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THE CLASSROOM PARADIGM:
DESIGN IN A TECHNOLOGY-DRIVEN ERA

by

Candace A. Thompson

A THESIS

Presented to the Faculty of
The Graduate College at the University of Nebraska
In Partial Fulfillment of Requirements
For the Degree of Master of Science

Major: Architecture

Under the Supervision of Professor Betsy Gabb

Lincoln, Nebraska

December, 2013

THE CLASSROOM PARADIGM:
DESIGN IN A TECHNOLOGY-DRIVEN ERA

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University of Nebraska, 2013

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Classroom design has an effect on a number of students' behaviors and performance. Architects and facilities directors are frequently faced with design decisions that impact students and do not always have the resources to help support their decision making. The purpose of this paper is to investigate how classroom design in education can facilitate students' learning and engagement in an ever-changing technological age. Is the traditional classroom environment the most effective set up? To explore this issue, the author will provide literature review and design examples to help guide the reader through ways to accommodate these changing needs—both the physical and technological designs of the classroom. Physical changes include design decisions such as layout, color selection, and furniture. Technological design centered on making technology available in and out of the classroom and having a space that is flexible enough to meet the needs of students. A thorough analysis showed that effective classroom design can impact students' performance, classroom engagement, and enhance the overall experience for teachers and students in the classroom.

Keywords: 1:1, technology, interior design, classroom design, multiple intelligences

ACKNOWLEDGEMENTS

To my college professor Betsy Gabb the one that never stopped believing in me and encouraging my pursuit of design in an education setting. Her passion and style of teaching has been an inspiration.

DEDICATION

Thank you to all of my students who have been a part of my curriculum in the classroom over the years. Being able to share my joy, love, and passion for design on a daily basis is a blessing for me. To those of you that I have sparked an interest in architecture and design—I wish you nothing but the best and look forward to what the future holds for you. For those that have graduated and gone on to study architecture and design—thank you for the emails and the visits on college breaks. There is no greater satisfaction than to see you and hear about your experiences and continued love for your major.

Lastly, thank you to my family, especially my husband, Eric. You are my best friend and I couldn't have gone through this journey without you. Thank you for being so supportive—from being my late night study buddy after getting the girls off to bed or becoming the jack-of-all trades, you are my rock and I owe my success in the program to you.

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INTRODUCTION

An achievement growth study conducted by Harvard University found that on an international level the United States and its educational system lags behind its counterparts. It also found eleven countries are moving forward at better than twice the pace of the United States (Hanushek, Peterson & Woessmann, 2012). Our job force needs competent workers and students need specific skill sets to stay competitive. This paper examines design of an educational setting. A discussion of current classroom design, coupled with dialogue about redesigning the classroom is included. The author is interested in physical, technological and instructional factors that impact how students learn and remain engaged in an ever-changing technological age. Educators, administrators, and any stakeholder who has a role in designing schools may have an interest in this paper.

For many of these stakeholders, the word school is associated with a little red schoolhouse that has a stereotypical classroom with desks in rows, a chalkboard, and a teacher standing in the front of room lecturing. Regardless of the vision, the classroom is meant to be a place where teaching and learning takes place. This setting is especially profound when we consider that the Education Commission of the States report students average more than 1000 hours in an educational setting per year (Bush, Ryan & Rose, 2011). In today's fast-paced advancing society, the learning environment needs to adapt to meet these changes.

While society continues to advance at a rapid pace, the classroom setting is often resistant to this change. In some cases administrators and school leaders are not equipped to make the changes commensurate with the direction society is moving.

The literature review that follows details four main categories this author believes would need to be addressed in a traditional classroom. (1) Classroom design, (2) the use of technology to support the learning, (3) addressing the health and wellness qualities of both existing and new spaces, and (4) instructional methods are all topics that have been researched.

CHAPTER I: LITERATURE REVIEW

CLASSROOM DESIGN

According to Nair, Fielding and Lackney (2009), a classroom needs to offer flexibility, adaptability and variety. To achieve this, they suggest that schools should offer items such as: “movable furnishing systems on casters, transparent glass roll-up doors leading to a central commons for breakout learning, flexible wall partitioning systems to create larger learning suites when desired, adjustable height work surfaces and even extending learning to covered outdoor learning terraces directly connected to learning studios” (p.123). Adaptability simply means accommodating human need, the humanity of students and changing the classroom size over the years. To accommodate students, designing for multiple intelligences (differentiating instruction to accommodate all learners in the classroom) needs to be taken into account. Nair, Fielding and Lackney (2009) state, “a balanced educational program will allow students to fully sharpen the “favored intelligences, as well as encourage exploration of the world utilizing their other intelligences” (p. 147-148). Figure 1.1 below provides visualization for how integrating MI (multiple intelligences) in a school would work.

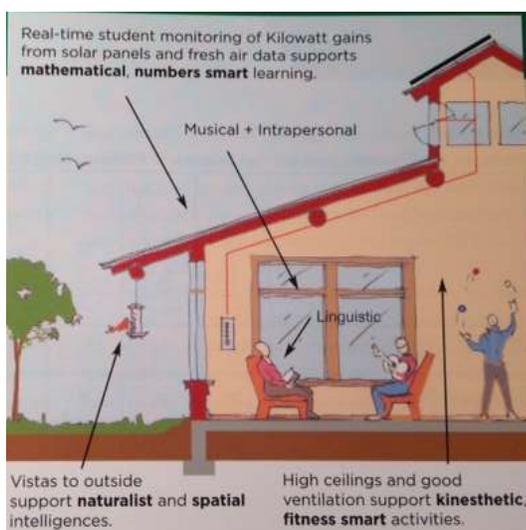


Figure 1.1: Designing for Multiple Intelligences. This figure illustrates a section of a classroom integrating learning styles.

Burke and Burke-Samide (2004) echo those findings. “More than seventeen studies have been conducted on the environmental elements in the Dunn and Dunn Learning-Style Model—design, sound, light, and temperature. All studies revealed that students achieve higher or have improved attitudes when their learning environment reflects their learning preferences” (p. 237). They point out, “all teachers must be taught how to redesign their classrooms correctly so that all students will be provided with the necessary space to accommodate their environmental learning-style preferences” (p. 238).

Today the goals of education facilities need to be to prepare students for beyond school and replicate the types of environments in which they will exist (Remenschneider & Raatz, 2013). One way to create this environment is to offer Real-World Learning Environments. Remenschneider & Raatz (2013) found this a very successful tool at the Milan Center for Innovative Studies, a traditional high school that has 23,000 square feet of space. To accommodate the project-learning curriculum, the school prepared every inch for learning and collaborating. “The interior environment models itself after the real-world experiences student will have after high school” (Remenschneider & Raatz, 2013, n.p.). Teachers share a planning space on the second floor and the administrative offices have been reduced. Throughout the school there is a design lab that offers students the flexibility to work alone, in teams or groups. There are Pod Bays that are occupied by booths, couches, and charging stations for the students’ many devices. The Milan Center is especially powerful because the environment is “equipped with everything you would find in a modern office” (Remenschneider & Raatz, 2013). Thus, students are not merely

receiving a high school education; rather, they are also gaining real-world experience as they attend school each day. Helm, Turckes, and Hinton (2010) support this and state “today’s graduates will likely spend time in a workplace where they will multitask, work on interdisciplinary teams, collaborate with consultants near and far, deal with disparate and conflicting information, and work with ever-changing technologies” (p. 66). They want to see the school support 21st century learning.

USE OF TECHNOLOGY

“All you have to do is look around to see how “natural” learning occurs... Today’s life learner will query immediately using any technology to find the answer or a pathway to learn more” (Magney & Sorenson, 2011, n.p.) With these technologies, it is important that classroom spaces be able to accommodate them. “Students want to retrieve information in common spaces, as well as in learning spaces” (Magney & Sorenson, 2011, n.p.). With the approach of customized learning, student ergonomics need to be addressed. “Furniture that is mobile, adjustable and supports students’ bodies (accommodating a variety of shapes and sizes) must be considered; comfort is important to learning and keeping students engaged. A variety of flexible furniture types and sizes also enable teachers to incorporate new learning approaches” (Magney & Sorenson, 2011, n.p.). Lastly, Magney and Sorenson suggest that learning spaces be flexible; have the ability to work both individually and collaboratively. Additionally, wireless technology, flexible furniture and presentation opportunities need to exist in the space.

Nair, Fielding and Lackney (2009) have found that “on those rare occasions where students are given an opportunity to comment on the quality of their learning environment, one answer always seems to make the cut—“give us more Soft Seating” (p.118). They reflect on the fact that adults need soft, ergonomic furniture at work to be productive throughout the day so should not students have the same opportunity in order to enhance their learning opportunity at school?

Burke and Burke-Samide (2004) found “more informal or comfortable seating can increase attention span and improve attitudes for some students. Researchers began investigating this phenomenon nearly twenty years ago (Hodges 1985). The resulting data confirmed a significant interaction between learning-style preference and the environmental design” (p. 237).

Physical classroom spaces are vital but so, too, are the virtual classroom spaces that now exist. Nair, Fielding and Lackney (2009) have worked with Professor Stephen Heppell, a futurist and school planner. They “estimate that barely one out of every five schools has a 21st century approach to ICT (Information and Communication Technologies), which involves creating policies that emphasize the possibilities and opportunities for learning that new technologies provide” (p.99). This is disturbing when you consider that in a “2008 survey by the United Kingdom (UK) group, Campaign for Learning, it was revealed that 52% of the average student’s time is spent copying notes from a book or whiteboard. The same survey revealed what children want more of is to learn in groups, to learn in a hands-on manner, and to learn with computers” (Nair, Fielding & Lackney, 2009).

As technology has advanced a large amount of learning takes place outside of the traditional classroom and students can easily interact with one another even when they are not face-to-face. The flipped classroom and virtual spaces are becoming popular approaches to reaching all learners. Brown and Lippincott (2003) believe mobile computing and related technologies are major factors behind why the classroom “can no longer encompass the teaching and learning options today” (p.14). They suggest the following be integrated into the classroom: writeable surfaces, real-time blogging, classroom chat rooms, dynamically available broadband, and a ubiquitous access to videoconferencing (p. 14).

With this surge of mobile devices in the classroom, research has begun to take place on classrooms that have taken a one-to-one (1:1) approach to learning. One thorough analysis of this was conducted by Penn State. Their study subjects “included the technical communication service course for science and engineering majors” (Faris & Selbar, 2013, p.367). The study was conducted among 24 students in fall of 2010 and a section of 18 students in the spring of 2011 (Faris & Selbar, 2013). It should be noted that there were also 10 teachers that participated in the study. The researchers (the information technology (IT) department) purchased forty 16-GB Wi-Fi iPads and accessories (keyboards, cases, apps, and iBooks) for the participants to use throughout the study (Faris & Selbar, 2013). Their data collection consisted of “structured interviews, written reflections, contextualized observations, and device analyses” (Faris & Selbar, 2013, p.368). They concluded from their studies that the technology would be more effective when used across the curriculum not just in an isolated course. Introducing

technology naturally introduces security issues and may create technology learning curve for those involved. From a student perspective, the use of the iPad was positive in that it afforded them portability and non-stop access.

HEALTH AND WELLNESS

Experts agree classrooms today must be flexible so that learning spaces can suit the needs of all learners. Long and Ehrmann (2005) cite several characteristics classrooms should have, many which exemplify the shortcomings of the traditional classroom environment. They emphasize the need to design spaces for people, not for technology built into the space. It is vital to have spaces that are “flexible for changing requirements” (p. 56). They highlight the need for “softer” spaces: places that are not simply stuffed with hard-seats and specific technology. Furthermore, design must center on a space that is accessible all hours of the day and open to a myriad of learning activities—even those not clearly defined today. Comfortable, collaborative environments will provide the most flexibility for students in this age. The Business and Institutional Furniture Manufacturers Association (BIFMA) established a safety and performance standard for educational seating. Through this standard, the seating must conform to specific guidelines and testing in areas such as: backrest strength, dead load and durability, performance of casters and wheels, etc. (Kennedy, 2013). Research has demonstrated how imperative it is that the classroom design be changed to accommodate the learning style of students. While it is not an option for all schools to re-build or undertake many renovations, teachers should be given the opportunity to make their current spaces as flexible and accommodating to multiple learning styles as possible. This

would afford all students the ability to succeed in an environment conducive to learning. With this said, classroom design can be affected by underlying issues with regards to health and wellness; a concern that many schools are forced to address. The diagram below (Figure 1.2) demonstrates the relationship between the school building and students' health and achievement.

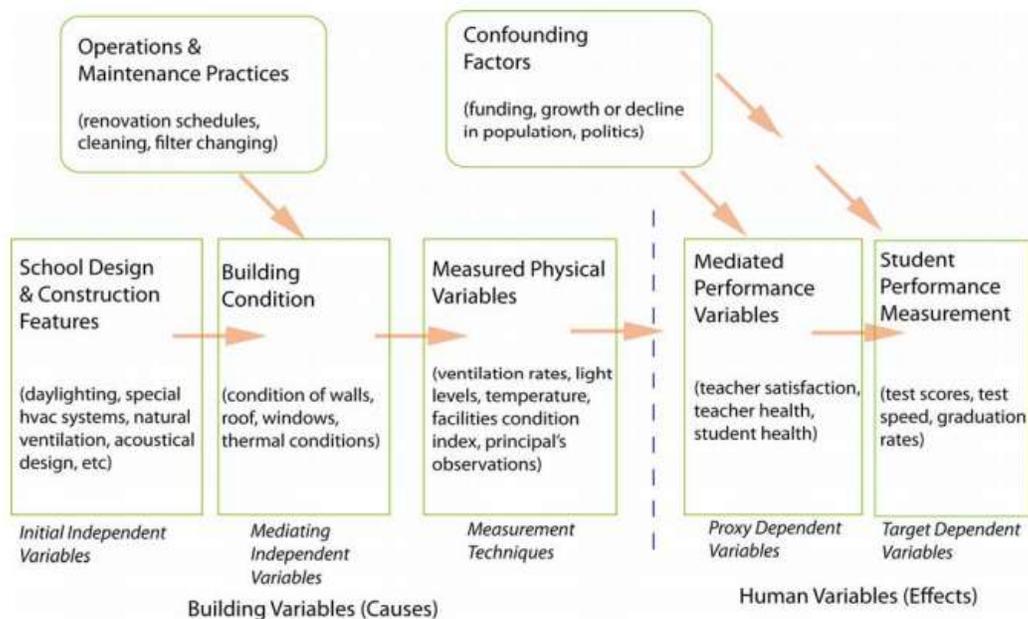


Figure 1.2: McGraw Hill Research 2012. This figure illustrates cause and effect and how to take larger issues and make them more manageable.

One can see the troubleshooting that can begin to take place considering that one-third of schools in the United States are in need of repair or complete replacement and half of these schools have unsatisfactory environmental conditions (Holloway, 2000).

The U.S. Government Accountability Office reports more than half of the U.S. schools have indoor air quality problems in some part of their campuses. "Asthma is the top chronic disease for causing student absenteeism, with more than 14 million school

days missed annually due to asthma attacks” (Buchanan, 2007, p. 48). These types of conditions are detrimental to anyone in the building, not simply those who have asthma. Research has consistently shown a direct correlation between building condition and achievement. If a student is not in the classroom, then they may not be learning. Moreover, if they are in a classroom that falls into these statistics, they will struggle to concentrate if they do not feel well. In Figure 1.3 below, Carnegie Mellon presents research showing the health gains from simply improving indoor air quality.

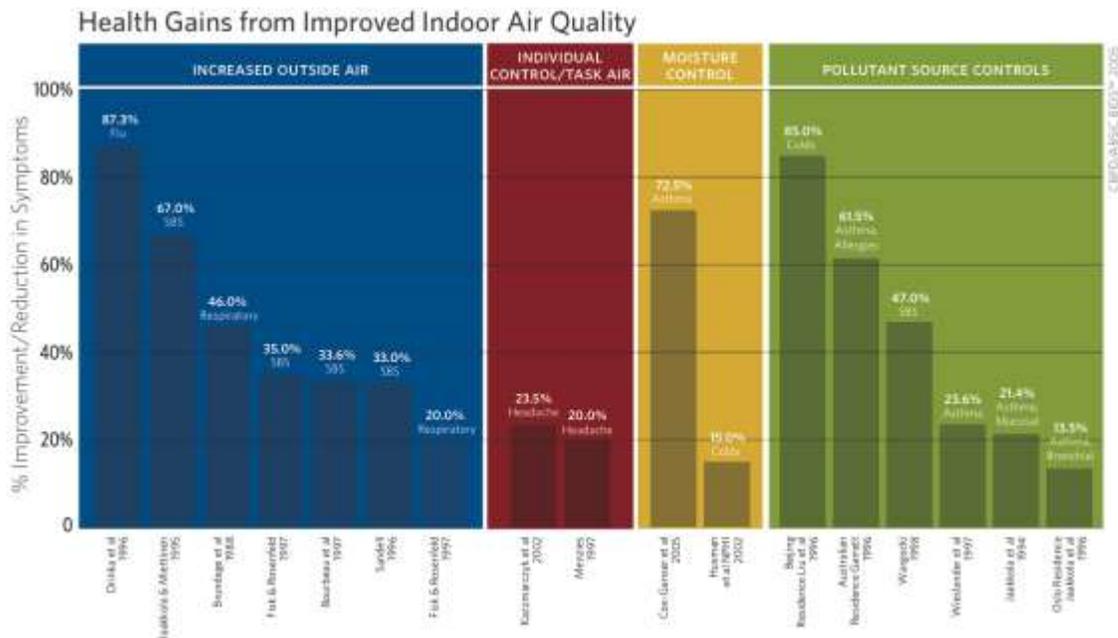


Figure 1.3 Health Gains from Improved Indoor Air Quality. This figure illustrates 17 studies that show a relationship between improved air quality and health.

In a study conducted by Earthman and Lemaster, results showed as much as a 5 percent difference in percentile rankings between schools with cosmetic problems versus those with structural problems. Students in buildings with cosmetic problems achieved

higher than those in a building with a structural issue. They also “found that building age was significantly related to student achievement and behavior. This is because building age serves as a surrogate for a number of specified variables such as the condition of the building, thermal control, support facilities, the conditions of laboratories and the aesthetic condition of the environment” (as cited in Holloway, 2007, p. 88).

There are also environmental issues that have been linked to health problems within schools. Mold and exposure to chemicals are two such issues that can be addressed and fixed at a cost. Aside from these, there are other factors that need consideration and changes to provide students with a strong learning environment. Johnson and Maki (2009) have found that color, size, sound, light, windows, and furniture all affect learning within a classroom. They found that “classrooms painted with color, lighted with full-spectrum lighting and devoid of visual noise resulted in students with reduced blood pressure; less off-task behavior, aggressiveness, disruptiveness; and improved academic performance” (Johnson & Maki, 2009, p. 143). Others support these results, too. Burke and Burke-Samide (2004) noticed, “light is one of the elements of the immediate environment that affects some students’ ability to learn” (p. 237). Furthermore, a study performed by Krimsky revealed “those who preferred bright light performed better when tested in brightly lit classrooms and those who preferred dim lights performed better in a dimly lit atmosphere” (as cited in Burke & Burke-Samide, 2004). Results such as these amplify the need to consider a variety of factors while designing a learning space.

Another survey conducted by members of The College of St. Scholastica support those results as well. One hundred college students were surveyed before and after being placed in two different classrooms—one with color on the walls and one without. The goal behind this project was to determine whether color in the classroom would have a measureable effect on students. What they found from the surveys is that “color in the classroom can reduce off-task behavior and anxiety, as well as positively affect perceptions of learning and sense of wellbeing” (Johnson & Maki, 2009, p. 145). Another result is while the color was the only variable manipulated between the classrooms, the lighting was directly affected as well. The room that was painted saw a decrease in glare and shadows, which the researchers link to helping students focus.

Still others have recognized a link between a classroom environment and student performance, health and wellness. Kats, Perlman, and Jamadagni found “providing superior daylight, air quality, thermal comfort, and acoustics can lead to increased academic performance” (as cited in Helm, Turckes, & Hinton, 2010, p. 69). Bringing in daylight, indirect/direct pendant light fixtures and daylight sensors to turn off lights when not needed to save energy are just some ways a Peoria, Illinois district planned and prepared their schools to be a healthful environment for their students. Sensors were used to increase fresh airflow and materials were carefully chosen to produce “acoustically efficient classrooms” (Helm, Turckes, & Hinton, 2010, p. 69). Careful design and planning judiciously allowed this district to produce a high-quality environment for students and teachers.

Similarly, other researchers have also noted a correlation between acoustics and student achievement. Burke and Burke-Samide (2004) learned that “sound is an element of the environment that can affect academic achievement” (p. 237). Their research highlights how student concentration levels and performance are directly tied to the decibel levels and quality of sound in a classroom. Several years later, the research of Ellis (2010) continued to support these findings. It is noteworthy to mention: “the acoustical design of a classroom has a profound effect on learning capabilities. Poor acoustics can cause as many as one-third of all students to miss up to 33 percent of verbal communication in the classroom” (p. 46).

The climate within a classroom also plays a role in student achievement. Murrain found that “research on the environmental element of temperature reveals that most students prefer a warm, yet comfortable instructional climate and even a marginal preference for a particular climate had an effect on achievement” (as cited in Burke & Burke-Samide, 2004, p. 237). Clearly, thorough analysis has revealed a number of elements which factor into the educational experience a student will have.

In Texas, a study was done to investigate “three research questions: (a) the relationship between the building condition of public high schools in Texas and student achievement scores in science, mathematics, and in English language arts as measured by the Texas Assessment of Knowledge and Skills (TAKS); (b) the relationship between the building age of public high schools in Texas and student achievement scores in science, mathematics, and English language arts as measured by TAKS; and (c) the relationship between building age and condition of public high schools in Texas and graduation rate”

(Blincoe, 2008, p. iv). From the research, the author discovered a correlation between the building age, its condition and the impact on student performance. “Students in older buildings and buildings in worse conditions perform at a lower rate than those in new buildings and buildings in better conditions” (Blincoe, 2008, p.65). Additionally it was found that “maintaining buildings in good or excellent condition does have an effect on the students’ success on standardized tests, like the TAKS. School districts need to keep pace with renovations and modern construction to provide the atmosphere that teachers and students need for high academic achievement” (Blincoe, 2008, p. 66). This study mirrored results from Earthman (2004). That research stated, “There is sufficient research to state without equivocation that the building in which students spend a good deal of their time learning does in fact influence how well they learn. Numerous studies have indicated that students in inadequate facilities (those that lack appropriate HVAC systems, have poor lighting, are old, are noisy, or lack functional furniture) perform less well than students in adequate facilities” (as cited in Blincoe, 2008 p. 69).

INSTRUCTIONAL METHODS

Finally, classrooms must be able to incorporate a variety of instructional methods. Long and Ehrman (2005) have suggested through their research of the need for 4 major changes in the classroom. The four ideas are: “learning by doing” matters, context matters, interaction matters and the location of learning matters. Each one will be expanded upon to offer further explanation. The first requirement for some portion of the classroom of the future is that they support coaching and instruction while “the student is doing what the student is learning to do” (p. 44). The second is using situated learning;

allow students “to learn about the circumstances under which it is appropriate to apply what has been learned; when the learning fits and when it doesn’t” (p. 44). The third characteristic is a space that offers students the opportunity to interact with both their peers and experts. Finally, the fourth idea reminds instructors that most learning “occurs outside the classroom” (p. 44).

Long and Ehrman (2005) find that instructors of today and of the future need to support the following key activities:

- Students need to be able hear what the faculty and peers are saying.
- Students need to be able to replay the material, perhaps instantly.
- Students need to be able to try something someone suggests, then and there.
- Students need to be able to work for short times in small groups, observing and critiquing one another’s work.
- Students need to be able to respond to questions, from their peers as well as from the instructor.
- The lecturer needs to be able to display student response patterns and use them to provoke further discussion.

All of these tie back into the topic of preparing for beyond secondary education, as these are characteristics and situations students will be expected to understand and apply as they continue into higher education opportunities. This literature review provides the reader with evidence regarding implications that need to be reviewed when either renovating or building ground-up.

After reviewing the topics aforementioned the author decided to pursue research on a personal level. The quantitative and qualitative research looked at how changing a classroom dynamic through the use of technology has affected student learning.

Additionally, the research looked at whether or not the students' environment was conducive for learning.

CHAPTER II: METHODOLOGY

Technology has soared in the past couple of decades and continues to take over all areas of life—from work, to home and now even schools. Since the launch of the iPad in 2010, educational facilities have begun to adopt this device and establish a one-to-one (1:1) environment in their classrooms, schools and even across districts. 1:1 can be defined as students having their own personal device inside and outside of the educational facility. In terms of deployment and requirements, schools are left to decide what is best for them.

The reason for addressing this type of environment is because the author currently works at a school exploring a school-wide 1:1 initiative and this academic year the Advanced Placement English Language and Composition courses mandated that students enrolled in those courses have iPads.

These students were given a list of requirements for the capacity, Wi-Fi needs and apps to purchase before the course began in August. The two instructors of the course spent their summer developing 15 iBooks for their students to use (in lieu of purchasing over \$300 in hard copies) and created a digital curriculum. In these courses the students have spent the last two years in their English classrooms using hard copies of books, notebooks to take notes, and presentations that involve props and markers.

The author developed a sixteen-question survey to determine how students' learning has been affected by the implementation of the iPad in the classroom, how often

they use the device, what they are using the device for, and how the classroom environment affected overall learning.

Based on previous research and findings, the author expected a few results. First, the iPads should make learning more interactive, convenient and organized. Second, students would find the device somewhat of a distraction—both during class and while at home. Finally, the classroom environment would have some elements that the students would want to change.

The individuals who completed the survey are all male high school students who range in ages from 16-18. Their parents were contacted via email to obtain consent. The parents also received a letter outlining the purpose of the research and the scope of the survey. The parents were asked to convey to their sons whether they could participate or not and, in turn, emailed consent for their sons to participate. The survey was comprised of sixteen questions and consisted of: choose those that apply and short answer. The survey was conducted anonymously at the beginning of their class periods.

COLLECTION OF DATA

The author went to the four sections of the Advanced Placement English Language and Composition courses over two days, as the school is on an A-B block schedule. The author read an announcement to the students covering what the scope of the survey was, the purpose of the survey, and told students that their parents should have communicated to them if they had consent to participate. They were also told that if they had not received consent or had decided not to participate that they should turn in a blank

survey. Students were given ten minutes to complete the surveys and the author collected them at the end of that time. The author thanked the students and the two teachers that allowed this to take place during their class time.

Once all of the surveys had been disseminated and collected, the results were tabulated. Out of the 77 students surveyed, 76 were returned and two were handed in blank. This is consistent with those present in the courses and with the parental consent emails. All short answer comments were listed out and the questions where students chose all conditions that applied were tallied.

ANALYSIS OF DATA

After a review of the literature, the author developed three hypotheses. The survey responses and the data obtained are organized based on these hypotheses. The reader will notice that this section is divided based on that arrangement.

H1: Learning would be more interactive, convenient and organized.

In question 2 of the survey, the students were asked how they use their iPad outside of class time. All (100%) of them use it for homework and 76% of them are using it for reading. On the flip side, 94.59% of them are using it for games or entertainment. See Chart 2.1 below for all selections and totals.

Usage of iPad Outside the Classroom

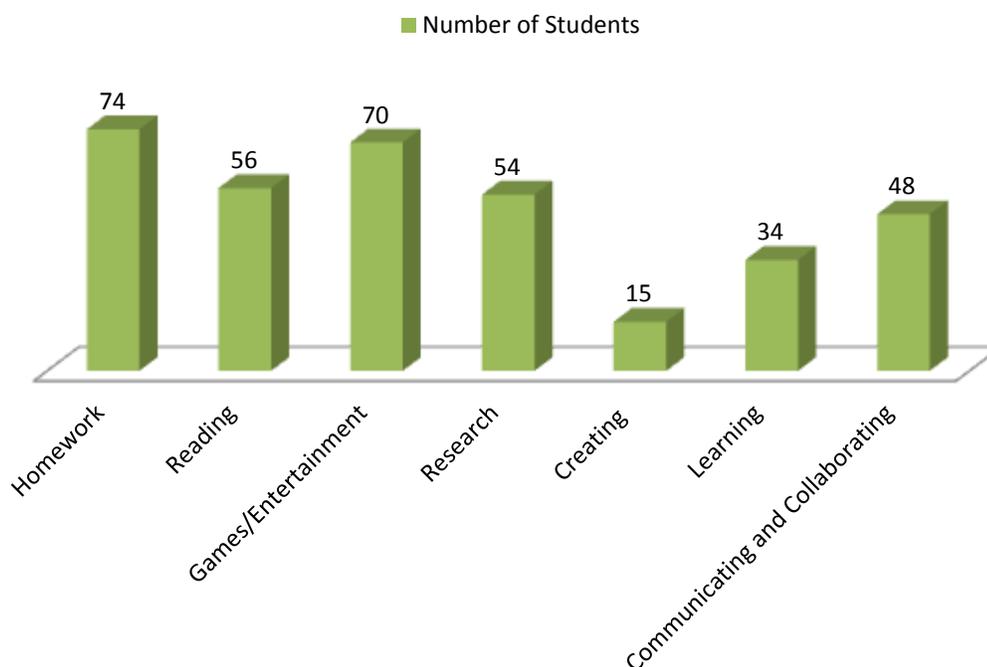


Chart 2.1: Usage of iPad Outside the Classroom

In question 4, students were asked how their learning experience has changed because of the implementation of the iPad in the classroom. Although this was a free response question, 70% of the students answered that class is more interactive, and they are more organized. Students also noted that the iPad has made their studying and work in class more convenient. Only 1% of students noted that the iPad in the classroom has been a disadvantage. Later in the survey, question number twelve asked students to rank a list of activities based upon the way they use the iPad in the classroom on a scale of 1-6 (1 being done most often and 6 being done least often). As shown in Chart 2.2 below,

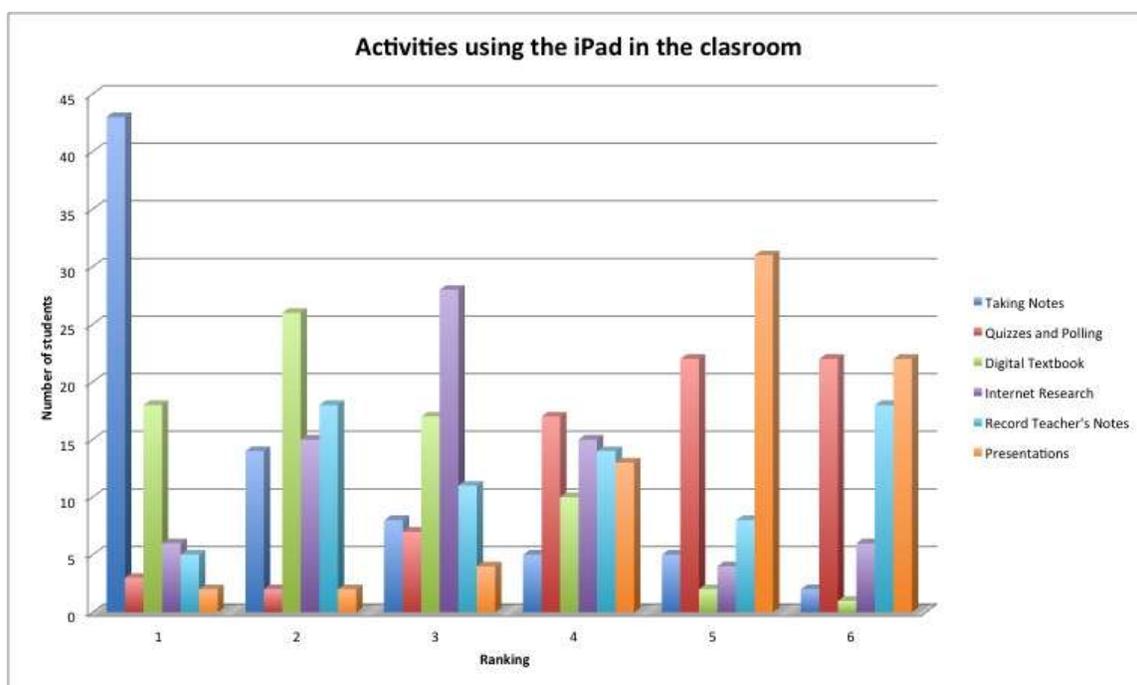


Chart 2.2: Activities using the iPad in the classroom

58.10% of the students are using their iPads to take notes in class, and further, one can see that referencing their digital textbooks and internet research seem to be the most predominant usage in the classroom.

H2: Students would find the device somewhat of a distraction.

Question number five of the survey asked students if they have a hard time staying on task when using the iPad in class. 51.35% of students have found this to be true for them. When asked, in question 9, if the iPad provided too many distractions while in class, 48.6% of them responded with yes. To explore this concept of being a distraction a step further, the author asked the students, in question 10, if they had ever used iMessage, played a game or used social media while in class (knowing that these are

not tools used in the curriculum). 86.4% of these students have admitted they have been off-task during class.

H3: The classroom environment would have elements that the students would want to change.

The two rooms being utilized to teach this curriculum are situated on the 2nd floor, they have four hopper windows that are each approximately two feet wide and the desks are from the mid-1980s. The desks have a blue plastic seat, a wood tabletop and a wired metal basket below the seat. The classroom is setup in a traditional way—the desks are in 5 rows with 6 seats in each. The teacher's desk and podium sit in the front of the room. There are two white dry-erase boards and a smart board. With the implementation of the iPads this school year, each teacher has been given an Apple TV. In the back of the room there are two small 4-shelf bookcases. The walls are painted a green tinted taupe and the lighting is a typical fluorescent setup.

Based on their responses to questions 13-16, the students stated that they want to see change in the classroom. Question 13 asked them if the current furniture in the classroom was conducive to learning. Question number 14 asked whether having the iPads made the current furniture work more efficiently than before. Finally, question 15 asked if the current furniture allowed for change in activities in the classroom. While they find the furniture conducive to learning, 40% of them find the desks uncomfortable and 10% find that the existing desks do not allow for multiple activities in the classroom. Question 16 was an open-response question asking the students to write in what they

would change in the classroom if they could. While only 50% of the students responded to this question, over half of them requested new desks (something comfortable and movable), and a new desk layout in the room—with several mentioning a U-shape. Other common responses included changing the wall color and incorporating different lighting.

FINDINGS AND DISCUSSION

As stated above, the intent of the survey was to see how students are reacting to having a 1:1 environment in the classroom. The survey results confirmed the students are using the iPads inside and outside of the classroom and their learning and instructional methods are changing. Anytime something new is brought into the classroom it is imperative that students are taught expectations for proper use. Since this group of students is a generation that has grown up with electronics, it is no surprise to this author to find that having their own device in the classroom creates distraction for them. Again, this goes back to educating the students on expectations and allowing them to be self-disciplined. With the course being an Advanced Placement course, the students enrolled are higher achieving and it is concerning to think about how lower achieving students might react to a device in another type of classroom.

The first three questions of the survey were designed to determine whether the students are using the iPad outside of the classroom and more specifically what they are using it for. The results showed that 71.6% of the students spend at least 1-3 hours on the device and that an additional 17.56% spend more than 3 hours per day using their iPad outside of the classroom.

Every single student in the course is using the device to complete their homework, 75.6% of them are using it to read, and 72.97% use it to do research. Just as much as the students are using it for school related activities it should be noted that 94.59% of them are using the device for games and entertainment outside of their school day.

With the usage of the device in and outside of the classroom, survey questions 6 and 7 asked students about whether they experienced battery problems in the classroom and whether there were any problems connecting to/or staying connected to the wireless in the school building. The results were that 98.6% of students reported no issues with the battery with almost all students reported they charge their device overnight. With the Wi-Fi issue, students had difficulty in the first month of the class, reporting that their signal would either drop or they would experience failure to connect. The IT department at the school provided these students with a secured Wi-Fi network and they have reported no issues since this creation.

Overall, students maintain that adding the iPad to their classroom has been a positive means for their education. When students were asked to rank how the iPad has helped their learning, more than two-thirds responded their learning had increased. The results from question 8 of the survey are shown on Chart 2.3 below. Students had to respond on a scale from 1-5 (where 1 was the lowest, 3 was no change, and 5 was the highest) how much they believe the iPad has helped their learning. The chart shown below gives a breakdown of the students' responses. It is noteworthy to mention that these classes are using the iPad on a daily basis. Students are not merely carrying these devices with them and using them on occasion. Every day a portion of the lesson

necessitates iPad use. Thus, students' perception that learning has increased may be more significant than in a classroom where not technology had been used.

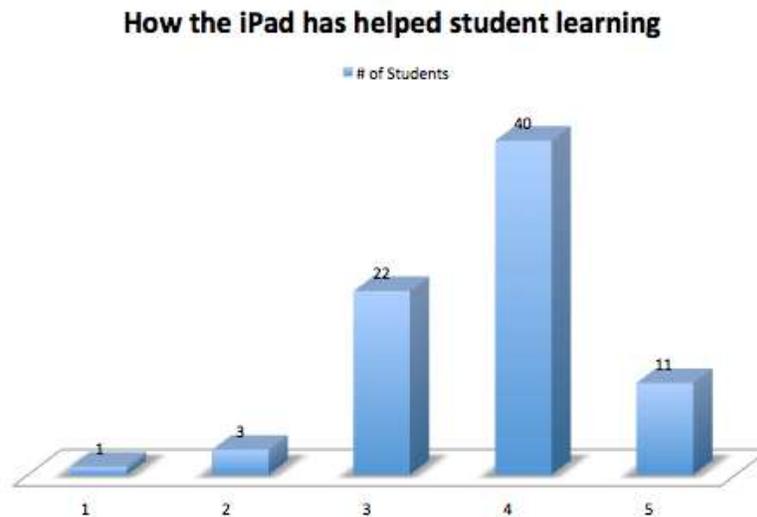


Chart 2.3: How the iPad has helped student learning

With regard to the answers about their learning environment, the data is not surprising. The classrooms throughout the entire school building are almost identical (some having even less windows) in layout and furniture selections. The students surveyed, unless having toured other schools or taken the design elective course may have no knowledge of what a classroom could have. However, with that said, 40% of them did call attention to the uncomfortable seating.

In pursuit of recommendations to be given to the school being used for research, the author has researched design examples of classroom layouts and furniture that are adapting to the ever-changing technology-driven curricula. These examples can apply to all levels of education, not simply the secondary level researched in this study.

DESIGN EXAMPLES AND RECOMMENDATIONS

One example that cites the success of deliberate design decisions in a high school classroom is documented in a Fall 2010 case study carried out by Steelcase. Working with a classroom in Michigan, Steelcase implemented a conversion of their classroom space. After conducting some research in a variety of classes, the design and consulting groups developed a “node” space, allowing for a versatile, comfortable classroom. Students had the opportunity to easily move for various classroom activities, they could store their personal items in a space beneath their chairs, and physically had more support from the new furniture used (see Figure 2.4 below).



Figure 2.4: Node Chair by Steelcase. This figure illustrates the specifications of the Node chair.

Students and teachers also reported a higher level of on-task behavior with the changes made. Students felt their concentration and focus was better and, overall, they reported a much higher classroom experience. Because of its comfort and flexibility,

students can see the teacher when he/she is in any part of the room. The furniture used enabled the class to go from a static classroom to an active classroom in a matter of minutes. Many cited an improved amount of physical support and believed their new environment to be more comfortable (see Figure 2.5 below). Survey results also reveal positive feedback from an aesthetic standpoint, too. This type of transformation is just one illustration of how the furniture choices used in schools can truly have a positive impact on the classroom, the teachers and the students.

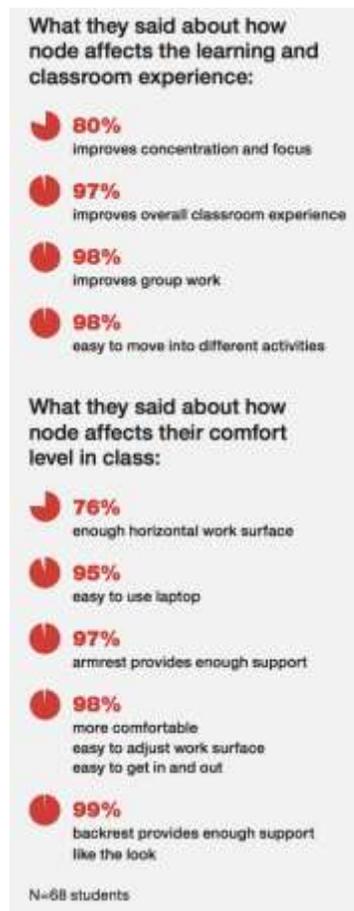


Figure 2.5: Node Chair Survey Results. This figure illustrates what students at Northview High School in Grand Rapids, Michigan felt about the chair.

Another design example can be found in Los Gatos, California. Hillbrook Academy is taking center stage with their implementation of the iLab classroom. Hillbrook teamed with partners Bretford and Hero, Inc., two commercial furniture companies with an interest in functional, ergonomic educational furnishings. Together, the three worked to combine collaboration, flexibility, and technology to create a space that allows multiple teaching techniques to take place in all subject areas. By creating this type of learning environment, the students become the architects, designing the space for their lessons each day. A sense of student-ownership is created and students are already becoming engaged in learning before class even begins. In Figure 2.6 below, you can see one setup of the room. All of the desks are mobile, foldable whiteboard tops. There are flat screen televisions on the walls, the students have chairs with casters, and the teachers have mobile whiteboards. In Figure 2.7, you can see how the space has been rearranged to accommodate group work. Since implementing the iLab in 2010, the class has been reserved for all class periods and the teachers and students are pushing to see all of the classrooms in the building to become iLabs. This type of classroom setting has not only provided a wealth of flexibility, but it has also given students an excellent model for collaborative learning.



Figure 2.6: Hillbrook Academy iLab Classroom. This figure illustrates one way the iLab classroom can be configured.



Figure 2.7: Hillbrook Academy iLab Classroom. This figure illustrates another configuration the iLab space can be configured.

In Owatonna, Minnesota, “The Options Program” has been developed and offered to their students. This goal of this program is to adapt learning to the changing world by allowing students more ownership over their education (Magney & Sorenson, 2011). Students work to meet state graduation requirements through research projects, professional mentorships and workshops. When they decided to implement this program, a renovation of the current building needed to take place. The 11,500 square foot space now features a flexible central space in the entry, full-height windows, technology upgrades to support collaboration, interactive display boards, wireless connections and much more (Magney & Sorenson, 2011). Seven classrooms were reconfigured with the following:

- A central core with flexible furniture to accommodate research stations, presentations, group and individual work.

- Staff workstations in the core space to foster communications among staff and students.
- Two flexible studios with a variety of furniture (four upholstered chairs with tablet arms, six two-person tables with wheels, and three four-person, round high-top tables with stools per studio).
- One studio classroom with tables.
- Two flexible studio classrooms that can open up for large group presentations.
- One learning lounge with circular couches for teaming and lounge-type chairs for groups or individuals.
- One video studio with a separate area for six editing stations.
- One 12-person conference room and two small-group conference rooms.

These design tactics created a building that provides students with real-world experience, learner-centered education and collaboration (as cited in Magney and Soreneson, 2011).

Research has also shown that technology can and should impact the design of a classroom. The United States Department of Education performed case studies at nine school sites throughout the country to determine the affect technology had on the classroom, teachers and students. West High School (WHS) in Columbus, Ohio saw a variety of results from their encounter. Many teachers noted a change in their teaching styles and philosophy, and noted a change in their students' approach to learning as well. The study noted "improved student communication, reasoning, information retention, collaborative skills, and self concept" (U.S. Department of Education). Student engagement had increased and a surge in student performance was evident as a result. WHS and the other schools involved in the case studies agreed that technology was integral to classroom design.

It is important to note that the physical room changes need not be separate from technological room changes. Dr. Robert Beichner, a professor at North Carolina State

University, has developed a project called “Student Centered Active Learning Environments for Undergraduate Programs” (SCALE-UP), in which physical changes are integrated with technological changes (De Gregori, 2011). The SCALE-UP approach features round tables that can seat up to nine students. The round tables allow students to sit in small groups and work in teams, if desired. Each group, or team, has access to a networked laptop and a whiteboard space. Thus, students have an opportunity to interact with one another, with the teacher, and can access information quickly. Students are immersed into a collaborative environment and also find themselves in a setting that resembles a professional workspace. While this project was originally intended to serve as a solution for higher education, Dr. Beichner notes that the approach has already been adopted in half a dozen secondary schools, too.

Many of the concerns discussed in the literature review have been addressed in Arkansas in the Fayetteville District. The United States Department of Education (2013) awarded them the title of Green Ribbon School this year, 2013. This school district has been implementing an energy management system since the 1980’s and have provided many of their schools with LEED construction and education, indoor environmental quality and waste reduction. They have “cut air conditioning usage, updated lighting and replaced windows with high efficiency glass” (p. 18). They have created a program called EAST (Environmental and Spatial Technology) to offer students exposure and experience to various technology. “Students learn and apply geographic information systems skills, web design, video editing, and software animation to environmental projects” (p. 19). With these changes over the past five years, the percentage of students earning

proficiency scores on state tests has doubled or nearly doubled in every subject area; in 2009 they were the only high school to exit in need of improvement status, and in 2010, their students made larger test score gains than their peers at every other state high school. (p. 19).

CONCLUSION

Any school in need of renovation, any school seeking to create an addition to a current space, or simply a school building from the “ground-up” can gain from the information presented. In an effort to keep improving this country’s educational system, administrators, architects and designers have a great deal to consider. While additional research is always warranted, the literature reviewed shows the reader a great deal. The acoustics, lighting, temperature and air quality all play a role in keeping the climate healthy and appealing to the users. Additionally, designers must pay particular attention to creating a space that allows for collaborative work. A classroom certainly needs to be a space that emulates a real-life environment—one that students will be exposed to when their education is complete. Finally, the learning space should be conducive to a variety of instructional methods. By integrating the findings in this paper, students will undoubtedly have a more positive attitude toward school and student achievement will increase.

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APPENDIX A

CERTIFICATE OF EXEMPTION



October 10, 2013
Candace Thompson
Architecture Program
1712 N 207 ST Elkhorn, NE 68022

Betsy Gabb
Dean's Office of Architecture
232 ARCH, UNL, 68588-0107

IRB Number: 20131013835 EX
Project ID: 13835
Project Title: The Classroom Paradigm: Design in a technology-driven era

Dear Candace:

This letter is to officially notify you of the certification of exemption of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study based on the information provided. Your proposal is in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46) and has been classified as Exempt Category 2.

You are authorized to implement this study as of the Date of Exemption Determination: 10/10/2013.

1. Since your informed consent form will appear via email, please include the IRB approval number (IRB#20131013835 EX) in the email message. If you need to make changes to the informed consent email, please submit the revised document to the IRB for review and approval prior to using it.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:

- * Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
- * Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
- * Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
- * Any breach in confidentiality or compromise in data privacy related to the subject or others; or
- * Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you should notify the IRB immediately of any proposed changes that may affect the exempt status of your research project. You should report any unanticipated problems involving risks to the participants or others to the Board.

If you have any questions, please contact the IRB office at 472-6965.

Sincerely,

Becky R. Freeman

Becky R. Freeman, CIP
for the IRB



APPENDIX B

INFORMED PARENTAL CONSENT – EMAIL

Good Morning Parents-

My name is Candace Thompson and I am a teacher at Creighton Prep. I am contacting you because I am currently writing my thesis to finish my master's degree from UNL. The topic I am researching and writing about is classroom design in the secondary school and the technology paradigm within. I have identified your son as a person of interest to survey because he is enrolled in the AP English Language and Composition course. This course is of particular interest because of their 1:1 iPad requirement for the school year. I am asking for your permission to allow me to survey them anonymously regarding how they feel the course and learning is going with a device in their hand in lieu of books. Below, is a formalized description of the consent I am requesting from you. Please communicate to your son whether or not you are going to provide consent. On the day of the survey in the classroom, I will be obtaining student consent and will tell student they should have heard from their parents if they can or cannot participate.

If you have any questions please let me know. I would like to have all email consent by Monday, October 14, 2013 so that I can survey the students during class next week.

Thank you for your understanding and your time.

Candace Thompson

Purpose: Student participation will aid in the general knowledge and understanding of the importance in design in a secondary classroom, specifically, one that embraces the ever-changing technology realm

Procedures: The first 10 minutes of the AP Literature and Grammar Composition will be designated to anonymously survey students regarding their feelings and usage of their iPads on a daily basis. All students will receive a survey and those that wish to not participate can hand in a blank survey.

Benefits: There are no direct benefits to them as a research participant.

Risks and/or discomforts: there are no known risks or discomforts associated with this research.

Confidentiality: The survey being passed out is completely anonymous and the data will be stored in a locked cabinet in my office and will only be seen by myself during the research. The results of the survey will be used within my thesis for my masters degree program.

Opportunity to Ask Questions: You and your child may ask any questions regarding the survey and procedure to either myself, or Dr. Betsy Gabb, my advisor at UNL, prior to agreeing to

participate in in the research (our contact information can be found at the end of this email). Sometimes study participants have questions or concerns about their rights. In that case, you should call the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965.

Freedom to Withdraw: Participation in this survey is completely voluntary. You and your child can refuse to participate or withdraw at any time without harming yours or your child's relationship with their teachers, Creighton Preparatory School, the University of Nebraska-Lincoln, or myself. You will not receive a penalty or loss of benefits to which they are otherwise entitled. Also, your son's grades will not be negatively affected by their participation or withdrawal from the research.

Consent/Right to Receive a copy: You are voluntarily making a decision whether or not to allow your child to participate in this research study. Your child will also ask for their assent to participate. To grant consent for your son's participation, **please reply to this email with the name of the child you are providing consent**. By doing this, it certifies that you have read this email, are allowing him to participate and understand the information being presented.

Thank you, and as mentioned above, here is the contact information for both my advisor, Dr. Betsy Gabb at UNL and myself.

Dr. Betsy Gabb
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402-472-9245
bgabb1@unl.edu

Candace Thompson
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cthom@prep.creighton.edu

IRB approval number #20131013835 EX