

Proposing Information Communication Technology Solutions for a Studio Business Environment

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Abstract

The Studio at the Copenhagen Business School is a classroom space designed for studio learning that doesn't fully utilize available technology. This proposal describes research we will undertake to suggest technologies that will improve the educational experience of students through aiding professors in their teaching. We will determine the most beneficial solutions by surveying faculty and students to establish technological literacy and preferences, in addition to interviewing select faculty to help identify how information and communication technologies in the Studio may help them achieve learning outcomes. With our proposed solutions, the Copenhagen Business School will be able to implement ideal technologies into the Studio.

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1.0: Introduction

The needs of businesses who hire from traditional lecture-based programs are not being fully met. Students are not learning the communication, teamwork, and presentation skills that are needed in the professional environment (Anderson, 2009). Studio learning is an educational method that has been established in art and design education; however, it has recently gained popularity in business education. Technologies, proven pedagogies, and new class spaces are being combined in business studio classrooms to produce graduates with the desired skills.

The Copenhagen Business School (CBS) is one of only eight universities in Denmark. The school was founded in 1917 outside of central Copenhagen. It currently enrolls 20,000 students and has a faculty of 1,500. Programs are offered in economics, languages, entrepreneurship, among other popular business concentrations. The Studio at CBS is a two-year old experimental space run by Stefan Meisiek, which is designed to complement what is learned in the classroom. The goal of the Studio at the Copenhagen Business School is to combine studio learning and technologically enhanced education. The Studio is a two-year old experimental classroom space that currently runs with minimal Information and Communication Technology (ICT). Implementing ICT in the Studio will help faculty meet their education goals.

Studio learning has been a popular pedagogical approach in the fields of art, architecture and design fields, but only recently has it been used in business or engineering education. Research has shown that bringing technology into the classroom allows for more flexibility in activity design, helps reinforce learning principles, and caters to more types of learning styles (Armarego & Minor, 2005). Student engagement, retention of material, and development of skills that are more in demand in the modern workplace, such as oral communication and

teamwork experience, all improve in a studio learning environment as opposed to a traditional lecture hall. Both studio learning and technology in the classroom encourage increased collaboration among students and professors.

Information on studio classrooms is limited to architecture, art, and design, which have different educational goals than business. The best practices in studio education for business are not explicitly defined, and research on implementing technology in business studio classrooms is minimal. Opportunities to improve studio learning can play a large role in facilitating the interaction and collaboration skills sought out by businesses, but it is not clear what techniques would be best to achieve it.

The goal of this project is to aid Copenhagen Business School faculty to create an ideal studio learning environment by identifying the needs of the Studio at CBS and proposing ICT solutions. Our research will combine literature reviews of successful case studies with on-site research methods. This will give us an idea of the needs and current state of the Studio, as well as the technological literacy of the Studio's occupiers. We will then determine the best possible implementation of ICT based on this research.

2.0: Background Research

Business education is traditionally performed in lecture halls. This form of learning does not teach students teamwork, critical thinking and problem solving which are skills most companies look at when hiring graduates (Anderson, 2009). As a result there has been a recent shift away from traditional learning to other forms such as studio teaching and flipped classrooms. These methods focus on collaboration between students with instructors having the ability to interact with students one on one. The different types of interactive teaching are fairly new concepts and are something in which many schools and universities are looking to expand upon.

One way this can be done is through the proper implementation of technology. Technology can either enhance or distract from a student's learning experience. When used correctly technology can make simple tasks easier such as professors having the access to projecting equipment or students having the ability to re-watch a lecture. Different forms of technology along with different forms of interactive learning have been used in classrooms involving the subjects of architecture and humanities. We are looking to combine these two forms of learning into a business classroom to enhance the studio learning experience.

2.1: Introduction to the Studio at CBS and its Goals

In order to make informed decisions on ICT solutions for the Studio at CBS, it is important to understand the goals of the Copenhagen Business School as a whole, as well as the Studio specifically. In this section, we explore the current standing of CBS and discuss the mission of the Studio.

2.1.1: The Copenhagen Business School

The Copenhagen Business School, located in central Copenhagen, is one of the largest business schools in Europe. It is a state-funded institution that offers a wide range of programs from business to alternative programs that combine business with social sciences and the humanities. CBS offers undergraduate, graduate, and PhD levels of study. It is a highly regarded institution; having been recognized as the third best business school in the world by Eduniversal, a ranking and rating agency that focuses in higher education. It was acknowledged as second in the world for International Business by the International Business Review in 2006. CBS was also awarded the 5 Palmes rating which means it is one of the top 100 Universal Business School which influences educational internationally. Additionally, it is ranked seventh on the top 10 European business schools according to International Recruiters (Accreditations & Rankings, n.d.).

2.1.2: The Studio at Copenhagen Business School

The Studio at the Copenhagen Business School is a small building dedicated to interactive learning which can host a class of roughly 40 students. The Studio is a classroom space that promotes hands-on learning and is meant to compliment the classroom pedagogy (Meisiek, 2014). The Studio encourages experiential, problem-based learning about issues faced and strategies used in the business world. It aims to be “a place where CBS teachers and students can work with processes like tangible business modeling, dramaturgic approaches to organizational behavior, visual and haptic design of organizations, strategies, and business processes, creative explorations of innovation and change, and much more.” (Studio@CBS, n.d.).

The Studio is used by professors who want a studio-based teaching environment. Any organization or person can book the studio for a course, workshop, meeting, or summer school. Many activities hosted in the studio are held by local businesses and allow students to work on real projects or challenges. Students also use the space to lead their own workshops (Meisiek, 2014). The studio is open for use by all students, including MBA and PhD students (Studio@CBS, n.d.).

Within the next year the studio will be moving to a new building. The new space can hold 80 people, twice the amount of the current space and is an old computer lab. Both the new and current studio spaces are equipped with wireless internet, and most students bring a laptop and a smartphone to class (Meisiek, 2014). This new space will allow the Studio an opportunity to expand from a simple classroom to an interactive learning classroom.

2.2: Studio Learning

Studio learning is an educational model that turns a classroom into the closest possible representation of the environment that graduates will find themselves in as professionals. Studio classes are outfitted with furniture that can easily be moved around to support multiple types of classroom activities, such as presentations, discussion, and group work. This is accomplished with activities based on project-based and experiential learning. Multiple case studies report that studio learning better suited individual learning styles, increased knowledge retention, student satisfaction and engagement, and helped students meet course outcomes (Majhi & Modi, 2012).

2.2.1: The Studio Classroom

In its simplest form, a studio classroom is any room that is capable of changing to suit the activity of the day (Lynch & Markham, 2003). In art education, this means a professor can turn

the classroom into a lecture-style space where students can watch him demonstrate a principle, or into a workspace where students have access to all the materials they need to work, or an exhibit space to allow students to critique each other's art (Hetland, Sheridan, Veenema, & Winner, 2013). Activities in a business studio can include discussing case studies, working in small groups on a design problem, or presenting solutions to the class. The people in the studio and the space itself have to encourage inquiry, discussion, and learning by doing. This responsibility falls on the professor leading the class, the students, and the equipment and room itself (Barry & Meisiek, n.d.).

2.2.2: Benefits of Studio Learning

Recent attempts to transition business and engineering curricula to a studio model have yielded improvements in multiple educational outcomes, such as increased student engagement and collaboration between students in a studio environment. Students became better problem solvers within their discipline because they were able to immediately engage in a discussion with their professor (Majhi & Modi, 2012). Teachers judged student learning progress more effectively when they were in the room engaging one on one with students (Majhi & Modi, 2013, Hetland, Sheridan, Veenema, & Winner, 2012). The studio model encouraged discussion among students, allowing them to develop their critical thinking, presentation and argumentative skills (Hetland, Sheridan, Veenema, & Winner, 2013).

The studio classroom improves student to teacher interaction over a lecture classroom. In a lecture based environment, professors have no ability to engage with students beyond the occasional question asked in class or in office hours. In a studio environment, students are able to ask questions without interrupting the learning of others. In addition, a student is more likely

to feel comfortable asking a question one on one with the teacher than in front of the whole class (Hetland, Sheridan, Veenema, & Winner, 2013, Lynch & Markham, 2003).

Professors can create more precise evaluations of students in a studio environment. In a traditional lecture hall, a professor is mainly able to judge a student based on his or her exams or projects, with the exception of lectures that are small enough to organically encourage conversation, and case study discussion rooms. A grader is only able to indirectly dissect and judge the students' thinking and problem solving abilities. The student is only able to get feedback in the form of one or two sentences from the grader, as the professor is often burdened with evaluating many students. The indirectness and brevity of feedback makes it difficult for students to understand where they are going wrong in their processes (Hetland, Sheridan, Veenema, & Winner, 2013). In a studio environment, the professor can directly observe a student solving a problem and is able to give individual, in-depth, immediate feedback. This helps students quickly learn problem solving methods that apply to the discipline (art, business, etc.). These interactions also enable students to learn domain-specific vocabulary that will help them going forward in the field. Studio learning is characterized by a professor's ability to wander the classroom and find "teachable moments" that help students immediately improve their problem solving skills and better direct them towards success with the goals of the activity (Hetland, Sheridan, Veenema, & Winner, 2013).

Studio classrooms also increase student collaboration and discussion. There is little to no interaction among students during a traditional lecture, limiting collaborative learning to ad-hoc meetings outside of the lecture hall. This essentially randomizes the outcome of any student to student interaction, and doesn't allow a professor to assist in guiding the discussion towards the goals of the course. In a studio environment, discussion can be encouraged by turning the

classroom into a forum or exhibit. An exhibit can be created to allow students to discuss their work in small groups, developing the presentation, rhetorical, and critical thinking skills of students. Chairs can be moved into a circle to create a forum style discussion, where the professor can help guide topics and questions to ensure that everyone is involved and reaching educational goals (Hetland, Sheridan, Veenema, & Winner, 2013).

The intimacy and openness of a studio classroom allows students to tailor their education experience. Individual learners are able to move to a quiet space and work away from potential distractions. Students who desire collaboration are able to gather around tables or move their chairs together to talk and share ideas. Professors are able to wander the room and identify student needs and provide resources and instructions tailored for the individual (Armarego & Fowler, 2005). It is important to note that some activities will not allow for individual choice; such as group discussions or strictly individual work.

Studio learning increases student-to-student and student-to-teacher collaboration, in addition to fostering creative thinking and problem solving skills. Teachers and professors spend their time guiding discussions, asking directed questions, and helping students. The quality of student assessment improves as the teacher is able to see the students as they solve problems. The smaller, intimate environment created in a studio classroom caters towards more types of learners than traditional lecture-based education.

2.2.3: Drawbacks of Studio Learning

Studio education is a more in-depth educational approach than lecture in the sense that it requires more participation from both teacher and students. Each session needs to be precisely planned and prepared for, as the class is based around activities instead of lecture. This includes

planning the precise layout of tables, chairs, and other equipment in the room - and then moving the equipment before class (Sawyer, 2012). It is likely that some professors might not want to spend the time planning and setting up multiple classroom designs, or they might not have the expertise to create an ideal setup for an activity.

Planning projects that span multiple class periods is also a heavier investment within studio learning. Projects need to be designed to have miniature checkpoints that line up with the course schedule; meaning that a class that meets daily will need different checkpoints than one that meets weekly. These projects need to produce the ‘teachable moments’ of failure that allow for discussion and reflection. A project that is too difficult will likely discourage students and possibly lead to a competitive atmosphere. A project that is too easy will not require students to fail or follow unique problem-solving approaches. The perfect studio project has enough constraints to encourage critical thinking and various ‘out-of-the-box’ solutions to a problem, but is not so constrained as to force all students towards one answer. Planning these sorts of projects takes not only time but also experience with student behavior that many professors might not have (Sawyer, 2012). Technology in the classroom will need to support the constraints and challenges set up by professors, and also not be able to solve too many problems for students.

One of studio learning’s goals is to encourage failure that will lead to ‘teachable moments.’ As mentioned earlier, it can be a burden on teachers to plan activities that will create these instances. It is possible that few of these moments will occur in what is a well-designed activity. A studio classroom is organic and random, meaning there is always a chance that students won’t create the intended failure pattern to lead to a discussion. Experienced professors will be better at creating activities more likely to create these situations, but it also requires

professor vigilance during class to make sure that students are reflecting on their work (Sawyer, 2012).

Studios are less efficient in educating large numbers of students. Hundreds of students can fit in a lecture hall and be taught by one professor, but a studio classroom requires a much lower student to teacher ratio to fully reap the benefits of the model. Most current examples of studio classes have less than 40 students and one professor (Meisiek, 2014). This raises the cost of education per pupil, as well as the space requirements. In addition, students are interacting directly with classroom materials in studio classrooms, instead of simply writing notes in their own notebooks in a lecture hall. These materials require a further raise in funding (Meisiek, 2014, Sawyer, 2012).

A final disadvantage of studio learning is that the model is new to many professors. Professors emulate behavior, mannerisms, and teaching style from their teachers. If the majority of professors were educated in a lecture hall as undergraduates and with an advisor in graduate school, many will be less comfortable in a studio classroom. Professors won't be able to easily identify what practices work best in a studio classroom until they spend significant time teaching in one. This could impact student performance in the classroom and irritate professors who might be uncomfortable in a different environment (Sawyer, 2012).

2.2.4: Current Examples of Studio Learning

2.2.4.1: *City University of Hong Kong*

In 1997 the City University of Hong Kong implemented a model of education that had students teaching other students course material focused on physics in a studio environment illustrated below in Figure 1. The space held 60 students, and the instructor divided the class

into six groups of ten. The students were distributed between the groups based on their educational backgrounds. For each studio session there was one instructor and two teaching assistants. The groups used computers, lab equipment, and video conferencing to complete their work (Stokes & Yu, 1998).



Figure 1 - The Classroom Setup (Stokes & Yu, 1998)

The instructor delivered course material in a traditional lecture classroom using overhead transparencies, computer displays, and laser disks. Groups then broke off and worked towards completing physics problems. The class would gather together after about half an hour, and a representative from each group would present their solutions and the processes they used to obtain this solution. The students were asked their opinions in the change of learning and Table 1 shows the results.

Table 1 - Small Groups Project Result (Stokes & Yu, 1998)

Students who said it was easier to ask questions and express their ideas as opposed to traditional learning	77%
Students who have more confidence to approach the teacher and express their ideas to the teacher	54%
Students who think studio learning shows them a different way to think	62%
Students who said that studio learning was student centered instead of teacher centered	56%

In addition to these positive outcomes, the study found that students were more comfortable asking their peers for help. Teachers in the study found that they were better able to help students; being present while teams work allowed for more directed feedback.

A challenge that arose was designing the class to ease the transition for the students from traditional learning to the studio classroom. “In order to switch from the traditional teaching mode to the ‘students teaching students’ mode, the instructor needs to invest significant time and effort in careful design and scheduling of the different activities within a session.” (Stokes & Yu, 1998).

2.2.4.2: Murdoch University, Australia

Murdoch University in Australia has recently started implementing studio learning in their undergraduate engineering programs. They started the transition by having third and fourth year student’s experience studio learning and then evaluating the effectiveness of the method. Everyone but international students found it easy to transition to the studio classroom environment. Another key finding was that students were more successful when they identified their individual learning styles and tailored their experiences to suit. This is possible in a studio setting as visual learners are able to go through different material than their peers without using

everyone's time. Likewise teachers were more successful when they catered to students' individual learning needs (Armarego & Fowler, 2005).

Based on the positive results, the university plans to continue implementing studio learning in more parts of the curriculum. Murdoch University hopes to improve students' project management, problem solving, group work, and communication skills through the increased studio time (Armarego & Fowler, 2005).

2.2.4.3: Indraprastha Institute of Information Technology, India

Indraprastha Institute of Information Technology in New Delhi, India has implemented an undergraduate Software Engineering course using studio-based learning. In the program, the students are divided into three groups with their desks grouped in a circular arrangement to allow collaboration between students. Following the conclusion of this study, students were asked a series of questions on their opinions on studio-based learning. It was found that over 70% of students thought they had a better understanding of the concept and over 55% of students had an increase in motivation. Additionally, observations were made that in large classroom settings, there is an increase in instructors work and more faculty may be required (Chaudhary, Gupta, Sarkar, & Sureka, 2013).

2.3: Technology for Education

In the recent decades, technology has been advancing at exceptional rates; however, the model of education in higher learning has not dramatically changed since traditional, lecture-based learning was widely standardized. We are now experiencing a significant shift in our modes of education aimed to better implement technology in learning environments. This shift can be traced back to scholarly articles and research papers written as early as the 1960s

(Tondow, 1961). In order to better understand what information communication technologies could be implemented into the studio at the Copenhagen business school, it is valuable to understand the impact this sort of technology has had on education in recent history, as well as clarify the issues surrounding this topic.

It is helpful towards our goals to understand how technology has impacted education as a whole. Then, we can explore how technology has impacted studio learning specifically. Another valuable subject to explore would be the degree of which the various parties within a studio learning environment are able to adapt to cutting-edge technologies, since it is important for faculty and students to understand the ICT in order for it to be used to its potential. Finally, we must look at examples of ICT that are on the market today so that we can more effectively brainstorm ideas of what to implement in the studio at CBS.

2.3.1: Technology in Learning Environments

The idea of bringing technology into the classroom is no longer a new one. In a 1961 article, Tondow explored the idea of replacing professors or teachers with computer units as a way to increase the efficiency of teaching. He explains the effectiveness of control units in terms of branching and fixed sequence programs, as well as using the units for methods of reviewing content for the students (Tondow, 1961). Automation was the focus of implementing technology into learning environments in the 60s, but that has since changed in the fifty years of new innovation in technology.

In the new millennium, the focus of technology in education has shifted towards using technology to further innovate pedagogies, as well as utilizing it as a supplement for education, rather than automating the process. A volume from the Organization of Economic Co-operation

Development (OECD) regarding innovation in knowledge states that there are four pumps for innovation in organizations: modular reorganization and specialization, utilizing research and development to its potential, the communication of knowledge beyond traditional limits, and exploitation of different technologies as well as technological advance (Edwyn, 2001).

Instance and Kools argue that technology does not have a single effect on learning environments; rather, they ensure that technology contributes to multiple components. For example, it may change who the “learners” are in a learning environment by means of introducing formerly excluded learners or by bringing people from around the globe together into a community of learners (Instance & Kools, 2013). Additionally, it may alter the “teachers”, such as the implementation of on-line or automated tutors. The ability to chat via text with an Apple Genius on the Apple website essentially creates a small learning environment in which an expert educates the consumer on any topic that they need assistance with (Contact Us, n.d.)

The role of technology can also change the content of education in enormous ways. Many computer programs or applications are able to expand student understanding by assisting in the visualization of abstract concepts in ways that textbooks or recitation is unable to achieve (Chesnek, 2001). Computer aided drafting is an example of how innovative programs can extrapolate a concept in a way that traditional drafting could not; drafting by hand does not allow the content to be seen in the three-dimensions it will eventually manifest.

The dynamics of how the content is presented can also be innovated with the implementation of ICT. Time is much more flexible with the concept of rescheduled learning, which complements the varied learning tendencies of a student body as well as educational philosophies that attempt to “break down the notion that learning has to take place in a fixed place and at a fixed time.” (Instance & Kools, 2013, p. 53). Rescheduled learning regards the

notion that information from the teacher can be accessed at a time that is convenient or preferable for the learner, by means of ICT such as video recordings of lectures or automated tutors (Instance & Kools, 2013).

The implementation of technologies can be beneficial to the learner; however, with the great strides made in technology, technological implementations should be done with great care. Technology can be confusing to teachers and students alike, and it requires proper instruction on how to be correctly used. Many educators have felt there are “insufficient quantities of qualified new technology educators entering the instructional ranks.” (Wicklein, 2004). These mal-informed educators cannot properly teach using technology without wasting time and effort by incorrectly using these tools that are meant to enhance learning.

The improper use of technology accumulates to a distrust in too much ICT in a learning environment. According to a past IQP, students do not like the addition of ICT solutions they are unfamiliar with, such as e-portfolios, at first (Gutierrez, Ketschke, Lextrait, & Rosen, 2011); however, the students were able to grow accustomed to the new technology and benefit from it. These results illustrate a concern explained in a 2001 report for the OECD that must be addressed to ensure quality in ICT-enhanced learning: “Digital literacy is now a fundamental learning objective for all.” (Edwyn, 2001, p. 16). Edwyn explains that, just as the ability to read is a required skill in order to read along with lectures, technological literacy is required to participate in technological activities (Edwyn, 2001).

2.3.2: Technology in a Studio Learning Environment

A large aspect of studio learning is the individualized, hands-on learning that takes place within it. A studio-influenced pedagogy allows students to define their own education by

creating personalized programs to achieve goals, utilizing the collaborative aspect of group dynamics, and taking on the responsibility of individual roles. ICT solutions are highly practical in enhancing these aspects of studio education (Instance & Kools, 2013).

ICT in a studio learning environment can help facilitate interaction within a group in a way that traditional learning does not allow. An example of this type of ICT is the NRICH website; NRICH is an online tool for teachers and students to incorporate tasks and miniature projects into the classroom. It is designed to enrich the mathematical experience with activities that are not typically practiced in a traditional learning environment (About NRICH: Project Aims, n.d.). These activities are better aligned with those practiced in a studio environment. Within only a year of teachers familiarizing themselves with the NRICH website, they found that some noticeable changes had taken place: “‘(The) department is now more willing to try puzzles out as a part of their teaching’ and ‘more peer interaction’.” (Jared, 1998, as cited in Monteith, 2004, p. 63) This example reflects both the facilitation of interaction, as well as another interesting detail: the faculty themselves felt more willing to try different teaching methods. The faculty at CBS may follow this same pattern if the Studio is well-equipped with beneficial ICT solutions.

Being connected to the internet provides access to communication that is not limited to one’s current location. This communication is valuable to the collaboration and group dynamics experienced in studio space. According to Instance, technology builds and supports widening partnerships, “through forging alliances, partnerships and networks, while extending the environment’s boundaries, learning spaces and resources.” (Instance & Kools, 2013, p. 54). The internet extends the environment’s boundaries and learning spaces by providing access to countless conferencing programs and social media websites for students to keep in constant

communication with each other.

The studio space must be well-equipped in order to properly benefit from the ICTs. Two criteria for successful ICT-enhanced education identified in the 2001 OECD are as follows:

“Schools must be fully equipped and supported for using ICT,” and, “schools need plentiful educational software and easily-accessed information on it.” (Edwyn, 2001, p. 17). The report further details that it is very costly to be equipped with ICT solutions and have the resources available to support it (Edwyn, 2001). Studio learning has also been deemed more costly than traditional learning methods (Taylor, Personal Communication, 2014). Combining these two factors suggests that the implementation of ICT in a studio an expensive effort.

While ICT can enhance aspects of the studio learning environment, implementing them may serve as a distraction to the learners. We interviewed a local professor experimenting with non-traditional teaching styles who decided to upload lecture videos on YouTube so that class time could be spent on more experiential activities and individual learning exercises. The professor experienced some complaints from students that the material was not very interesting and YouTube’s suggested videos would draw them away; however, the professor used YouTube as an alternative to the Coursera online teaching program which students are unfamiliar with. As explained in section 2.3.1, students do not resonate well with programs they are unfamiliar with. For this reason, the type of ICT solution implemented in non-traditional pedagogies must strike a balance between familiarity and engagement.

2.3.3: Examples of Current ICT Solutions

In this subsection, we will explore some newer technologies that have been recently implemented in learning environments. Through studying the following ICT solutions, we

become more aware of the possibilities that are available to us for our proposition. The examples that follow were chosen to fulfil three categories of ICT that we may consider for the Studio at Copenhagen Business School: a hardware solution, a software solution, and a program for a specific teaching tool.

2.3.3.1: Hardware Solution: Wacom Technology

Wacom products are a staple of design and art studios in the twenty-first century. The international company has a line of graphic tablets that typically come equipped with design programs such as Photoshop Elements and Corel Painter Essentials, as well as being equipped a digital pen that is compatible with the specific model. They have a line of drawing pads intended for home users or professional artists, and they also sell a tablet with an integrated LCD screen. A high end Wacom device is illustrated below in Figure 2. These tablets typically connect to a computer via a USB cable, and use their pressure-sensitive drawing surface as an input for the computer's functions (Creative Products, n.d.).



Figure 2 - Wacom Intuos Pro Special Edition (Creative Products, n.d.)

The brand's website has a page devoted to business solutions with Wacom. Since the studio at CBS should have hardware that may be used in the business industry, this technology may be a suitable option to implement into the Studio. The interactive displays offered by

Wacom support several partners' software to broaden the devices' functionality; examples can be found in Appendix A (Business Solutions, n.d.).

2.3.3.2: Software Solution: Tidebreak

This company creates interactive spaces to be used in team, business, or classroom environments. This ICT allows multiple users to gain access to a shared desktop display, typically on a projector or a large screen. It is accomplished through a server-driven software that students can install on their own personal laptops (Koeller, Koemans, & Woody, 2005). ClassSpot PBL, illustrated in Figure 3, is the software that they offer for specific use in an interactive classroom for project-based learning, from which ClassSpot PBL gets its name.



Figure 3 - ClassSpot at Middle Tennessee State University (ClassSpot PBL, n.d.)

ClassSpot PBL is designed to blend teaching with team interaction by utilizing technologies from their two other software: TeamSpot and ClassSpot. TeamSpot creates a 'group worksurface' that allows each individual with a laptop to move content and files to the shared worksurface. This grants each team member the ability to complete individual tasks while still encouraging collaborative efforts. The ClassSpot software is designed to provide a

screen to capture the attention of a body of learners, while allowing the learners to share information wirelessly with their own personal computers. The teacher using this software leads discussion with the main presentation as a focal point, and he or she has access to ‘faculty only’ features that control the access that the learners have to the front screen. In combining these two software, ClassSpot PBL allows a facilitator to present information and guide the learners by assigning tasks to each team’s group worksurface, while also allowing the groups to share their results or research with the front screen that the teacher uses (ClassSpot PBL, n.d.).

2.3.3.3: Teaching Tool: Coggle

Coggle is a cross-platform software that enables users to convert information into a visual representation of key words and their association with other words or topics. Figure 4 illustrates what a ‘mind map’ by Coggle looks like. Typically, a mind map begins with a central focus that serves as the topic. Next, subcategories would branch out of that center, further breaking down the concept into smaller topics. Each individual user may format their mind map differently based on how he or she relates the concepts therein. A 2002 study showed that learners who studied using mind-maps recall significantly more correct information than those who study using their own methods (Farrand, Hussain, & Hennessy, 2002).

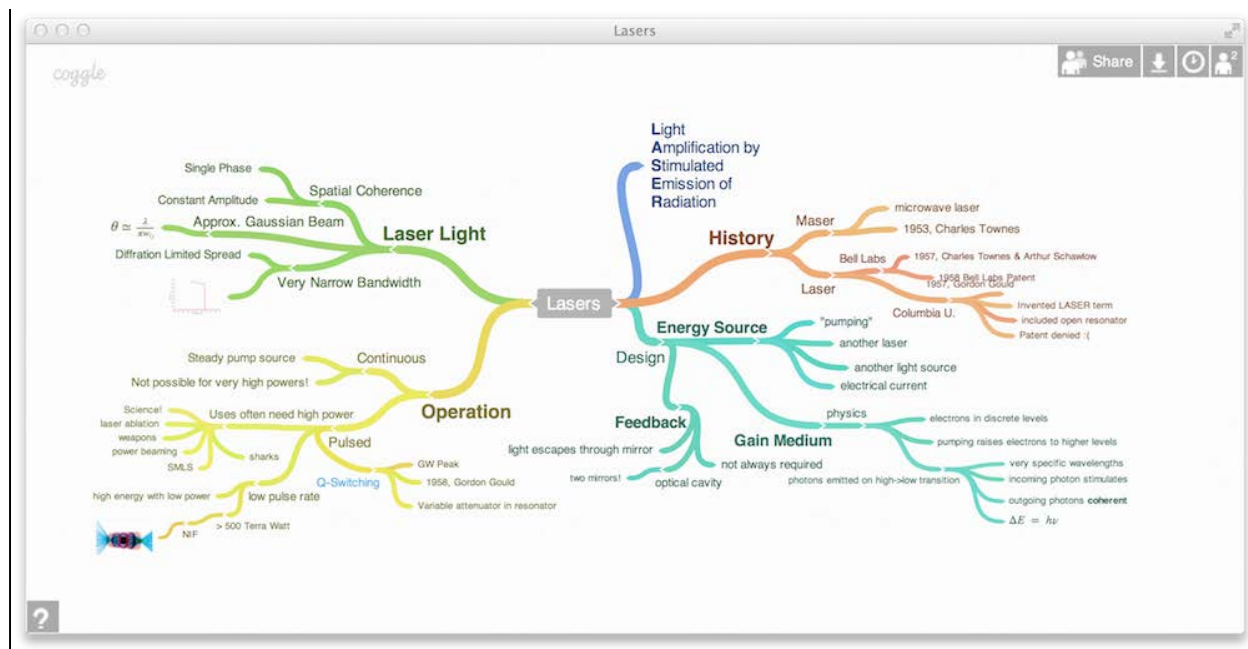


Figure 4 - Mind Map by Coggle (Coggle, n.d.)

Coggle easily develops mind maps that can be shared with other learners or faculty. It is cross-platform, meaning it can be used on Windows and Mac computers, because it is based in a browser. It also operates collaboratively. This enables users to start a mind map and grant others permission to contribute their information, or create an incomplete map and ask learners to fill in blanks. Another interesting feature in Coggle is the ability to drag-and-drop pictures from the web directly into the map. Coggle is still in a beta phase right now, but it is free for users who have a google account (Coggle, n.d.).

2.3.3.4: Significance of ICT Examples

While these examples of currently used ICT have proven helpful in classroom environments, it is beneficial to note that these have not been successfully implemented in a studio environment. The differences between studio and traditional learning highlighted in previous sections imply that they require particularized attention when considering what would

benefit each method. These three examples serve as stepping-stones towards reaching our eventual goal by providing information on a current hardware solution, software solution, and specific teaching tool.

2.4: Business Education

The goal of a business education is to prepare students to solve a multitude of problems potentially faced in the business world. As described in *The Cambridge Business Review* “the pivotal objective of teaching business studies at higher education level is enhancing and updating the knowledge and capabilities of students to meet the challenges of time.” (Ali, 2008). Students need to be equipped with the problem solving tools, interpersonal skills, and domain knowledge to solve real-world problems. After Enron’s well-publicized collapse in 2002, and the 2008’s global financial collapse, a greater emphasis has also been placed on ethical decision making in business curricula (Archer, 2004).

2.4.1 Business Education Issues

The recent economic collapse of 2008 can be partially attributed to the failures of the current prevailing business education model. In a lecture hall, the required problem solving and ethical evaluation skills are difficult to teach properly. Other aspects are being emphasized, such as maximizing profits and shareholder value within a company. With little education in systems thinking, graduates are going on to make decisions that improve profits in the short term at the expense of long term stability. Business students would be able to practice these key skills in a studio classroom (Taylor, 2014).

A traditional lecture-based business education does not adequately get students involved with real-world cases in order to develop their skills and apply acquired knowledge. In order to

develop professional skills, business students need to be working together on projects, not sitting in a lecture hall and reading through case studies. By using the latest technologies and working with businesses on real projects, students can better meet educational outcomes and be better prepared for the business world (Ali, 2008). Again, these educational outcomes can be met within a studio environment.

2.4.2: Non-ICT Business Education Improvement

Business education outcomes could be altered by making a few simple changes, which many consider to be beneficial. Having group discussions introduces students to considering many points of view before forming a plan of action. Changing the discussions into debates helps develop critical thinking and rhetoric skills that will be important in leadership positions within businesses (Ali, 2008).

Class size is a common issue among many academic disciplines. It is hard to have a hundred students in a lecture hall develop the practical skills they will need in a business environment. By shrinking class sizes, student to student and student to teacher interaction will be increased, and time will be freed up for activities that allow skills to develop. Adding on to this by changing to a studio classroom will allow for a broader range of activities that can develop more specific and relevant skills. Shrinking class size does come at a cost, however. Fewer students per professor results in an increase in professors needed to teach the students. More professors means more instruction spaces that are required.

2.4.3: Alternative Pedagogies

Outside of generic improvements for business education, another way of improving the education is through the adoption of alternative pedagogies. Traditional education is having the

professor lecture during class hours, and assign work and projects for outside of class.

Alternative pedagogies aim to alter the structure of class time, or change the focus and delivery of teaching.

2.4.3.1: Critical Management Studies and Critical Management Education

Two core issues of business education, specifically the management area, are politics and abstraction. Management education has largely attempted to remain neutral on politics, trying to avoid discussing moral and political viewpoints in relation to management methods. However, it's argued that management education is inherently politicized, and this fact must be discussed in the education process itself. When you are managing other people, you must make decisions that can affect others negatively, and you will have an inherent bias (Grey, 2004).

Abstraction is a very important scientific concept; one that many educators have attempted to work into management education. Being able to create overarching solutions for nonspecific problems can save time, money, and effort. Management, however, is a messy and complex process. There is debate as to whether or not management problems can be abstracted, due to a large number of variables that are in each scenario.

2.4.3.1.1: Critical Management Studies

Critical Management Studies (CMS) is a broadly used term to define a management education system that is an “overtly politicized version of management studies.” (Grey, 2004). This education system accepts that management education is inherently a politicized education. CMS doesn't focus on neutral techniques for management; instead it focuses on teaching proper values to the students. The values may differ from course to course – for example, the CMS Workshop website states that profitability is a value (Train-the-Trainer Workshops, n.d.)– but the much more important aspect of CMS is the focus of values.

2.4.3.1.2: Critical Management Education

Critical Management Education (CME) is a more practical and less theoretical education system that is spawned from the core concepts of CMS. CME, like CMS, acknowledges the politicization of management education, and embraces it in order to teach students. Much of traditional management education, as previously stated, is abstracting management problems. Having a solution for a certain problem should allow for a different, similar problem to use the same solution. This is where CME drastically differs from traditional learning. CME says that abstraction in management is impossible due to the cluttered, crazy mess that management is.

Instead, CME focuses much more strongly on actual experience, and increased observation of cause and effects from personal actions. For example, in a generic group project that is assigned, group members regularly meet outside of normal meetings to analyze what effects their choices and actions had on the project process (Grey, 2004).

Overall, CME suggests a stronger focus on values and experience in management education systems. This can be extended to cover all forms of business education, and can help with the studio.

2.4.3.2: *Demonstration-Based Learning*

Demonstration Based learning (DBL) is another possible route to improving business education. Business education has been criticized for focusing too heavily on theory, as opposed to having the students learn the “hard-way” through self-experience. However, with large class sizes, this could cause issues due to lack of personal interaction with the professor. DBL helps to solve this issue by having visual demonstrations, whether through video, group discussion, or practice. DBL is based on social learning theory (Bandura, 1978). The goal of DBL is to allow students the opportunity to observe management methods, in hope that the learner will be able to

correctly apply the method themselves for all relevant opportunities (Gutierrez, Ketschke, Lextrait, & Rosen, 2011).

DBL is an education system that embraces abstraction. It focuses on enabling students to learn management methods through observing, with the hopes of later applications. DBL also enables a much more interactive classroom style, much akin to the studio learning style, and many aspects of one can be drawn into the other.

2.4.3.3: Flipped Classrooms

Traditional education styles mostly consisted of lecturing during classroom hours, while students would have to complete homework assignments and projects outside of class. With the advent of easy access to technology, a new form of teaching has arisen. Flipped classrooms take the previously mentioned traditional education styles and flip them. Students hear lectures and read notes online, outside of the classroom. When they come to the classroom, instead of lectures, they work on assignments or projects in the class.

Flipped classrooms have a number of benefits over traditional learning styles. Teachers are able to have a much more active role in the student's education, due to the actual work being done in the presence of the teacher. If the professors teach the same class multiple times, they can fine tune various lectures to be more relevant. Students can listen to lectures at their own pace, and can even re-watch parts they didn't understand. Many students have said that they enjoy blogs/videos over books, as well (Steed, 2012).

There are criticisms of the flipped classroom, however. Flipping the classroom requires a heavier devotion of the teacher's time to planning and recording lectures (Ullman, 2013). If the students don't understand the material in the courses, in-class time can be wasted through too

many redundant questions (Hamel, 2014). The continued problem of lack of technology literacy also rears its head here, as both the teacher and the student are required to be adept at using the necessary technology (Tucker, 2012). Having students watch videos online can cause unnecessary distractions. Due to the sidebar of YouTube showing different videos, students complained about it hard to focus on watching the given videos consecutively (Hamel, 2014).

Flipped classrooms seem to benefit business education business greatly, as they can promote a much more interactive classroom, but do have several pitfalls that must be accounted for.

2.4.3.4: Project Based Learning

Studio learning is often incorporated with project-based learning, a pedagogical approach arguing that students learn best when they apply what is learned in the classroom through completing projects. Students are given a project that will force him or her to demonstrate an understanding of what was discussed in lecture, and also push him or her to develop further knowledge in the field. A studio environment complements the gains of a project based curriculum.

Projects are similar to those seen in the educational discipline so that the student will have already faced some of the core domain challenges upon entering the workforce. A large body of research has shown an increased learning and mastery of subject material among students who engage in Project Based learning. The independent learning encouraged by project work helps students learn problem solving skills similar to those of professionals in industry (Thomas, 2000).

In multiple studies, schools with a project based curriculum posted better standardized test results, despite testing students less in class. An interesting bonus to the implementation of a project based curriculum is that teachers reported being more confident in their ability to have students meet educational outcomes, and they felt that they were able to give their students better feedback (Taylor & Ladkin, 2013).

The pedagogical gains from Project Based learning have been firmly established and are directing many institutions to change their curricula. Increases in test scores, student engagement, problem-solving skills, creativity, and other “21st century skills” are impossible to ignore (Jocelyn & Oliver, 2005, Thomas, 2000). These improvements align with the goals of studio learning. In addition, class work in studios often takes the form of long-term projects. The studio classroom allows for professors to engage with students and help them in solving these difficult projects while also serving as a creative space that encourages creative and collaborative problem-solving of difficult challenges.

2.4.3.5 The Case Study Method

In 1910, Harvard Business School introduced a new teaching pedagogy in the form of case studies (Rebeiz, 2011). This education method consists of presenting students with a problem (referred to as a case study) that they must analyze outside of class, both individually and in a group. Class time is then spent by the professor facilitating discussion between the students, often calling on various students at random. The discussion is fast-paced and debates between students are frequent and encouraged. The Case Study Method (CSM) forces students to form opinions on problems that will arise during real-world business, while challenging them to defend their thought process. The CSM also helps facilitate professor-student interaction, as students are forced to respond to questions posed by the professor.

This pedagogy cannot be ignored due to the usage by Harvard Business School, which is ranked as one of the top business schools in the world. The CSM has helped the Harvard Business School to produce high-quality business graduates, by highlighting the importance of hands-on education. The students are able to learn many, if not all, of the critical skills mentioned earlier by being forced to have an active involvement in the classroom.

The benefits of the CSM are similar to those of studio learning; the goal of the class is to engage students and teachers in active participation, whether through discussion or activities. While a studio space allows for furniture to be moved and other activities performed, an ideal classroom for case study learning is a layered semi-circle that allows all students to see each other. Figure 5. A CSM classroom can be seen as a fixed set-up of a studio space that aims to suit a single activity.



Figure 5 - Case Study Method Classroom

There are many established nuances with traditional lecture-based business education. However, there exist plenty of options to improve the process. We have explored multiple possible solutions, such as class size, introducing technology, and differing pedagogies. Our project will be exploring the alternate pedagogy of studio learning, and adding information communication technology to it.

3.0: Methodology

Our objective is to find ICT hardware and software options that will aid professors in teaching courses at the Copenhagen Business School Studio. We will be proposing a set of ICT solutions for multiple budget levels, as the available funding is not yet known.

Our team will be working mostly on-site at the Studio from March 17th until May 6th. The implementation of our solutions will take place after our departure. We hope to persuade the administration at the CBS that certain technologies can have a positive impact on student engagement and learning in the Studio.

The following steps will be taken to complete our objectives:

- Identify the educational outcomes of the Studio in the context of the CBS
- Identify the current state of the Studio in terms of technology, infrastructure, and classroom space.
- Determine the technological literacy of students and faculty at the CBS
- Bring together our findings to find the best solutions for established budget ranges

These points are illustrated in Figure 6 below:

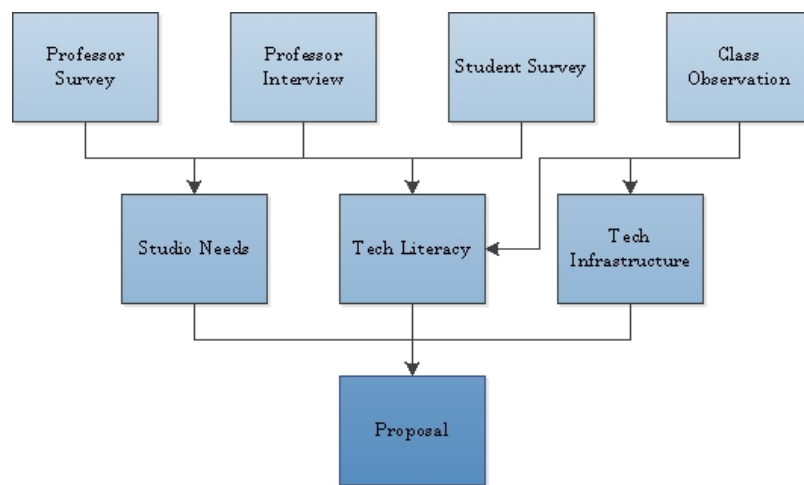


Figure 6 - Objective Roadmap

We aim to complete these stages of our project according to the timeline illustrated by

Table 2 below:

Table 2 - Gantt Chart

Tasks	Week							
	Prep	1	2	3	4	5	6	7
Identifying Goals	█							
Current State		█						
Technological Literacy			█					
Solutions					█			

3.1: What are the desired outcomes of the Studio?

In order for our project to be successful, we must first look at the broader picture of our goal: establishing the desired outcomes of the Studio. This involves three parts: what the faculty want, what the students want, and what skills businesses want students to learn. In our project we will mainly focus on the needs of the faculty. By suggesting solutions to improve the Studio, we will be changing the way classes are taught and the methods that professors use to teach. The faculty need to be able to integrate studio learning and ICT successfully. At the end of the project, they will be the ones deciding if the solutions we provide them are beneficial.

The needs and desires of the faculty can be found through surveys and interviews. We plan to conduct interviews because we can get specific opinions and more personalized data to find out what exactly teachers want from the Studio. We will ask our sponsor for names of professors currently using the Studio, and ask them a series of questions ranging from what the

studio is currently doing right, to what the studio can improve upon. We will also interview professors who do not currently use the studio, as a different perspective on the studio will be useful in order to improve it. We plan on conducted recorded interviews with at least two professors who have used the studio, and at least two who have not. An example of the questions we will ask can be seen in Appendix B. We also plan on surveying professors in order to get more information and more opinions on studio learning, as well as technology used and technological literacy, which will be referenced in sections 3.2 and 3.3, respectively. We will determine the best way to contact professors and reach as many professors as possible. An example of the survey can be seen in Appendix C. We will observe current courses being taught in the Studio so we can determine what is lacking, and have a firsthand experience on what needs to be done to improve the Studio. We will look to see what methods the professors are using now to teach and how interested the students are. We will also see how much information is being taught during a studio class.

The students' needs are also important, and must be taken into consideration. Students must be willing to experiment with studio learning, meaning they must be open to changes in the ways they are being educated. Students require an engaging environment in order for their education to be successful. We will conduct surveys to see what students' opinions of the studio are, and what changes they'd like to see. Examples of questions that will be asked on the survey can be seen in Appendix D. We will aim to contact the students directly by handing out questions in survey form during class times, and if more information is necessary, by emailing questions to students directly. This also gives us an opportunity to ask questions pertaining to the use of technology by students and their technological literacy that will be discussed in Section 3.2 and Section 3.3, respectively. As we are looking for the general needs of students,

specifics that we could learn about through interviews are not necessary. Given extra time, we may also ask recent graduates of CBS what they wish they had learned in class that they later learned in the business world. This will help us understand what gaps in learning there are at CBS.

Finally, we may want to find out what businesses want graduates to know. Businesses' opinions are important as they will be the ones hiring the students. The faculty aim to educate the students in such a way that the student's education can be used in the real world. Using email, we may contact businesses that are interested in what studio learning has to offer, while inquiring about what skills they would want new hires to have. This will enable us to better know what skills students should be trying to develop through the Studio with the help of ICT.

3.2: What is the current state of the Studio?

A necessary step towards determining the goals for the studio at CBS is to identify the current infrastructure it has. Even before considering ICTs to implement into the Studio program, it is valuable to examine the state of the old and new studio spaces. This allows us to recognize opportunities to enhance the teaching ability of the professors, as well as improve the learning environment for the students. Once this has been achieved, we will have the ability to search for ICTs that specifically address concerns by the involved parties.

Our team plans on evaluating the teaching and learning conditions of the studio program, both physically in layouts and equipment being used, and conceptually in lessons being performed in the studio space. These evaluations will prove helpful in narrowing down the possibilities of ICT solutions we can introduce. By restricting our choices to those that would increase the effectiveness of the current studio, we can provide optimized solutions. Identifying

limits of the new studio space allows us to narrow down our options by pinpointing restrictions that we would need to provide additional solutions for or work around.

The degrees to which we will evaluate the current state are:

- Identify equipment used by faculty during lessons
- Identify equipment used by students during lessons
- Organize a list of classes taught at the studio and types of lessons
- Determine infrastructure of new studio building
- Identify layout of new studio building
- Identify restrictions and areas in need of improvement

We will start our examination by sitting in on lessons performed at the studio within the first week or two. We will evaluate the current level of technology that is used in the Studio by the various users of the studio, including professors, student groups, and local businesses. We will take note of the subject of the activity taking place, the lesson's activity, and the equipment used by students or faculty. A chart with the information that needs to be observed will be available to the group member sitting in on classes in order to keep observed data organized. The chart will be formatted similarly to Table 3 below, but additional information may be added as necessary.

Table 3 - Studio Observation Chart

Facilitator:	Describe Activity:	Student Equipment:	Other Notes:
Subject:		Faculty Equipment:	

This data will give us a greater understanding of what the studio space is currently used for, how each lesson or activity is conducted, and deficiencies in the studio space that could be improved. We can use the knowledge of the current level of technology and the learning environment in order to gain context for the ICT solutions that we will propose. We will need to consider the cost-benefit analysis for each ICT solution. If current technology is already present that will only be marginally improved by our proposition, then that proposition will be a lesser priority than a proposition that drastically improves a process in the studio. These priorities will be addressed more in-depth in section 3.4.

As mentioned in section 3.1, surveys will be conducted to gather information about the current state of the studio as well. The faculty and students can give insight to what types of technologies they have used in the Studio and what kinds of lessons have taken place.

After determining the current knowledge of the studio as it stands today, we must find out the state of the new studio space that will be occupied in the coming years. Our ICT solutions will be implemented into the new studio space, so it is useful to know the infrastructure and the layout of the new studio. We will contact and interview an IT personnel, and ask them about the current IT infrastructure levels of the new studio space. In the interview, we hope to find out

information such as the bandwidth limitations, and the current use of ICT in the new studio space.

In addition to the learning about the infrastructure of the new space, it is helpful to determine the physical layout of the building. Different ICT will be needed depending on the size of the area available. ICT needed for a larger area will differ from ICT needed in smaller, sectioned areas. We will take pictures of the new studio space to be able to reference what the space will look like, and we will draw a rough blueprint so that we can have an idea of where the ICT will be implemented in the near future. This information will further narrow our possible solutions so that we can choose the most appropriate solutions to the CBS.

After we find all of this information, we will meet as a group and identify specific needs that must be met before choosing ICT solutions. We also will keep a list of restrictions guiding our search for when it is time to choose the technologies that will best suit the needs of the Studio. For these reasons, the lists will be crucial in our decision-making process, which are discussed more thoroughly in section 3.4.

3.3: What is the current technological literacy?

Another necessary step to prepare the Studio for increased ICT is to judge the technological literacy of the teachers and students. If the teachers and students aren't able to use the technology we propose, they will struggle to complete their education. As has been discussed earlier, many people have trouble adapting to new technology. If we can ascertain what technology the teachers and students are comfortable with, we can narrow down what ICT solutions we wish to propose.

Teachers are the crux of the technical literacy issue. Teachers must be able to use the technology to create their lessons, and be able to instruct students on its use. If the technology is

too complicated or unfriendly to the teachers, they will simply not use it, and it will go to waste. By adding questions to the survey, we will be able to judge the teachers' average technical literacy.

In addition to running a survey, we plan on selecting several teachers randomly to interview. In this interview, we will ask about their preferences in technology and their comfort level with using various technology. These interviews will enable us to get a more in-depth knowledge about the technological literacy of the professors, which in turn, will allow us to better implement ICT solutions that won't cause problems with their lessons.

Judging the students' technological literacy is also an important step. If the students are unable to use the technology well, their grades and motivation may suffer. Students routinely have their own pieces of technology that they bring to class, which can increase their technological literacy. Many students own, use, and bring both a smartphone and a laptop to class. What technology they own does not, however, define the students' technological literacy levels. We will still need to survey the students on their technical literacy, while also asking about what technologies they bring to class. This way we can learn about the abundance of student-owned technology, and their levels of literacy.

3.4: Propose ICT implementations for various budget situations

With the myriad of ICT options available, the first step in creating a proposal will be to list each technology option, along with its pros, cons, characteristics, and cost. As results from our on-site work are processed, we will continually evaluate the solutions on our list, and remove any that we deem to be unfeasible, unsuitable, or unsatisfactory for the Studio.

ICT solutions will be evaluated in various ways, such as their cost, effectiveness, ease of use, and any other variables that we find are important through our on-site work. For example,

we may find that the Tidebreak software would be too difficult to use for either the students or faculty. It is also possible that the activities run in the Studio classroom would have no use for the Wacom tablet. All of these decisions rely on input from students and faculty at the Studio.

If time permits we would like to test an implementation of one of our proposed solutions. Testing is a secondary objective, but if given more than a week and a half at the end of the term, we will work with our sponsor to run a classroom activity that uses an ICT solution. We will survey students on whether they thought the technology improved the classroom experience, as well as asking the professor whether the technology helped students meet the goals of the activity. We will also ask both parties how easy the technology was to use. Our findings will be included in our final report, and our proposal on the specific technology will be changed based on the results of the study.

The final step will be to break the remaining options into budget ranges. The budget levels will be determined in collaboration with our sponsor, Stefan Meisiek, and anyone else at the CBS who has oversight of the budget. Based on survey and interview results we will identify the pieces of technology most desired for the Studio. We will then add on other solutions to higher priced 'packages' to further improve the Studio if higher funding is available. It may be the case that the sponsor uses our most basic proposal at first, and then adds technology from higher levels as funding becomes available over time. Our proposal will not only need to identify the technology itself, but also the attempted educational outcomes, such that the sponsor would be able to substitute in newer technology solutions years down the road.

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Appendices

Appendix A: Wacom Software Partners

- **Presentation/Whiteboarding:** Wacom's pen display and tablet products work with any whiteboard or presentation software. Here are some that feature a variety of pen, marker and other tools that take advantage of Wacom's pen input.
 - **Open-Sankoré (Sankore):** Open-Sankoré is a multiplatform, open-source program that is available for free. It has a whiteboarding environment that allows you to open prepared content or create and add content spontaneously. Open-Sankoré also provides tools for desktop annotation that allow you to reference and mark up content and applications outside of the whiteboarding environment.
 - **Wizteach (Qwizdom):** WizTeach is interactive teaching software designed for use with any interactive whiteboard. Its tools are designed to enhance teaching and learning outcomes across multiple subject areas. The innovative toolbar design lets you open as many or as few of the tools as you like. And WizTeach offers versatility because its toolset can be used over any application.

WizTeach works on Windows, Mac and Ubuntu.
 - **Easiteach (RM):** Easiteach is a complete whole-class teaching and learning application that puts you in the driving seat for creating and delivering engaging lessons and resources. It can be used in two different modes. The primary mode is a whiteboarding mode. The other – known as Glass Mode - provides an annotation layer over any application. Easiteach has been designed to be extremely flexible and can be used across different manufacturer's hardware.

Easiteach provides a host of powerful tools and features that help you create and deliver engaging lesson plans. Glass mode gives you the ability to annotate over applications even when outside of Easiteach's primary whiteboarding environment. Easiteach supports both Windows and Mac.

- **PDF Revu (Bluebeam):** PDF Revu is an extremely powerful application for PDF creation, markup and editing. With its effective toolset, it can be used as a platform for presentations. Create materials in advance or start with a blank slate. Insert new pages to existing documents as needed. Pen and marker tools let you add information, notes, and sketches to your material. The application also offers a host of drawing, shape and editing tools. PDF Revu also gives you great flexibility on how to configure your toolbars – to make them as simple or complex as you would like.

PDF Revu supports full screen mode which allows you to present your document like a slideshow. In that mode you still have access to pen and marker tools.
- **PowerPoint (Microsoft):** PowerPoint is the most widely used presentation application. PowerPoint includes pen and marker tools that can be used in slide-show mode to add content, annotate or highlight key points. If you are using PowerPoint with windows, you can save all your annotations and markings as part of the file. If PowerPoint 2007 or a later version is used on Windows Vista or later, PowerPoint also gives you access to pen tools in slide-creation mode – which means that you can add hand-created content when creating slides.
- **PDF Annotator (Grah!):** While PDF Annotator is geared more toward document review, mark-up and commenting, it can serve as an effective

presentation tool. Documents created in any application can be converted to PDF, then opened in PDF Annotator. The application offers a host of pen, marker and drawing tools to allow you to enhance your material or create new information. The pen and market tools support the pen pressure information that Wacom's pens provide. If you need to add to your prepared content, new pages can be inserted into the document. When you exit a document, you can save your annotations.

PDF Annotator also has a full-screen mode which displays your content like a slide show. While in full-screen mode, you still have access to your annotation, mark up, and edit tools.

- **Ink2Go (EyePower Games):** Ink2Go is screen annotation and recording software. You can easily write on top of any other application that is currently active on the desktop, even a video window – Ink2Go acts like a virtual transparent overlay. Your annotations can be saved as an image file, or you can record your session as a video. Ink2Go features pen and marker tools, with selectable colors and widths, to help you communicate and share your ideas. For both PC and Mac.
- **Screen Capture and Content Hosting:** Screen capture is a valuable tool in today's classroom. Capturing all of your notes, annotations and drawings as part of the presentation helps recreate the live, face-to-face interactions. And once your presentation has been captured, it can be posted for students to access and view. For flipped classrooms, screen capture is a key component to creating content for students to view

and study outside of the classroom. For more traditional classrooms, lectures can be captured and archived for students to access at a later time to aid in their studies.

- **Camtasia Relay (TechSmith):** Camtasia Relay provides an easy way to record lectures and presentations and publish them for students to view at a later time. Class sessions can be saved for students' review to solidify their understanding, or to catch up if they missed a class. Camtasia Relay's screen recording makes all of the technical decisions at a central server, making publishing of recordings simple.
- **Camtasia Studio/Camtasia for Mac (TechSmith):** Camtasia is an easy-to-use, powerful tool for recording lectures and presentations and turning them into videos for students to watch as a study aid. Capture anything on your screen – all the real-time elements needed for effective communication and knowledge transfer. Camtasia has enhanced editing tools to let you polish your video before publishing.
- **Snagit (TechSmith):** One of Snagit's many features is to do screen captures. Once you create screen videos, you can share them instantly to YouTube, Facebook, and elsewhere. Snagit also features a host of tools to help you communicate visually.
- **Ink2Go (EyePower Games):** The Ink2Go screen annotation application includes a screen record function, allowing you to turn your annotations into video to share with others.

- **Open-Sankoré (Sankore):** Open-Sankoré provides a screen-record function to complement its whiteboard and annotation capabilities. Save your work as a video and share it with students at a later time.
- **Eduvision (JDL Horizons):** EduVision from JDL Horizons is a full-featured video streaming platform and Internet broadcast television service that allows you to upload and run your video on your website. Schools can use it to control and host their own video content, including teacher- and student-created presentations and lesson plans.
- **Lecture Capture:**
 - **Vision (DyKnow):** DyKnow's Vision lets educators present, share, and record and archive content. In addition to notes and annotations made by the teacher, students can add (and save) their own personalized notes directly onto the lesson plan content. At the end of each class students leave with the teacher's notes and their notes in a personalized notebook which can be replayed anytime, anywhere. In addition, Vision includes a variety of collaborative tools to encourage student interaction.
 - **Campus (Tegrity):** Tegrity Campus is a fully automated lecture capture solution used in traditional, hybrid and online courses to record lectures as well as supplementary course content. Its personalized learning features make study time incredibly efficient and its ability to affordably scale brings this benefit to every student on campus.

- **Mediasite (Sonic Foundry):** Sonic Foundry created Mediasite as a purpose-built, appliance-based platform for lecture capture. It features an automated workflow to record, deliver, manage, search and track video-based instruction. The Mediasite Recorder automatically turns itself on and sends whatever instructors present – on a laptop, tablet, whiteboard, document camera, visualizer – to the Mediasite Server, where it is streamed live and archived for immediate playback on demand. It integrates with your existing classroom and campus systems to make it easy to take courses online.
- **EchoSystem (Echo 360):** EchoSystem automatically creates, produces, manages and shares instructional content for student review anytime, anywhere. The EchoSystem is friction-free for institutions, reliable enough to take on the largest deployments in the world, but agile enough to painlessly record and produce instructional media everywhere teaching occurs.
- **Distance Learning/Collaboration:**
 - **Collaborate (Blackboard):** Blackboard Collaborate's web conferencing creates a rich environment for remote learners. Its capabilities include two-way audio, multi-point video, interactive whiteboard, application and desktop sharing, rich media, breakout rooms, and session recording. Collaborate also integrates with many of the leading learning management systems.
 - **Connect (Adobe):** Adobe® Connect™ for eLearning provides the ability to teach and communicate to a dispersed audience. With Connect, you can create and deliver virtual classes and on-demand courses, share animated presentations, video, audio and images, or use the integrated whiteboard tools to enliven

classroom discussions. You can also integrate content created in Adobe Presenter or Captivate to increase the interactivity of your lessons.

- **WebEx (Cisco):** WebEx web conferencing lets you connect with anyone, anywhere, in real time. WebEx combines desktop sharing through a browser with phone conferencing and video, so everyone sees the same thing while you talk. Utilize the built-in annotation and whiteboard features to enhance collaboration and information sharing.
- **GoToMeeting (Citrix):** Citrix's suite of products (including GoToMeeting and GoToWebinar) provide unified conferencing for presentation, collaboration, training and teaching. All products in the family support desktop and application sharing and have drawing tools that can be used within their interface.
- **Skype (Microsoft):** Skype supports screen sharing via Skype Premium. Combined with a whiteboarding or desktop annotation application, hosts can deliver a lesson plan and interactively mark up, annotate, or incorporate input from others.
- **Telepresence Systems:** Telepresence systems can support the integration of peripherals that can aid in collaboration and communication of ideas – like Wacom's pen displays and tablets. Here is a sampling of companies with telepresence solutions.
 - Cisco
 - Polycom
 - Vidyo
 - Radvision

- Vue
- Teleris
- **Classroom Management:**
 - **Monitor (DyKnow):** Supervise, guide and interact with students on their computers or encourage collaboration with this user-friendly classroom management software.

Appendix B: Professor Interview Questions

- What classes do you teach in the studio at CBS?
- Are there any unique lessons you conduct that you find the studio space is ideal for? If so, describe them.
- What technological equipment aids you in your lessons in the studio?
- What non-technological equipment aids you in your lessons in the studio?

Appendix C: Professor Survey Questions

- What classes have you taught in the Studio at CBS?
- Do you prefer teaching classes at the Studio?
- What are the most beneficial parts of teaching in the Studio?
- What areas can be improved on in the Studio?
- What technological equipment have you used for lessons at the Studio?
- What non-technological equipment have you used for lessons conducted in the Studio?

Appendix D: Student Survey Questions

- What classes have you attended in the Studio at CBS?

- Do you prefer to take classes at the Studio? Y/N
- What are the most beneficial parts of taking lessons at the Studio?
- What areas can be improved on in the Studio?
- What technological equipment have you used for lessons conducted in the Studio?
- What non-technological equipment have you used for lessons conducted in the Studio?
- What technology do you bring (i.e. Smartphone, Laptop) to lessons at the Studio?