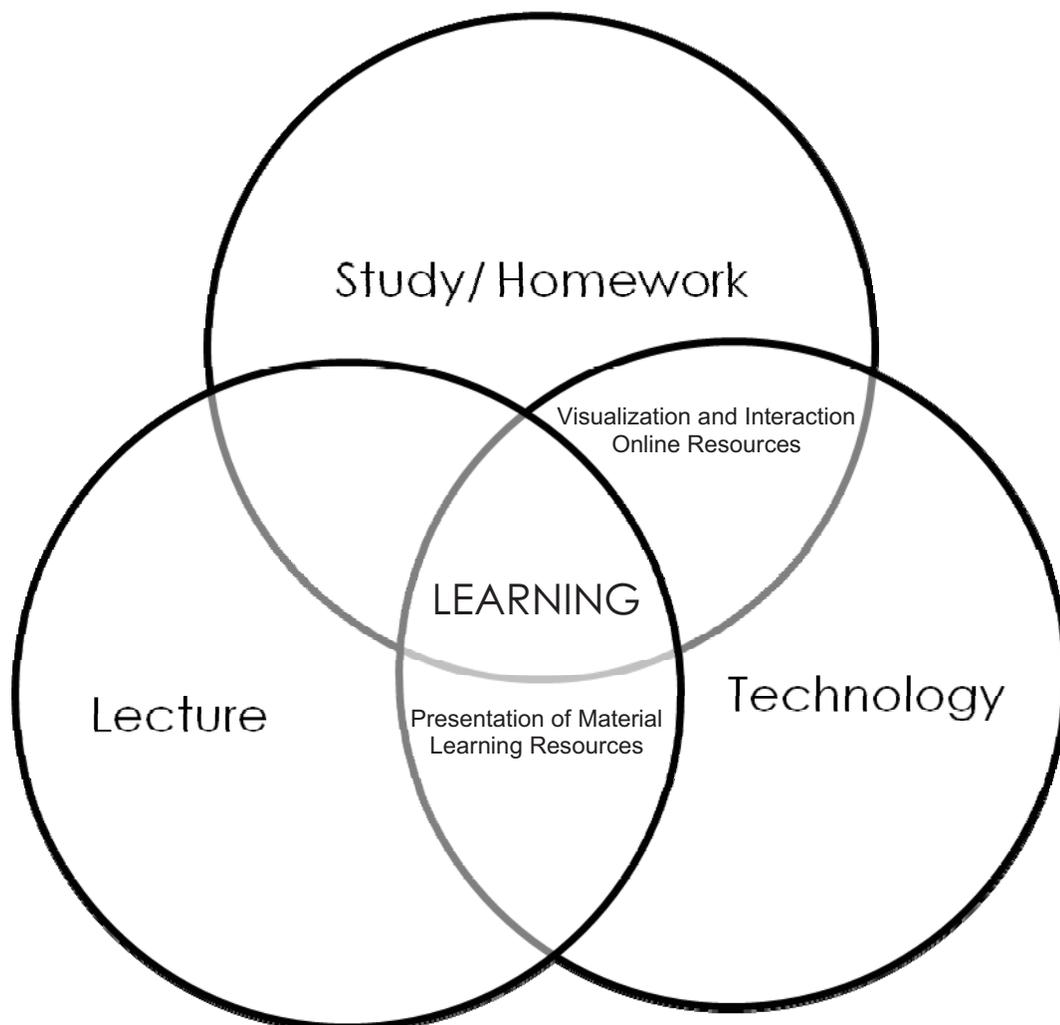


Figure 3. Technology as a tool influences both Study/Homework and Lecture.

5.3. Study/Homework as a Tool

The third and final tool of the model is the study/homework component. Homework, with methods described by the participants as both traditional

problems via book and also online applications, was where learning was cemented. According to IP4, “you really have to do homework and stuff to really understand it, either on your own or study other ways.” IP6 expressed that homework involved more than simply solving problems. In his words, “there’s a lot more behind the scenes when you are trying to do homework.” IP1 described homework as a method of studying, “I rely mostly on homework to study for things. So, I mean, that’s my study time really.” She goes on to explain how lecture provided the overview but homework was where she felt she really learned the material:

I think homework is most effective tool for me. I don’t really find lecture that helpful. Um, maybe in some classes, like chemistry, I thought lecture was helpful because I would get a brief overview of what we were talking about and then I would go home and really get into what I was learning with homework and stuff.

While participants IP1, IP4, IP6, IP7, IP8, and IP9 said that their learning occurs through homework application or on their own studying, they also expressed that they were first introduced to the concepts during the lecture setting. Through repetition and practice, the participants felt they really learned the material.

Applying effort and self-studying were also mentioned by the participants as to where their learning occurred. As IP9 expressed, “It also just depends on the amount of time that you put in.” IP1 shared a similar view, “I have teachers to teach it. It is not so much the teacher teaching, it’s the student giving the effort to learn the material and stuff.” When IP8 discussed where his learning occurred he said, “A lot of times it’s just from my own studying.”

The idea of homework and study was expressed by the participants as where the majority of their learner occurred. As discussed, the lecture played an important role introducing the necessary material for the participants to succeed in their homework assignments. Technology, as previously discussed, whether through homework applications or lab experience, provided further resources for learning. Figure 4 depicts the full learning model with all tools and influences

shown. The following section reviews the three components that comprise the learning model.

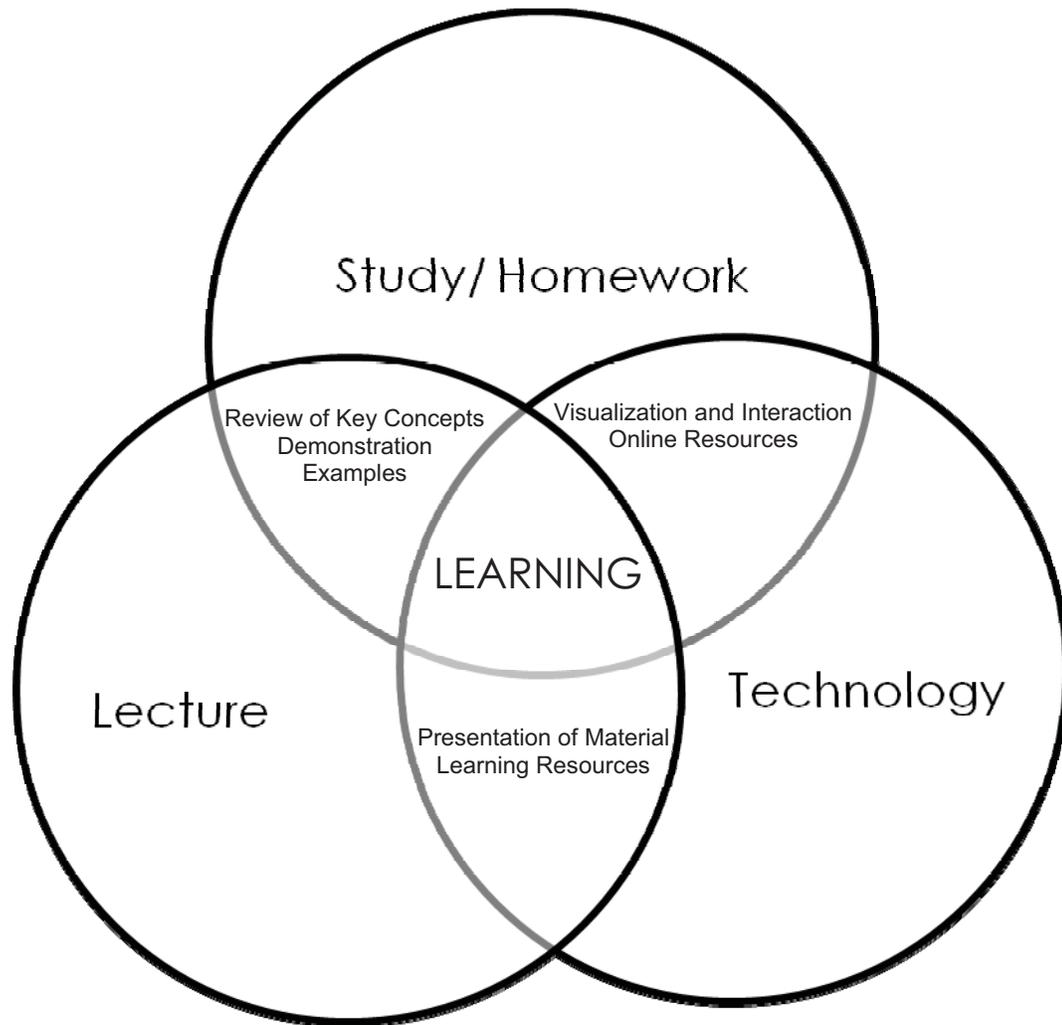


Figure 4. The three tools employed in large lecture classes as experienced by the participants. Learning is a synthesis of all three tools.

5.4. Review of Learning Model

The learning model discussed in this section employed three separate tools utilized within the large lecture classroom. These tools: Lecture,

Technology, and Homework, work together to synthesize learning for the students. As discussed in the Results chapter, the participants expressed the importance of each tool, though not labeled as such, and how each contributed to their learning. The Lecture tool provides a review of key concepts and offers a forum providing demonstrations and examples of applications. The technology component of the model provides an avenue for delivery of content material as well as additional resources such as software applications that facilitate learning. Finally, the Homework tool provides application and practice of concepts reviewed during lecture as well as interaction with technology. The following section provides recommendations based on the findings of this study.

5.5. Recommendations

This section discusses recommendations which emerged during the study. Prior to this discussion, limitations on the recommendations are provided.

5.5.1. Limitations

It should be noted that the following recommendations are based on the participants' perceptions and experiences as recorded in this study. The data collected for this study focused solely on large lecture classrooms and did not compare or review other teaching methods. Furthermore, the participants' perceptions and experiences may not be representative of true learning and retention.

5.5.2. Recommendations from Findings

Three recommendations emerged from the findings of this study. The first recommendation involves using technology during lab sessions to create learning experiences for the students. The participants expressed strong feelings towards the use of technology within their lab portion of the class. They described how

they used the technology to visualize concepts. The participants also described themselves as visual learners which is a key characteristic of the Millennial generation. These experiences within the lab setting seemed to speak to their preferred learning style. One recommendation based on the results and analysis of this study is to continue to incorporate lab session along with large lecture classes. Integrating technology which provides visualization or creates a simulated experience provides a key component to the participants' learning. It complements the material learned in lecture. Integrating industry software further prepares students for the marketplace.

The second recommendation directly expressed by the participants is providing lecture materials or outlines for students on-line. Providing an outline of the content material provides an overview of the lecture for the students. It helps to set the frame of mind for students who want to review the material prior to class time. Focus would still remain on the professors while they explain and demonstrate the content material. Providing full lecture notes ahead of lecture period would allow professors to review the notes with the class and possibly have more time to walk students through explanations and examples since the students would already have access to the notes for early review. Some of the participants shared the concern that they miss important concepts when they are trying to take notes during lecture. Posting lecture notes on-line helps the participants follow along with the professor. The participants also discussed utilizing the lecture notes posted on-line by some of their professors as study tools. One participant expressed the concern of lower attendance if professors posted lecture notes on-line. Utilizing technology such as i-clickers during lecture to record attendance or quiz grades offers one possible solution for this concern.

The third recommendation is to successfully integrate the use of on-line applications such as Blackboard to provide additional learning resources within classrooms. As pointed out by some of the participants, organization is the key to these applications. Navigating such applications and using on-line resources is strength of this generation. Several of the participants discussed a preference for

on-line resources used as learning and study tools. The participants expressed positive experiences with tutorials and step-by-step examples posted by their professors. They discussed their motivation to use these resources even though they were not a requirement of the class or assignments for credit. Fully utilizing on-line applications to provide experimentation, problem solving, and visualization would further aid the students in their learning.

5.6. Summary

The purpose of the study was to document and analyze how Millennial engineering and technology students experience learning in large lecture classrooms. To help achieve this purpose both qualitative and quantitative methods were used for data documentation within this study. The semi-structured interviews provided in-depth discussions with participants where they discussed their perceptions toward traditional teaching methods employed in large lecture classes. These participants also shared how they experienced technology within large lecture classrooms. The data collected from these interviews were analyzed and discussed. From this data, a learning model depicting how Millennials experience learning within the large lecture classroom was created. This model employed three separate tools utilized within the large lecture classroom. These tools: Lecture, Technology, and Homework, worked together to synthesize learning for the students.

The findings from this study were analyzed to help identify whether change is needed in the large lecture classroom structure. Three key recommendations based on the findings of this study were provided. The first recommendation involved using technology during lab sessions to create learning experiences for the students. The second recommendation was to provide lecture materials or outlines for students on-line. The third recommendation based on the findings of this study was for professors and

instructors to successfully integrate on-line applications such as Blackboard into their classrooms to provide additional learning resources.

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APPENDICES

Appendix A. IRB Approval and Participant Information Sheet

Participant Information Sheet

Research Project Number _____

RESEARCH PARTICIPANT INFORMATION SHEET
How Do Millennial Engineering And Technology Students Experience Learning Through Traditional Teaching Methods Employed In The University Setting?

Dr. Patrick E Connolly Ph.D

Liz Howard

Purdue University

Computer Graphics Technology

Purpose of Research The purpose of this research is to document how Millennial engineering and technology students experience traditional teaching methods employed in the university setting.

Specific Procedures Each interview will be audio-recorded and transcribed verbatim. These interviews will allow participants to describe and discuss their experiences of learning through traditional teaching methods used in engineering technology lecture classes.

Duration of Participation Approximate duration of interview will be between 10-20 min. Participants will only be asked to participate in one interview.

Risks Breach of confidentiality is a risk. Please review the “Confidentiality” section to view the safeguards used to minimize this risk.

Benefits No apparent benefits

Compensation Student volunteers from CGT 164 will be eligible for extra credit.

Confidentiality The project's research records may be reviewed by only by the primary researcher, Liz Howard, and the primary investigator, Dr. Patrick E Connolly, and by departments at Purdue University responsible for regulatory and research oversight. Only the primary researcher will have access to the audio-recorded data from the interviews. Once the data has been transcribed, the audio data will be destroyed. No names will be provided on the transcripts. Interview participants will be referred to as “Participant A”, “Participant B”, and so forth.

Voluntary Nature of Participation

You do not have to participate in this research project. If you agree to participate you can withdraw your participation at any time without penalty.

Contact Information:

If you have any questions about this research project, you can contact the primary researcher, Liz Howard via phone at 404-376-6625 or email at eahoward@purdue.edu or the primary investigator, Dr. Patrick E Connolly via email at connollp@purdue.edu. If you have concerns about the treatment of research participants, you can contact the Institutional Review Board at Purdue University, Ernest C. Young Hall, Room 1032, 155 S. Grant St., West Lafayette, IN 47907-2114. The phone number for the Board is (765) 494-5942. The email address is irb@purdue.edu.

Appendix B. Demographic Survey

CGT 164 Demographics

Please enter your name to receive extra credit for CGT 164. Your survey answers will remain confidential. Only your name will be provided to the instructor so he/she can award credit.

Study Topic: How Do Millennial Engineering And Technology Students Experience Learning Through Traditional Teaching Methods Employed In The University Setting?

If you would be willing to participate in a short 10min interview for this study, please provide your email address below.

Please select your gender:

- Male
 Female

Age range:

- 18 or under
 19 - 20
 21 - 22
 23 - 24
 25 or older

Major:

- CEM
 CE
 CGT
 BCM
 ID
 Other

Which methods do you use to stay in contact with friends/family? (Select all that apply)

- Phone
- Email
- Social Network (Twitter, Facebook, Linked-In, etc.)
- US Mail
- Other

What technologies are utilized in your classes? (Select all that apply)

- Textbook
- Internet
- Blackboard (or similar on-line application)
- Software Programs
- Other

Rank in order (1- favorite, 4- least favorite) your preferred method for doing homework and studying.

- Textbook
- Internet
- Blackboard
- Software Programs
- Other

How often a day do you spend using technology (computer, Internet, social media, texting, etc.)?

- Less than 1 hour a day
- 1-2 hours daily
- 3-4 hours daily
- 5 or more hours a day
- Never

Rank in order (1- most frequent, 5- least frequent) your uses for the computer, phone, and other technology devices.

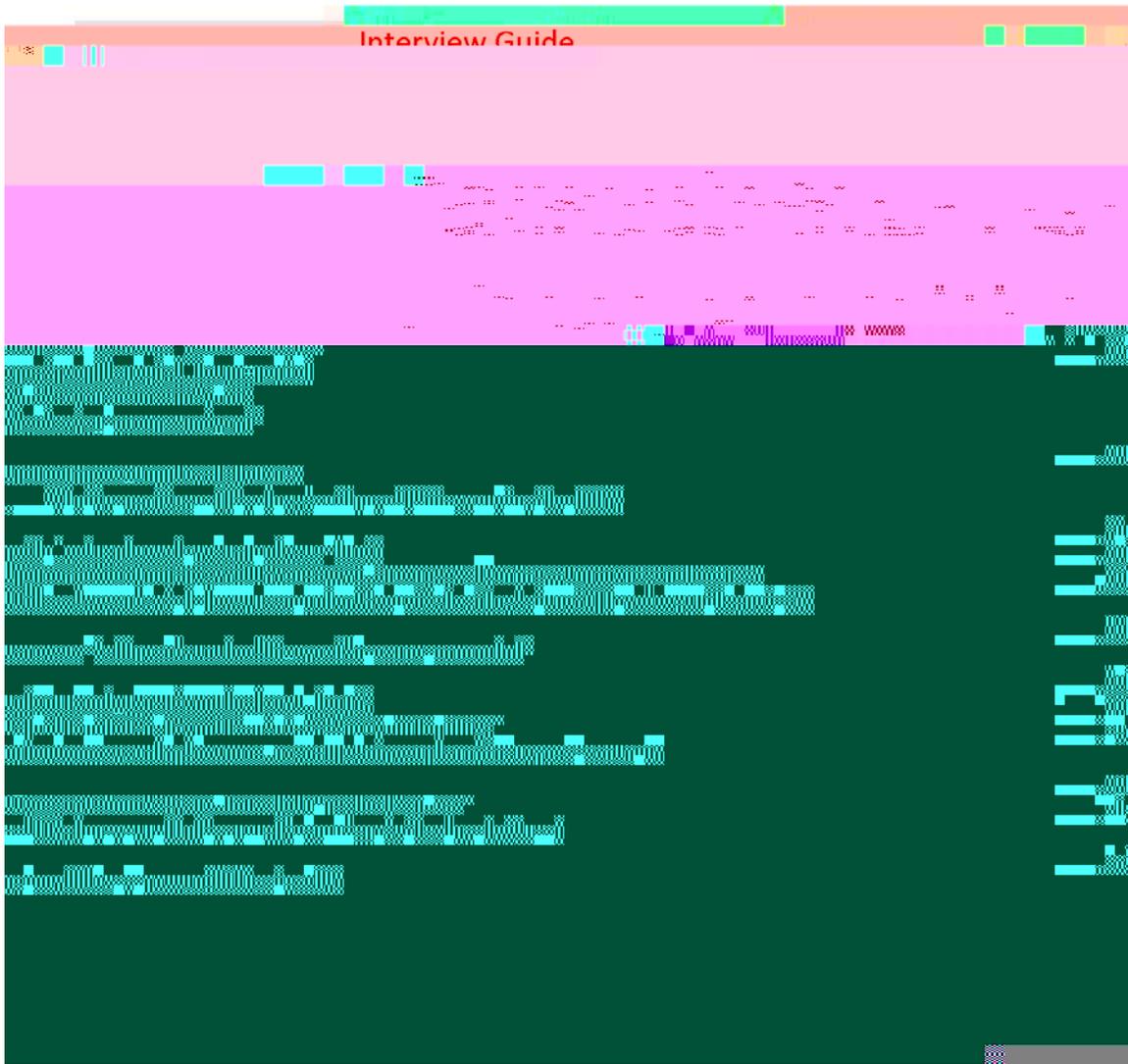
- Educational Purposes (homework, studying, etc.)
- Communication
- Entertainment
- Planning/ Time Management

Other

How much technology would you prefer to see utilized in your classes?

- Extensive Usage
- Moderate Usage
- Limited Usage
- On-line Class

Appendix C. Interview Question Guide



Appendix D. Sample of Researcher Observation Field Notes

Monday, October 25, 2010

3:26pm

- Talking/ Chattering all about
- Students sporadically placed
- Laptops out on desks, about every one in ten students
 - One student with Facebook open
 - One student with Blackboard open
 - Others have laptop open, but staring off into space, biting pens
- Cell phones – students seem to have cell phones out looking to be checking email or playing games
- Students are coming into the room, looking for friends, filling seats, sitting down and talking with one another

3:28pm

- Professor turns on the projector, it shows a single view of AutoCAD projected onto the large whiteboard above the chalkboards in the front of the lecture hall
- Most students are filling in the middle section starting three to four rows from the front. They fill the seats fairly evenly to towards the back of the hall
- Students are pulling out laptops, paper, notebooks, and pens

3:30pm

- The professor has lab 8 up on the projection screen
- Students are still filing into the hall from the large doors in the rear
- Chatter is getting louder in the hall, echoes throughout
- See some students reading the exponent

3:31pm

- The lights are dimmed by the professor as he calls to get started
- Professor begins to make announcements
- Students begin to quiet down
- Still a low chatter, but quieter than before
- Students still coming into the hall
- Most students are starting to pay attention to the professor, looking in his direction, not talking
- Still hearing separate conversations
- Lots of chair squeaking, find it louder than the chatter
- Hard to hear some of what the professor is saying, words get lost in the squeaking of chairs and low chatter
- Chatter is beginning to pick up, seems about one fourth of the students are talking to neighbors

3:35pm

- See sketching assignments on some students' desks, some students are working on them
- Some students are typing on cell phones
- Students around me are taking notes, there is some nail biting, some are watching the screen
- Hear chairs, coughing, low conversations
- Can hear a slight reverb on what the professor is saying

3:38pm

- Professor announces that he is going to give some dimensions that the students will need to complete their lab, lots of students reach into their bags to pull out notebooks and pens and laptops
- The sound increases as students move in their chairs to do this
- See some students frantically searching for writing utensils
- Most students seem to be engaged in listening to what the professor is about to tell them
- Students are writing down notes as the professor goes through the lab assignment. He is walking through it step-by-step
- Some students are drawing on their paper what the lab and dimensions look like as they follow along with the professor
- Some students with their laptops open have Microsoft Word open and look to be taking notes
- One student sitting around me has AutoCAD open
- Now that the students seem more engaged in what the professor is demoing, the sound of squeaking chairs is quieter
- There is still a low level of chatter that can be heard in the hall
- Most students seem to be looking forward watching the screen, pens in hand
- With each new step drawn by the professor, students around seem to take a note or draw out what the professor has just shown them

3:43pm

- Hear sniffing
- Hear a conversation
- Hear coughing, lose some of what the professor is saying
- See student turn to their neighbor looking to ask a question, write a few notes, and go back to looking at the screen

3:46pm

- Notice some students with earphones/headphones at the beginning of class still have them on
- Some students have not started doodling on paper, two students near me
- Hear the sound of squeaking chairs, starting to pick up again
- Professor continues to go through the lab problem showing the students how to create multilines that they will need to complete the assignment

3:48pm

- In front of me students are sparsely placed, ten students
 - One is sleeping
 - Two are taking notes
 - One has laptop open with AutoCAD working on the lab
 - Four are just listening to the professor, pens down
 - Two are playing on their phones
 - Five of the ten students have cell phones just sitting on top of their desk not using them

3:50pm

- Most students who I see with notebooks out are no longer taking notes, just appear to be listening to what the professor has to say
- Professor asks the class a question about what they see on the screen, the class answers back in unison, about 50% look to respond aloud
- Looking around, along the rows, most students are looking at the screen, one or two in the row may have their head back or down, some with their eyes open, some with eyes closed
- Hear low chatter, y mostly hear or their, may be students asking questions of neighbors

- Professor starts explaining about how to create doors for the assignment. He walks them through step-by-step
- Students start to take notes again, writing down notes with each new step he announces
- The professor starts to give codes and standards of what are appropriate sizes for the doors to be used according to industry standard, some students write this down

3:56pm

- The professor asks how thick a door should be, some students respond verbally or turn to their neighbor to ask if they know
- One student near me begins to pack his bag. He walks out of lecture.
- The professor begins wrapping up with the final steps of the lab. As he does this, the noise of chairs starts to pick up. The low chatter begins to increase. Can now hear the zipping up of backpacks

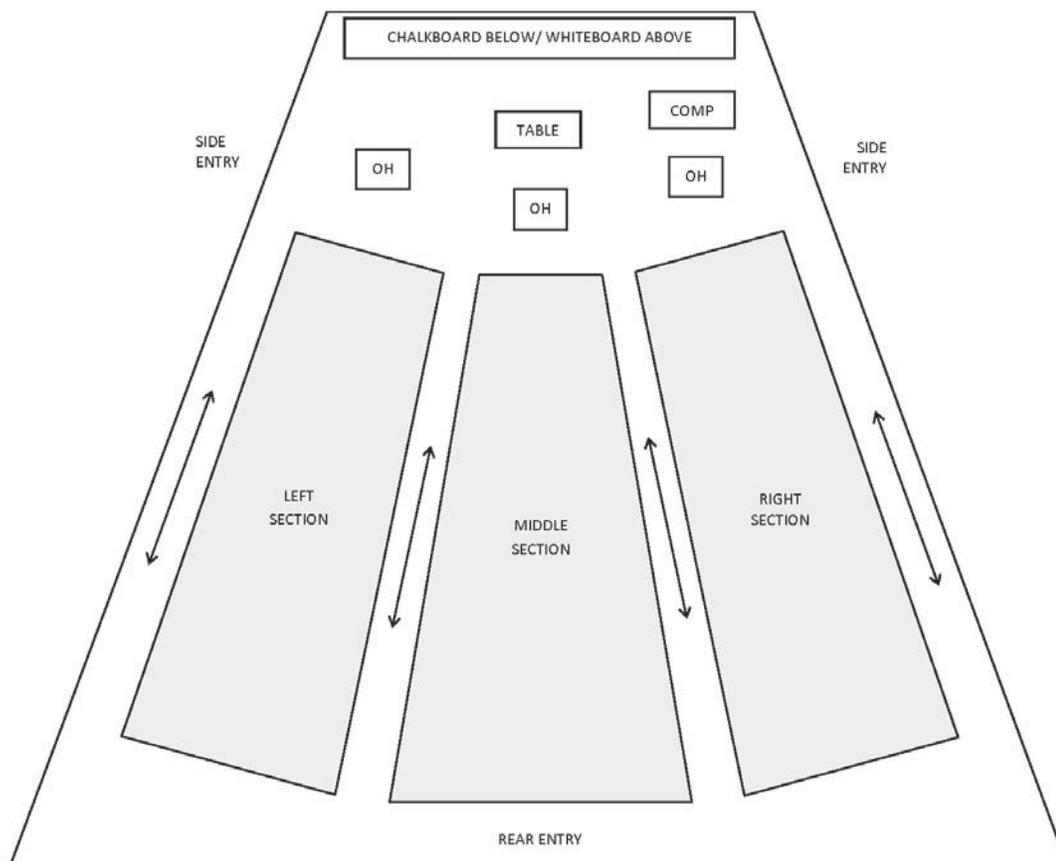
3:59pm

- Professor tells the students that he is changing the dates of when the lab assignments are due
- Students are talking with one another and the noise level increases
- The professor pulls up the course website and show where the students can locate the PDF document they will need for lab 9. He reviews the document with the class
- As he does this, the noise level seems to dull a little as he continues with his explanation
- Students lean forward on their desks looking at the screen seemingly engaged in what he has to say
- One student in front of me is taking notes on a printed copy of the document the professor is reviewing

4:05pm

- The professor flips the lights back on and tells the students they may meet with their final project groups if they wish. He announces that the lecture is over

Appendix E. Researcher's Sketch of Classroom Layout



Appendix F. Participant Interview Transcripts

Interview 1

R: We are going to begin by talking about the use of technology in engineering classes. What types of technologies have you encountered in your classes here at Purdue University?

IP1: In engineering we use a lot of technology. We used Matlab. We used OWL online. We used Web Assign, Blackboard. A lot of different, um, websites to do our homework and stuff like that. I think even in, what was it, we use Python in Physics. And then, now that I am a BCM major we don't use as much technology. We use, let me think, we use Excel in BCM175. And I think, I mean I use Word. Um, In CGT, though, we do use AutoCAD, so that's where I have been spending most of my time on the computer. But besides that, I don't use much technology.

R: OK and you did include what classes you use these technologies in which was my next question. Can you tell me a little more about for what purposes these technologies are used for?

IP1: Yea, most of them are to get homework done, or, um I forgot, in my BCM100 class we do this online discussion boards on Blackboard. So we do that. Um, I'm sorry, what else did you want me to say?

R: Um, I was asking about the purposes.

IP1: Ok, yea, online discussion, completing homework assignments, submitting homework assignments. Um, in AutoCAD to do drawings on the computer. That's about it. Oh, yea, and in one of my classes we take online quizzes and that kind of prepares us for the tests. And I don't, there not really mandatory and I don't know if you really get points for them. But if you go through them, um, a certain amount of times you can be better prepared for the test. So I do use that a lot.

R: Great, so would you say you are satisfied, or are you satisfied with technology, your experience?

IP1: Yea, yea. Especially, I think it's useful for when you are trying to find your grade and stuff to. 'Cause I know I was telling my dad, you know, I would go online and check and see what my test grade was. And he would say, "I remember when I was young and at Purdue back in the day and we had to go and check on the sheet, and you would get so nervous trying to find your grade on there and whatever." Now you just go online and check it out, though, which is cool. And there's a lot of, it's really convenient too, like, I don't know, being able to do everything online. 'Cause, especially in math classes and science courses in engineering you could answer questions and then they would tell you if you were wrong or not. And then they would tell you how to fix it or they would tell you what you did wrong. And you could try it again and multiple submissions instead of using a textbook where you don't know if the answer is right or not. That was helpful for me, especially Owl in Chemistry that was really helpful.

R: We are going to switch gears a little bit and talk about technology that is used in the large lecture based classes and your experience of the lecture. So how would you describe a typical engineering/BCM/technology large lecture format class?

IP1: Um, I would say, typically, you are going to have a PowerPoint and, yea, mostly just a PowerPoint and the teacher will have visual aid and will have problems up on the board. And they'll compliment that with extra problems later on, and dry erase board or something but, yea

um. I know in Physics we had clicker quizzes, we would have those on the PowerPoint and they use that technology to get quiz points.

R: Can you tell me what percentage of the class is lecture given by the professor?

IP1: Oh, lecture, um, what do you mean?

R: Where they are actually providing information to you, talking about the topic.

IP1: Instead of just making you read the PowerPoint?

R: Yes

IP1: I would say 100%. I mean, most professors just don't show you the slide, they read them and usually speak with it and you'll have quiz points on the PowerPoint. PowerPoint is helpful especially if they put it online cause then you can use that to study for a test. I have found that really helpful for chemistry cause they would have a lot of test questions from the PowerPoint slides in class.

R: During the lecture, how do you spend your time?

IP1: Um, depends on the class. If, um, I find that I learn a lot in lecture, and a lot of the information on the test is from lecture, then I will pay more attention in lecture. So, in CGT I find it's not as useful to pay attention in lecture. So I do my drawings or something in lecture. Because in high school I took a drafting class, in high school, so I already knew how to do isometric drawings and stuff, so I didn't pay as much attention and stuff during those lectures. But if he was starting to talk about the midterm or something else, I would start paying attention.

R: OK, so what percentage of the time would you say that you are engaged or paying attention to the lecture? In your other classes too.

IP1: In my other classes too? Hmm... it just depends on the class. Maybe like 70%, not a lot.

R: What things do you do to kind of help you remember the content of the material that you learn in lecture? Such as taking notes or typing notes on a computer.

IP1: If the teacher doesn't give me review material, then I do take notes in class. Or, I will, I rely mostly on homework to study for things. So, I mean, that's my study time really. But in lecture, yea if I feel like the lecture offers a lot of information and stuff, I will take notes.

R: So what are your feelings about the delivery of the content material?

IP1: Uh, I like PowerPoint 'cause I am very visual. So, in physics we had a lot of demonstrations and that helped a lot. But, I like, in CGT I wish, maybe, he would take more time explaining how to do the drawings 'cause I feel like he does it very fast. And maybe spending more time explaining different commands and what they do or something. But, I mean, a lot of my classes, I have teachers to teach it. It is not so much the teacher teaching, it's the student giving the effort to learn the material and stuff.

R: Um, what about the lecture format helps you to learn? What specific aspects are beneficial to you?

IP1: Visualization. Like whenever a teacher draws something out instead of just saying it with words, I understand it. Or, like with math when they write the whole problem out and then they

show you step by step what's going on instead of just saying "ok, then you would do this..." 'cause I think different people learn different ways... visual...

R: So what about the lecture format is an obstacle to your learning?

IP1: Um, sometimes if the teacher goes off on a tangent then I do too. It's hard to get back. Um, so yea, if they are talking about a bunch of stuff I don't find that I need to know and then I might not pay attention and when they do say something I need to know then that's an obstacle.

R: Ok, so how effective for you do you think lectures are? For your learning that type of material?

IP1: Um, I, I think homework is most effective tool for me. I don't really find lecture that helpful. Um, maybe in some classes, like chemistry, I thought lecture was helpful because I would get a brief overview of what we were talking about and then I would go home and really get into what I was learning with homework and stuff so I would have kind of a brief overview and then get into my homework. But, I um, for the most part, I don't think lecture is as helpful for me. But it is good for just, like, generally getting the idea of what we are learning.

R: Ok, and you talked about types of technology that are utilized in the lectures which is PowerPoint and the quizzes, are there any others you can think of are utilized?

IP1: Uh, discussion boards, um..., oh and in physics, like I said, we use Python and Python helped you visualize, to view what is going on and enter in different code and different information to make objects do different things. So it was a way to experiment without actually experimenting with objects. I think that was pretty cool.

R: Well, do you have anything else that you would like to add to kinda talk about your experience in the lecture?

IP1: No, that's it.

Interview 2

R: We will start by talking about your use of technology in your classes as a whole here at Purdue. What types of technology have you encountered so far in your classes?

IP2: Um, in many lectures we use overhead projectors, and I don't know how to describe them but they show a picture, you have a piece of paper, clear laminate and that gets projected onto the screen. And then, um, I guess chalkboards.

R: How about, is this lecture, lab, or both in which you use these?

IP2: Both.

R: Any software, in your labs, that you are using so far?

IP2: Yes, in CGT 164 we are using AutoCAD 2010. And that's it.

R: That's it?

IP2: Yes.

R: Alright, so for the purpose of what you are talking about, the overheads and things, are those used to deliver content?

IP2: Yes, to show problems and explain. Just visuals and notes.

R: And, do you generally use these technologies often?

IP2: Yea, so it's there in every class.

R: Alright, are you satisfied with the use of this technology?

IP2: Yes, I'm a visual learner so I like to see things in front of me.

R: Alright, so we are going to kinda quickly switch gears and talk the large lecture class such as cgt164 that you are in. And, I'm sure you have been in several others probably. So, can you describe to me what a typical large lecture format would be? From beginning to end.

IP2: Students walk in, teacher starts off the class, and typically we will use an overhead projector as well as a microphone to speak to the students. And go throughout the material. Ask questions, make sure we, his or her students are paying attention and learning the material. And then class is dismissed.

R: Ok, what percentage of the class do you feel the teacher is lecturing, speaking to the students?

IP2: I'm going to say 100%, but I'm not sure how many of the students are actually paying attention.

R: Ok, are there times, um, that are there for students to actively participate in discussion with professors during a lecture?

IP2: In lecture, depending on the class, typically not. Students are always able to ask questions, raise their hands, stuff like that, but it is hard for a student to ask their own question.

R: During lecture, how do you spend your time?

IP2: I take notes and try to learn as much as possible.

R: Ok, what percentage of the time would you say that you are actively engaged, paying attention and taking notes?

IP2: 80 or more.

R: And, um, what things do you do to help you remember the content of the lecture?

IP2: If the PowerPoint or whatever in class is online prior, then I have that, review notes, look up whatever in the textbook.

R: And what are your feelings about the delivery of the content material?

IP2: Uh, it's very thorough. I do like PowerPoint presentations, they do have notes and to be able to read it and write in down myself as well as have a professor explain the material.

R: So you are satisfied with it?

IP2: Yes

R: Ok, um, what about the lecture helps you learn?

IP2: Uh, just going over the material, and sometimes you have to teach it to yourself but having a professor there who know what they are talking about, to tell you this is that for that reason

R: Do you feel that the lecture has any obstacles to your learning?

IP2: Uh, yea. Just the amount of people in the class it can take away from trying to learn, learning experiences, if you have a question it might not always get answered. And that's pretty much it. Just that there's a lot of people in the class.

R: And, um, how effective do you think lectures are for helping you learn?

IP2: I would say they are very effective but I prefer to learn in a smaller group, personally.

R: Ok and you discussed for me the types of technology that were used in the lecture classes, lectures and labs, and your satisfaction with that. Do you have any other thoughts or anything else you would like to add about your lecture experience? Something you may not have been asked?

IP2: Sometimes the professors do go a little bit fast and I may not have time to write down all the notes. Um, one class, OLS, the notes are online. I do prefer that but students would skip more class. I would like if there was another way to get that material besides just that lecture.

Interview 3

R: We will start by talking about your use of technology in your classes as a whole. What types of technologies have you encountered so far in your classes here at Purdue?

IP3: Um, mainly computers.

R: Ok, can you maybe tell me as far as what software you have used?

IP3: Just this year or all years combined?

R: Whatever you can remember best.

IP3: We, we've used Matlab, we've used AutoCAD, all the Microsoft products, a couple other ones for engineering last year, but that's about it.

R: Ok, for what purposes do you use this software?

IP3: We use this software mainly for homework assignments and in labs as well.

R: Ok and you mentioned Matlab, so is that one that you use, I guess, in homework to help you with problems or is it lab based?

IP3: Matlab is more homework based and you just, I don't know, I never really learned what to do with it.

R: That's ok, um, let's see, are you satisfied with the use of technology that you encountered so far?

IP3: Can you reword that?

R: Sure, do you feel that the use of technology such as what you are using for homework helps you in anyway? Does it help you with the homework, help you learn?

IP3: Uh, yea, I think it's a lot better than just going out of a book because out of a book there is one or two examples, and with this it's like you can almost use their formula their structure exactly how they did.

R: Um, so we will switch gears a little bit, and talk about lecture based classes, lecture and recitation. Can you describe for me what a typical large lecture class would go like, from the beginning of a period to the end?

IP3: You go in, you sit there, you watch a slide show, listen to the professor say the same thing.

R: ok, so what percentage of the time do you feel that the professor is lecturing to you?

IP3: Um, the whole time, like I said. And usually you almost don't need to listen as long as you take a look at the PowerPoint.

R: Ok, um, are there any other activities that sometimes go on during the lecture such as maybe student-teacher interaction or question time?

IP3: Um, there's usually, well usually in most classes the students have to go out of their way to raise their hand and ask but then, or ask after class. But then a couple professors ask during.

R: Ok, do you feel there are times when professors will walk through problems?

IP3: Yea, and a lot of the classes such as in engineering last year. In a lot of them we used technologies that are like not normally used. For the Matlab and AutoCAD this year, the teachers walk through it step-by-step a lot.

R: Ok, and during lecture, how do you spend your time?

IP3: Um, I spend my time taking notes, watching, listening.

R: Ok, what percentage of the time would you say that you are engaged or paying attention to the professor?

IP3: Um, it depends, sometimes, sometimes you get listening and to their stories and stuff. And most of the time I feel like I'm just reading off the slide and writing it down.

R: And, what types of things do you do to help you remember the content of the lecture?

IP3: Uh, I highlight my notes a lot and go back through them later. And study them basically.

R: Ok, so what are your feelings about the delivery of the material as far as the professor giving the lecture, the notes, and slides?

IP3: I've had a couple professors that were fun, like they told stories and stuff. And other ones just literally read it and it's just really boring and you don't even want to go in the mornings.

R: So you feel that a certain style of delivery for you is better than other deliveries?

IP3: Yea, yea.

R: Ok, what about the lecture format helps you to learn?

IP3: Um... (pause)

R: What things are done in lecture that you are helpful for you?

IP3: When they point out what's going to be on the exams and on the quizzes, I guess.

R: Ok, what about the lecture format causes obstacles to your learning? What things are done by the professors that you feel are not helpful to you?

IP3: Uh, sometimes they go a little too quick going over things and they don't cover things enough as they should or don't clarify if they need to.

R: Ok and can you think of other technologies that you used during the lecture class besides PowerPoint that you mentioned?

IP3: Not really, not in any of my classes.

R: And how satisfied are you with the use of technology such as PowerPoint that is used

IP3: Um, I think they're good. They help a lot and they are very informative and full of everything you need.

R: Ok, and is there anything else you can think of that you would like to add about the lecture experience or recitation, how you feel about it?

IP3: No, not really.

Interview 4

R: We are going to start today by your use of technology in your classes here at Purdue. What types of technology have you encountered in your classes?

IP4: Um, all sorts, from like projectors, slide shows to like writing on overheads.

R: Ok, and which classes do you use these technologies, which classes do you see different technologies in?

IP4: Uh, math is pretty much all overhead and basically most everything else is slideshows, projectors. Our engineering 195 has all sorts of stuff, projectors, laptops, everything.

R: Ok, do you use a lot of different software programs in labs?

IP4: Um, yea, some I guess. CGT, especially. Um, physics we use different ones.

R: And for what purpose are they used? To help with homework, with solving problems?

IP4: Um, well, for physics it for like visualizing what we are doing and CGT it just like doing the assignment. That's about it.

R: Ok, and um, let's see; are you satisfied with the use of these technologies in your classes?

IP4: Um, yea, for the most part. I think 195 uses a little too much. Sometimes it is just a little easier to pass out a sheet of paper than to go online, find it, change it, then like save it back in a certain place and like it is just so confusing and when stuff is down and isn't working.

R: Do you feel they, some of the ones you found more successful, do you feel they help you learn, help you visualize things better?

IP4: Yea, some.

R: Ok, we are going to switch gears for a little bit talking about the large lecture classrooms. Um, it can be large lecture or you can also think about recitation as well. How would you describe a typical lecture class period from beginning to end?

IP4: um, they would just talk about what's the new information in lecture and have iclickers for a quiz.

R: Ok, and what percentage of the time do you feel the teacher is actually lecturing or presenting material to you for the class?

IP4: Um, presenting information or presenting relevant information?

R: How about both? Tell me maybe a little bit about that.

IP4: Um, I don't know, I feel like that they give you information pretty much the whole time, like 90% or something. Um, not sure how much of it is like actually on the exam but some of it is just background information

R: ok, and I guess, what, are there any other activities that may go on, such as teacher-student interaction or group discussion that happens during lecture classes?

IP4: Not really

R: Any question, answer time?

IP4: No, um, 164 is probably the most I've seen questions asked and not even that often in like one class.

R: And is there a comfort level of asking questions

IP4: Yea, I mean it's kinda weird; you are in front of 300 people asking questions, so...

R: Ok, so during lecture how do you spend your time?

IP4: Um, listening, like I take notes sometimes but I find it's better to just listen and remember than to write stuff down. So, I do some of both

R: Ok, that kinda brings me to one of the next questions, what types of things do you do to help you remember, so is that how you try to retain information?

IP4: Yea, that's how I try. Just understand it instead of just notes then reading the notes

R: Ok, and what are your feelings about the delivery of the content material? Or how material is delivered during lecture?

IP4: Um, uh, it depends on the class obviously. Some are better than others. Um, I almost need a specific class.

R: So a class by class basis or professor by professor basis?

IP4: Yea.

R: What about the lecture format helps you learn? Which lectures do you feel are most beneficial to you? How are they organized?

IP4: Um, I learn a lot from CGT. Just cause, watching him with AutoCAD is really good. I don't really pay attention to the other one, like shapes and stuff, isometric thing. Uh, I learned a lot from calculus 'cause they just have all the information and I don't like to read the book. Um, I don't listen at all during physics 'cause our professors are horrible. Um, that's about it.

R: Ok, what, um, I guess, about the lecture format would be an obstacle to your learning? What happens in lecture that causes you to feel it is not successful?

IP4: Um, uh, I will sometimes get information that is, it doesn't really matter, I guess. So, I guess that.

R: How effective do you feel lectures are for helping you learn the content in which they present?

IP4: Um it's a good start. It's a good basis, but you really have to do homework and stuff to really understand it, either on your own or study other ways.

R: Ok, and what types of technology do you see are utilized during your lectures?

IP4: Slideshows, projectors, and overheads. Pretty much it.

R: And are you satisfied with those types of technologies?

IP4: Um, the overheads can be really annoying because they are old and sometimes they are like darker and gray and you can't see the corners and stuff. So, that could be better. And, I just came out of physics lecture, his slideshow is **awful** (*emphasis on this word*). He put like tons of equations and tons of words that were like completely filled it with all different reds and blues and different colors and it was just so confusing. So, I don't know, that was bad.

R: Are those slides, or is that information available to you in other formats to look at later?

IP4: Um, you can read the book but I think he has the slides online so you can go back and really read through it.

R: Ok, well, is there anything else that you would like to add or your feelings about lecture or anything I haven't touched on?

IP4: Um, I don't know. I'm good.

Interview 5

R: So today by talking about your use of technology in your classes here at Purdue. What types of technology have you encountered here in your classes?

IP5: At Purdue, I've used technology through the internet and AutoCAD program.

R: Alright, and, um, which classes do you use these different types of technology?

IP5: In CGT 164 we use AutoCAD and intro to Revit program. In a lot of my other classes we use a lot of online with blackboard.

R: Ok, and for purposes, do you use them to help with homework, to help with studying, or?

IP5: Most classes a lot of the worksheets and stuff you have to go online to find them. Teachers don't give them out. And like others, we have like discussions, you write in online so everybody can be connected together.

R: Ok, so to locate files needed for the class and you said discussion?

IP5: Yes

R: Ok, so you use these technologies, do you use these often? Weekly thing, daily thing?

IP5: More of a daily thing. I mean I'm using them.

R: And do you feel that using these types of technologies, the blackboard you mentioned, AutoCAD, does it help you learn any?

IP5: I feel that it does help me learn. I think that, more with AutoCAD, that it's a hands-on experience and that's how I learn better, I guess.

R: Ok, are you satisfied with the use of technology in you classes that you have?

IP5: Yea, coming from high school we didn't use technology as much but it's been a good experience here. I'm learning a bit more.

R: So you feel it is more, that you are using it more than you did in high school?

IP5: Yes.

R: Ok, cool, thank you. So we will switch gears just a little bit and talk about your experience of the lecture class and the technology you experience during lecture, large lecture classes. So would you walk me through what a typical lecture period would be like?

IP5: When we are at lectures, the professor would start out, he might gives us like a, well in our OLS class we have like an intro, just an ice-breaker video for everyday... kinda just loosen up the mood. And then we usually move into the, they usually have PowerPoint where they start taking us through a lesson and they will teach that way. And then usually they will have like a quiz they will go through on the PowerPoint at the end.

R: Ok, thank you, and, so what percentage of the class do you feel would be kinda the lecture portion where the professor or instructor is going over the material?

IP5: I think about probably 60-70% of class the professors are going through the material.

R: Ok, and then the other activities you described, such as the ice breaker and the quizzes, is that kind of, or what percentages would those take up?

IP5: Like 10-15%

R: And for your lecture classes, the different ones, do you feel that there is teacher-student interaction, maybe group discussions, or does it depend on class to class?

IP5: I think it depends more class to class. Some professors will get more students involved and have, like, different activities during their lectures to try to just show more of, just trying to teach us. Others just talk more the whole time.

R: Ok, so think more specifically of a large lecture class, when the class has more students, 100 or more students. Um, what do you see around you? What do you hear around you during lecture?

IP5: I think there are a lot of people who don't quite pay attention and are more toward the back of the room. They'll be like using cell phones, going off in just like a low constant chatter. But I don't know if they are not paying attention or talking about the lecture maybe.

R: And during lecture, how do you spend your time?

IP5: Um, I'll sit there and um pay attention to the professor and try to watch and see what they are doing so I can learn the material if we are going to have a quiz or go through the homework.

R: Ok, so I guess um, on average how often, what percentage do you feel you pay attention or are you engaged in the lecture?

IP5: Um, typical day I'm probably 80-85%. Depends if it is 7:30 in the morning or not.

R: And um, let's see, what things do you like to do to help you remember the content of the lecture?

IP5: I like to write down notes during the lecture and try to like copy things that stand out to me that will make me remember.

R: Ok, and what are your feelings about the delivery of the content material?

IP5: I feel that the professors do a good job. Like with the PowerPoint it helps show you a visual aid and makes it easier to understand than just them talking cause you might miss something.

R: So, thinking about the lecture format you have been describing to me, what do you feel helps you learn?

IP5: I think technology is pretty much what helps me learn. Just overall, 'cause it gives you another source where you have the teacher teaching you and it just adds on to help you process the stuff even more.

R: Um, what about the lecture format would you say is an obstacle to your learning?

IP5: Um, I think maybe like the really large lecture is more of an obstacle because you can get distracted from people around you, if they're doing stuff. But with the smaller ones there's more people like paying attention

R: So would you say its size, like the more size the more distractions?

IP5: yea

R: Ok, and um, what type of technology do you see are utilized during your large lecture classes?

IP5: Um, during the large lecture classes usually have, like, a computer with you if you want to like type down your notes. Or, like, a lot of people have like the phones that and other technology that can be looking up online if the notes are on there to follow through.

R: And what about the professors, what do they use? Do they use different types of technology in the lectures?

IP5: Yea, uh, the professors, if they have, like, their online resources they'll go onto it and show you where they are at. And so that way you have a full understanding of how to find it when you get there.

R: ok, now tell me how satisfied you are with the use of technology during the lecture

IP5: I'm about 85 to 90% satisfied. Um, some class could use more technology to teach us but I guess it depends on the class.

R: Ok, and can you tell me if there is anything you would like to add or talk about your experience, maybe something we haven't touched on?

IP5: I think I'm alright.

Interview 6

R: Alright, so we are going to start by talking about that you have experienced in your classes here at Purdue. So, can you tell me about the types of technology that you have experienced so far?

IP6: Um, well, in my first year we didn't use iclickers then we started using iclickers this year. And its good motivation to actually go to class 'cause in big lectures you get the feeling where you are not always learning something or you are getting distracted too much when you are in the lecture. And the overheads, make like, you can actually do stuff like right in front of your face and then it goes on the screen for everyone else to see. I think that's a useful tool.

R: That's pretty neat. Now, when you say overheads, is that something where you are doing it as a student or the professors are doing it?

IP6: Well, it's the professor using the overhead projector that goes onto the screen.

R: And, um, which classes do you experience these technologies in?

IP6: Um, well, a lot in CGT 164, and physics 218. And it was chemistry last year. And not so much math this year, but math last year, in like the bigger lectures, like math 159 and 161, they did a lot of overhead projectors and chalkboard

R: Ok, um, so do you use any other types of technologies like during labs that you have or homework or studying?

IP6: Well, like, the online homework, those programs, I, personally, I like doing homework better on the internet than I do writing it out on paper and turning it in 'cause its easier for me to keep all my notes and then not have to turn them into the teacher. And, we use other programs. I've used Matlab and AutoCAD and both of those have been easy for me to use 'cause I guess, it's , um, id rather be doing that than like actual homework problems. Like cause I get to see the results of I make something and it's just nice to finish a product and look at it.

R: Very cool, and do you feel you are satisfied with the use of technology you have seen in the classrooms, lectures, homework?

IP6: Yea, I think so.

R: Ok, kind of switching gears just a little bit, looking at the experience of like a large lecture class. Um, can you describe or walk me through a typical lecture period?

IP6: Alright, well, it start at on the :30. And then it's usually not 'till like five minutes later until like class actually begins, and then it's a lot of just speaking and you can't ask questions. And you're just supposed to write down notes and sometimes it's harder to just listen there and pay attention than to be paying attention but actually participate in class. And going through lecture, taking notes, and then sometimes there's examples or demos if you are using computer programs or any kind of math problem. And then, it ends.

R: Ok, so what percentage of the class time do you feel the professor/instructor is lecturing or teaching?

IP6: I would feel that I could mainly summarize most of the stuff in about half of the class time. And the other class time they're doing stuff that I already know and sometimes you do other things to use your time up.

R: What types of things do you see or hear around you while you are in lecture?

IP6: I hear in, it wasn't so bad in my other classes last year, but in physics 218 now its, there's a lot of talking going on while the professor is trying to teach. And that's like a class where you want to understand and it's really hard and distracting for me to try to listen to the teacher and then hear something in the background sometimes.

R: And then do any or do you remember seeing when looking around, can you tell what other students are doing around you?

IP6: Yea, there's people either listening or on their phones, or sleeping or the computer. But I mean I try to pick a quiet area in the back, not in the back where everybody's talking, but decently.

R: Ok, and during lecture, how do you spend your time?

IP6: In lecture, I spend my time taking that stuff that I don't know like seriously. And then if I already know something then I'll probably look at my phone for just boredom purposes.

R: Ok and what percentage of the time would you say that you are engaged or paying attention, like what you just described?

IP6: Like half of the time.

R: Ok, and what things do you do to help you remember the content of the lecture?

IP6: I write down the notes and then later on I'll go over them. And then last year I used to have a live scribe pen where I could take the notes and also record the lecture but I lost it. And I wasn't using it as much as I thought I would, so.

R: So, what are your feelings about the delivery of the content, like the material that the professor does? How do you feel about that?

IP6: It's not exactly what you're supposed to actually know. Like there's a lot more behind the scenes when you are trying to do homework, its not just equations. He goes over the stuff but doesn't actually tell you how to apply it all the time. We're just learning equations. I mean I haven't really had any other lectures besides like science and math, so I wouldn't know too much besides that.

R: Ok, so what about the lecture format helps you learn?

IP6: Um, I would say just knowing, I guess, having know that it's a Purdue professor and that I am here for, like, a good purpose and that I am actually trying to learn so gives me my motivation to learn and to pay attention. And then knowing that he is some sort of like high up and knowledgeable that I can trust him, most of the time.

R: Ok, now what about the lecture format do you feel is an obstacle to your learning?

IP6: Um, having so much freedom, I would say. I mean I could probably apply myself a lot more if it was like a single classroom

R: Can you describe or explain that a little bit more?

IP6: Yea, like, last year, in math classes we would have three lectures and two recitations and that was 159 and 161. This year I have math 221 and we have just three class periods and it's like an actual classroom size. And so we have, we go there and actually participate more and get a more like one-on-one experience and understand things more, 'cause like the class is figuring it out as a whole. And that's the one setback that bigger lectures have.

R: It doesn't have the interaction that you feel you have with smaller classes?

IP6: Yes.

R: Ok, and during your large lecture classes that we talked about earlier, what types of technology are utilized by the professors?

IP6: Um, some of them use like the PowerPoint. Or they have, well like in engineering 195 they had the new rooms with the whiteboard around the whole entire room and then different projectors around and I thought that was a great tool that they used and it was easy for everyone to see, to understand. And I had one class that used the iclicker like I said before. Besides that I think that they just use their own board, chalkboard.

R: Ok and how satisfied are you with the use of technology in the large lecture class?

IP6: I think it's good. It's a step forward and a big improvement in that its going to help a lot of people with like disabilities and its stuff that they can actually they have lectures that they can record videos and have them online and all the notes online. So I think it's a good step. It's more accessible to different types of people.

R: Ok, and is there anything else you would like to add your experience in lecture? Something I may not have asked about or questioned?

IP6: Not that I can think of.

Interview 7

R: So, I want to begin today by talking about the kinds of technology that you have encountered here in your classes at Purdue. Can you tell me about those?

IP7: Uh, at Purdue, it's a lot more online course stuff than I have been use to. Its easy to adapt to, hasn't been a difficult transition. Uh, in my physics class we have WebAssign and that's not too big of an issue until we get to something like your third guess. For engineering we use blackboard and iclickers, and those can be temperamental. And then, of course, CGT, well I guess AutoCAD and that's good to know as well.

R: Ok, so the classes you are talking about, like physics and the other places, for which you have used those types of technology, are they for, to help you with labs? With homework or with studying? Um, what are their uses?

IP7: The online stuff is mostly information about the class, like the syllabus and schedule, and then submitting homework online. But, like, in my physics lab we use P Python, which is nice to model solutions and in engineering we are actually learning programming languages and that's good to know.

R: Ok, do you feel that these different software and technologies that you use, do you feel that they help you to understand the material?

IP7: Yea, uh, I really like the P Python in physics because it's taking the material that we are learning in class like the gravity and the springs and we are actually being able to see and model that without doing calculations tediously.

R: Ok, do you use a lot of textbooks in these classes as well?

IP7: Oh yea. Um, physics we have the whole read along to do the homework. Engineering, its not as text based, which, I'm not sure. Its kinda my most annoying class. The one you kind of dread going to since you don't know what to expect. But, (pause) yea.

R: Um, are you satisfied with the use of technology in your classes so far?

IP7: Yea, I think there is a good balance. I mean, the class shouldn't be all online, all computers. I don't want to abandon the textbook. But, at the same time, we should be introduced to those because that's what we will be using more in the real world.

R: Ok, switching gears just a little bit. And we are going to talk about the large lecture class, technology that is utilized there and also your experience. So, can you walk me through a typical lecture period?

IP7: I only have, well I guess, physics; it's more of a big lecture hall. We've got like 50 kids in it. But we use iclickers, which are nice. And he has PowerPoints on the screen, and sometimes he brings out other demonstrations. But its, the PowerPoint is good to get the idea across and walk through an explanation.

R: Ok, what percentage of the class time do you feel the teacher or instructor spends lecturing or going over material?

IP7: For physics, the whole period. But for, and CGT the whole period. But for, like, history and my calc class there is a lot more interaction. Like question-answer, explanation.

R: Um, what types of things do you see and hear going on around in your larger lecture classes?

IP7: It's a lot less student-teacher interaction. We're just kinda sitting there absorbing the knowledge or at least trying to. And, it's a lot, it's a little distant. But, like, after class you can still go up and talk, which is nice. But other than that, there is kinda a separation, the teacher down at the podium, students up in the seats.

R: Ok, um, and you were talking about some of the classes you have, about time to ask questions. And you said that after class you have time to ask questions. Do you feel comfortable asking questions during class? Is that encouraged or discouraged?

IP7: Yea, like my history professor, Professor Fulley, he will often stop, at least like every five minutes, and ask if there are any questions. And, unfortunately, sometimes won't finish everything he had planned because we get caught off on a tangent.

R: Ok. How do you spend your time during lecture?

IP7: I pay attention. I'm not really a big note taker, but just kinda try to reconcile what he is saying with what's on the screen and my own previous knowledge.

R: And what percentage of the time would you say that you are engaged or paying attention to the professor during the lecture?

IP7: Most of it. I don't really have any distractions. I don't bring my laptop to lecture. It's just; he's the only thing I pay attention to.

R: And, what things do you do to help you remember the content of the material?

IP7: The homework.

R: And, do you ever notice what people around you are doing during lecture?

IP7: Yea. Sometimes I'll look to the side and there will be a guy doing the crossword and a group over there talking. But, most of the time I can avoid those distractions.

R: Ok. So, overall, what would you say your feelings are about the delivery of the content material? How do you feel about that?

IP7: The lecture does a good job of introducing the material. And then like the small recitations, the lab helps do a good job cementing it, resolving any problems or questions.

R: Ok. Um, overall, what about the lecture format helps you to learn?

IP7: I think, the whole, just keep going, not..., if there is one person who has a question you just don't stop the whole thing. You keep going. Introduce all the new material as planned. It's not stop and go.

R: So, having it continuous?

IP7: Yea.

R: And then, what about the lecture format causes obstacles to your learning?

IP7: The lack of, the lack of, well, stop and go.

R: So, for you, personally, how effective do you think the lectures are for helping you learn the types of material that they cover?

IP7: Been very effective.

R: Ok, and during large lecture classes, what types of technology are the instructors or teachers using?

IP7: For the ones in the big lecture halls they use the PowerPoints or the projectors. But for smaller lectures, it's usually just the chalkboard.

R: And are you pretty satisfied with the use of chalkboards in smaller lectures and PowerPoints in your larger lectures?

IP7: Yea. It makes it easy. It's a different environment for each one and those are the technology that suite the environment.

R: Ok. And you do you have access to some of the materials before or after class?

IP7: Yea. Physics is really good about posting the PowerPoints online after class. Engineering sometimes posts them. But, other than that, its, I'm pretty safe.

R: Do you ever go back and use the notes and slides that are posted?

IP7: When reviewing for a test.

R: Ok, is there anything else you can think of that you would like to add about your lecture experience or technology?

IP7: ITAP does a really good job of organizing everything, I guess. I mean, I'm not literate enough in technology to be able to do it all myself. But I like frequently ask questions and do whatever and I can usually figure it out. Or, if not, go over to the Stewart Center.

Interview 8

R: We are going to begin today by talking about your use of technology in your classes as a whole. Tell me about the types of technologies you have encountered in your classes here at Purdue.

IP8: All my classes?

R: Sure

IP8: I mean, uh, obviously computers. Some different, like, test machines in labs. Technology. And also software and stuff like on the computers?

R: Yes, software programs, internet, Blackboard...

IP8: Yea, all those.

R: So, which classes do you use specific technologies in?

IP8: Um, oh, obviously AutoCAD and computer for CGT. Um, is Word something you would consider as a technology?

R: Absolutely.

IP8: We use that, um, things like that for my classes. Actually, I was trying to remember one I used the other day for my lab report for geometrics. It was Corfind(?), I don't know if you know of it. Um, and then, but yea, the basics mainly, Excel and Word for lab reports. And, um, and AutoCAD for geo. And, um, technology, specifically, we use (?), I don't know if you would consider that, for surveying too. That's a technology too. And that's it.

R: Now are these, do you use a lot of the different software and technologies that you mentioned, are these to help you with lab? Supplemental to textbooks?

IP8: Not really supplemental to textbooks, but, uh, to backup your observations and to create another side of your observations.

R: Ok and you talked about using Blackboard. Do you use that in a lot of classes? How?

IP8: Yea, mostly just receiving information. Whether about exams or homeworks, exams, and labs. And actually, I think, what technologies to use for labs and for homeworks, whatever.

R: Ok, are you satisfied with the use of technology in your classes here at Purdue?

IP8: Hmm, for the most part. For my geometrics class, maybe it's just the teacher himself, but, like, on Blackboard its kinda everywhere. So it can kinda, all these different links and whatnot. And it kinda gets, uh, I don't know, time consuming. And not really frustrating, but just it can be organized better, I think.

R: Ok, um, switching gears just a little bit. Looking at your experience of large lecture classes such as 164.

IP8: Uh, huh.

R: Can you walk me through a typical lecture period, from beginning to end?

IP8: Just 164 or any?

R: Maybe any general lecture period you experience.

IP8: Big lecture-wise, they often start off with announcements about something new. And then you get right into the notes, um, whether there be lecture slides or videos or writing notes on the board. Yea, things like that. And then, it depends on the lecture too. 'Cause like Clark, he does the slides on one and do the, um, AutoCAD on another. So, a mix of how-to and things to get you to know, material to learn.

R: Ok, how much, what percentage of the class time do you feel the teacher or instructor spends lecturing or going over material?

IP8: Hm, I mean for him, its, I mean most of the time. I would say about 90%. For others though, like my dynamics teacher, he kinda goes slower and kinda makes lots of jokes in-between, so it's more like 70 maybe 65. I mean, when he does teach the material it's good. But, I don't think he uses his time as efficient as possible.

R: Ok. You talked about announcements sometimes at the beginning of lecture. Are there other times for group discussion or interaction or questions during lecture?

IP8: Um, not devoted specifically to them. I mean, you are allowed to raise your hand and ask a question, but I guess the bigger the class the harder that becomes. Because people get more intimidated by it, I have no idea.

R: Um, when you are sitting in lecture, what kinds of things do you see going on around you? Sounds that you hear around you?

IP8: Uh, I mean, some people might be taking notes on their computers or on paper or just listening. And then others just randomly talking. Might be actually doing homework like the drawings. But some of the time people will just be talking.

R: Ok, during lecture, how do you spend your time?

IP8: I, I write my notes.

R: And what percentage of the time would you say that you are engaged in the lecture, paying attention?

IP8: Probably just under whatever the percentage is of the speaking is, covering the actual material stuff. But then, I don't know, minus 15% because of like people talking and I get distracted or people do something and I get distracted or, um, maybe miss something and you need to ask somebody a question so that takes away a little bit too.

R: Ok, Overall, what are your feelings about the delivery of the material during lecture?

IP8: It depends on who is teaching it, really. I mean, sometimes in, um, chemistry I don't really, or even math, I just didn't get the stuff because they're flying through the stuff that, you know, 'cause they want to throw out a lot of information at once and I just didn't get it. Deliver could have been good, but I just didn't, I didn't see it too much 'cause I, I was trying to write it down.

R: So, it's really dependent on, as you said before, professor style of teaching and speed of delivery?

IP8: Yea.

R: Ok, what about the lecture format helps you to learn?

IP8: I mean, I like pictures. Pictures or visualizations. Um, I guess that's one good thing about the dynamics teacher, even though he doesn't use his time efficiently, he's a little slower so I can, like, kinda see the stuff as it comes. He's not like trying to crank through it so fast.

R: Ok, what about the lecture format is an obstacle to your learning?

IP8: I mean, (pause)

R: Or, are there any?

IP8: I guess it would only be if I was, just if there was so many notes that I had to write that I can't really learn because I have to write it all down. And then they don't have slides. Slides can help some too. Though sometimes that gets in the way too because if I print them out, I try to go through them. So there is kinda a balance.

R: Ok. How effective do you think lectures are for helping you learn the material that they are trying to teach?

IP8: I mean, truthfully, I haven't found lectures the most useful. I mean, I guess that's for homework purposes. 'Cause I don't really know what's, what I store in my mind for, like, when I get to an exam, I don't know what I draw from all the time. A lot of times it's just from my own studying. But, I don't really know from lecture what I take in and store for later. Or, often times I don't have time to go over the notes again.

R: Um, during lecture, what types of technology are utilized? You mentioned slides, are there others?

IP8: Um, we usually have chalkboards, screens, slides, internet.

R: And how satisfied are you with the use of those during lecture?

IP8: I mean depends on how the teacher sets it up.

R: And is there anything else you would like to add about your experience?

IP8: No thanks.

Interview 9

R: Can you tell me about the types of technology you have encountered so far in your classes here at Purdue?

IP9: Um, in my classes here at Purdue, I encounter many things such as things like computers and textbooks and other articles and magazines. And, I definitely believe that using a computer is the best way to be studying at Purdue, through all the different, um, programs that they offer, through the different courses.

R: Ok, you mentioned programs, um, how about internet technology?

IP9: Internet technologies, as in like?

R: Blackboard?

IP9: Ok, I think Blackboard is very good except the teachers don't really update it that often. Um, and usually, I only get one or two grades on blackboard. The rest of them are, have to do with the corresponding website. So like Spanish would be on the Spanish website. And math, math is going to be on the math website which makes sense. But I do think Blackboard is very good. 'Cause I used something like it in high school and middle school, so.

R: Ok and the technologies that you mentioned, um, for what purposes do you use them?

IP9: Um, well, they have different recourses for different courses. So, like, if I were to take a Spanish test this week, they have Spanish exercises on top of the homework I have already completed. And the same for math. They have past exams and stuff on the website. Uh, um, for CGT, and like, online they have different, they have all the homework assignments and then they have shortcuts and stuff. So every website can help you with what you need to do.

R: Ok. And looking at all the different technology types that you mentioned, um, is there a style that you prefer over another?

IP9: Um, I prefer using a computer over a book, but that's just my opinion. Um, I do think both are very reliable sources. But, in my opinion, I think that we should just switch to technology and computers 'cause it's easier to use. And you just walk around with one little laptop instead of, like, books and papers and stuff.

R: Ok. When you are using these technologies for homework and studying do you feel that certain types make it easier to understand or visualize certain information?

IP9: Um, I mean, I like to think so. Definitely anything online if I study it hard enough it's going to help me. The same with the book. It also just depends on the amount of time that you put in. And also online it's also a plus that you are able to print off something that's important. And so if you want to just read it off a paper instead of just scrolling through your computer, you can also do that. Which I think is very cool.

R: And you had mentioned before we started that you have AutoCAD. Do you feel that helps you to visualize?

IP9: Oh, yea, definitely. I mean I like AutoCAD and all. It's kinda a hard program for me seeing as how I never really used it before this. But I think it's a good program and once we start getting to like 3D models and stuff like that, I'm sure it's a lot easier to visualize than if I was to like draw a

3D shape model on piece of paper. 'Cause you are able to move it around and see all the different points and areas and stuff.

R: Ok. Are you satisfied with the use of technology that you have encountered here?

IP9: Um, yea, I'm very satisfied. I mean there's no problems. I'm glad I have a textbook that I can always go back to and then I also have things online that help me study for the tests. So, both of those combined work out pretty well.

R: Great. Ok, we are going to switch focus and look at the use of technology in engineering lecture-base class. I also want to ask you about your experience of the lecture class. So, to begin, can you walk me through a typical lecture period?

IP9: Just a normal lecture?

R: Yes.

IP9: Ok, I'm going to walk with my headphones, imp going to sit down. And usually it won't get started for a couple minutes. And we'll go over things that are due or things or things that you need to review, which is good because it reminds me of what I need do. And then he'll start going into the lecture and which I'll usually take notes unless it's on something that we already went over or something like that. But, I mean, sometimes they are pretty hard to go through though, 'cause I'm tired if I went out the night before or something, I'm going to be exhausted in class and I'm going to want to sleep. I think it's also good that most of the teachers put the lectures online so if you miss or aren't feeling well or something like that you can also go back and take notes on your computer, which is nice. But, definitely going to lecture is important and you need to do it.

R: Ok, what percentage of that class lecture time would you say that the instructors tend to teach?

IP9: Um, I mean, plus or minus five to 10 minutes I mean, five minutes to get settled in and then five minutes at the end when everyone's getting packed up and not wanting to listen anymore. He starts, they all usually start coming to an end. But, usually the whole time they are talking and teaching. So, it's not a problem.

R: Are there any interactions, student-teacher interaction, or group activities that will happen during lecture?

IP9: Um, not during lecture. Um, any lecture I've been to. I mean smaller classes like my Spanish class is 20 people so we are going to do different types of things and activities. So, if the classes are smaller. I've never seen activity done in a lecture before, though, so. That would be interesting.

R: Can you tell me about what sights, sounds, things you see around you during lecture?

IP9: Um, well definitely there's quite a few people sleeping. There's people on their phones. There's people on their computers doing other homework which I sometimes do if I have something due at the end of the day and I want to work on it. I will bring my laptop to class. But, I would say about half the class is paying attention and taking notes and the other half is just doing different things.

R: Ok, and during lecture how do you spend your time?

IP9: Um, usually taking notes. And if not taking notes, just paying attention in and out. It just kinda depends on the day.

R: So would you, could you tell me a percentage you tend to be engage, pay attention during lecture?

IP9: Engaged, probably around 70 plus percent, probably 70ish percent.

R: What would you be thinking during a normal lecture?

IP9: Um, usually I'm thinking about when I'm going to get out, but, um, I try to stay focused on topic, most of the time. And, if it's something I already know or I've already reviewed or I did homework on, I tend to dream off or do something else, but usually I'm attentive in class.

R: Um, what are your feelings about the delivery of the content?

IP9: Um, I mean, there's no other way to deliver the content material than just to give a lecture, I mean, which is fine with me. I mean, I've, we've all been in lecture since we've been in 9th and 10th grade. So, it's just something you get used to. Its fine, its school. That's how it is.

R: What about the lecture format helps you learn?

IP9: Um, well definitely chapters are going to help you learn, because it's just a small base of material. You aren't having to learn so much, so. And the way that they go over it in lecture is actually pretty well laid out. They have different slides and different explanations for things. And, so, they have it pretty well, pretty well done.

R: Ok, what about the lecture format do you find is an obstacle for your learning?

IP9: Um, I don't like, as in like a lab. For example, at the beginning of the year, just going to, like, CGT and my TA is just not as good as she should be so she'll just sit there. And I was just really lost in what I was doing I had no idea how to use the program at first and so it took me a long time. Um, so that's where I feel lost, in a class where I don't know what I'm doing and then the TA or the teacher is of no help.

R: And how effective do you feel lectures are for helping you learn?

IP9: Um, I think they are effective. It's the only way to learn. 'Cause if you are paying attention to lecture then you are obviously wanting to learn. And if you are not paying attention then you are not going to learn. You are going to put it off till later. So, if you are paying attention during lecture you are going to learn.

R: Ok, can you talk to me or tell me a little bit about the technology that you see utilized during lecture?

IP9: Um, PowerPoints, graphs, sometimes they have different internet, um, uh, websites that they'll show in reference to, videos, it could be anything. Anything that is going to be on topic and help you learn.

R: And are you pretty satisfied with the usage and amount of technology used?

IP9: Am I pretty satisfied? Very. I mean, I have no problems with anything, really.

R: And, anything else you can think of to discuss your lecture experience? Anything you might want to add?

IP9: I think that it could be a little more geared toward students and not towards what the professor wants to do. Just, as in like, he doesn't have to sit there and talk about just one topic for 20 minutes. He can move on and go through the notes and try to explain other things that we don't know. Instead of just staying on one thing forever and having us go and read the book later, and just not know what's happening.

R: Anything else?

IP9: No