

Designing A Home Video Studio For Online Synchronous Teaching

September 11, 2020

Sean P. Willems

Haslam Chair in Supply Chain Analytics, Professor of Business Analytics and Statistics

Haslam College of Business, University of Tennessee, Knoxville, TN 37996

willems@utk.edu

Abstract

COVID-19 forced universities to move online in the second half of the 2020 spring semester. That transition was necessarily rushed, but faculty and students benefited from the fact that all participants were familiar with cultural and teaching norms. New students entering programs in the summer and fall of 2020, however, do not have the advantage of immersion in their cohort's culture or their school's teaching norms. This document describes my attempt to create a home video studio to more closely approximate the on-campus experience, and provides recommendations for a minimally-sufficient studio.

Key words: home studio design; on-campus teaching; online synchronous teaching

History: Current version: September 11, 2020

1 Introduction

The studio in Figure 1 was designed and built in 30 days. On April 22, 2020, I learned I needed to deliver my summer operations management course fully online. I spent 14 days trying to find studio space, before my family graciously volunteered to give up space in our house. The design and implementation began on May 6, for a June 5 go-live date.



Figure 1: The completed studio includes two camera stations in a 420 square foot room.

Five experiences most influenced my design approach:

- In collaboration with Steve Graves, creating two MITx courses: [15.762x Supply Chains for Manufacturing: Inventory Analytics](#) and [15.763x Supply Chains for Manufacturing: Capacity Analytics](#). These eight-week courses have each run multiple times with thousands of participants and hundreds of verified learners.
- In the fall of 2019, developing supplemental online content for my on-campus graduate elective [BZAN 555](#) using the Haslam College of Business' lightboard studio.
- Teaching online class sessions in the spring of 2020. I was not the instructor of record for any class but I did lead class sessions for cases I had written.
- Watching my college-aged children shift abruptly to online distance learning in the spring of 2020.
- Reading the student feedback UT and MIT provided faculty regarding the student experience with online learning in the spring of 2020.

These experiences gave me the opportunity to reflect on the profound differences between asynchronous online courses (i.e., MITx) and synchronous on-campus courses (i.e., MIT and UT). As an operations person, I immediately mapped this to the educational equivalent of the product-process matrix, as shown in Table 1.

Student location	Online	Spring and Summer 2020	Traditional edX/MITx
	In-person	Traditional on-campus	
		Synchronous	Asynchronous
Delivery method			

Table 1: Course delivery can be mapped to the dimensions of student location and delivery method.

For those unfamiliar with the product-process matrix, the core insight is that the main diagonal is an efficient use of resources, and the off diagonal is inefficient. From Table 1, this insight implies that online-synchronous courses are potentially suboptimal in terms of faculty effort and the student experience. Furthermore, my MITx experience convinced me I could not easily transfer my on-campus course to a synchronous online format.

I have heard my colleagues say our competition is Netflix, TikTok, YouTube, and similar platforms. I disagree. Our competition is our own teaching, reimaged in a world of TED Talks and high-quality talking head productions (like Frontline, 60 Minutes, etc.). For summer 2020, I had the added challenge, relative to the spring semester, that the students had never seen a high quality, on-campus business school product. Students that have seen us in the classroom understand the mapping from on-campus to online. If they have never seen the on-campus product, they don't know what they don't know. For these new students, the production quality really does matter.

In 2018, I was teaching the on-campus equivalents of the MITx courses when I agreed to participate in 15.762x and 15.763x. I remember thinking how great the timing was, because we could videotape the on-campus courses and integrate them into the asynchronous format of MITx. After taping four on-campus classes, I had a discussion with John Liu, now MITx Digital Learning Fellow. After reviewing the videos, John basically said:

These videos are great but we can't use them. They perfectly capture the on-campus experience. Online learners watching these videos would come away wanting to be on campus at MIT, and they are not on campus at MIT. Learners don't want to know how great MIT on-campus courses are. They want the content from MIT courses presented in a way that matches how they learn online.

John’s comment had a huge impact on my thinking, because it was so true to my experience. When we design online asynchronous courses for MITx, our major goals are scalability and clarity. We are trying to remove unnecessary ambiguity that, to a certain extent, we often keep in our on-campus courses because it promotes critical thinking and shared learning. I believe online asynchronous classes strive to achieve minimal sufficiency where the minimally sufficient bar is quite high, while on-campus synchronous courses promote profound comprehension.

COVID-19 has forced a learning model on us that is neither on-campus and synchronous nor online and asynchronous. Instead, it is an online synchronous class that attempts to replicate the on-campus synchronous experience. My MITx experience was invaluable in helping me realize how hard this transition would be.

The student feedback for spring 2020 motivated me to spend more than 300 hours designing this home studio. Some examples of student feedback taken verbatim from spring 2020 include:

- Use multiple cameras so that one screen is set up for a chalkboard but you can still see the professor.
- Have the professor stand like they normally would
- Proper lighting and camera setups.

Section 2 explains the design criteria I employed, while Section 3 describes my home studio in detail. Section 4 shares the knowledge I gained from the first eight weeks of using the studio. Admittedly, the studio I have created is expensive and space-intensive. Appendix A describes what I believe are the minimum sufficient requirements for a business school home studio, one which other faculty members have purchased for less than \$800. Appendix B provides links to content creators I learned from when building this studio.

2 Studio Design Criteria

The on-campus teaching process cycles between teaching modalities. The instructor walks around the room, facilitates class discussion, writes on the board, and projects applications onto a display. For a significant portion of the classroom session, the instructor is the focus of most students’ attention, except when the students are engaging in conversation or looking at their devices. A traditional **Zoom** instructional session does not match the on-campus experience. Switching modalities

in Zoom is cumbersome, resulting in time delays. While the student can exercise limited control over the display viewed in Zoom, the instructor occupies a small corner view when screen sharing is enabled.

To more closely replicate the on-campus experience using Zoom, I needed to make two changes. First, I used **Open Broadcaster Software** (OBS) as the command center for the studio, letting it serve as the virtual camera Zoom uses to broadcast content from the studio cameras, the document camera, and any application on the computer. Instead of Zoom using a camera for the video feed, Zoom uses OBS as the video feed, and the instructor's choices on OBS dictate what is broadcast through Zoom to the audience; Lo et al. (2020) provides a tutorial on configuring OBS. Second, I created two camera stations that I moved between, depending on the on-campus teaching modality I was trying to replicate. The *talking-head* station, pictured in Figure 2, places the instructor behind a standing desk equipped with a document camera and a personal computer. The *lightboard* station, pictured in Figure 3, places the instructor behind the lightboard.



Figure 2: The talking-head station comprises a standing desk, computer, confidence monitor, and document camera.



Figure 3: The lightboard station requires its own camera and confidence monitor.

The stations engage students differently. The talking-head station is general purpose while the lightboard station is immersive. Figure 4 depicts the desk for the talking-head station.



Figure 4: The standing desk holds the document camera, keyboard, mouse, and Stream Deck.

The talking-head station allows the instructor to easily converse with students, facilitate class discussion, write with the document camera, and present material from a computer. The station mimics the on-campus student experience by presenting a common image of the instructor across modalities, albeit cropped and sized depending on the modality. For example, Figure 5 displays the discussion view:



Figure 5: The discussion shows the instructor in a format that mimics normal in-class interaction.

The sides of the discussion view from Figure 5 are cropped to fit both the instructor and the document camera in the document camera view shown in Figure 6.

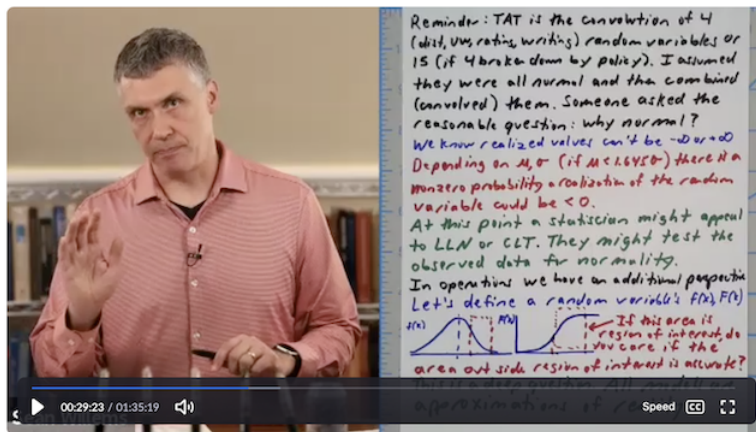


Figure 6: The document camera view crops the instructor's picture from the discussion view in order to provide a seamless transition between teaching modalities.

Camera views broadcasting a computer window require more of the available screen space. Therefore, the image of the instructor from the document-camera view is reduced and moved to

A powerful benefit of the talking-head station is the single-camera view of the instructor does not change across teaching modalities. The camera image gets cropped, sized and repositioned but the perspective remains constant. This exactly mimics the on-campus experience, particularly because all of the camera views keep the instructor large enough for the student to notice the instructor’s mannerisms and movements that are part of any normal classroom session.

8

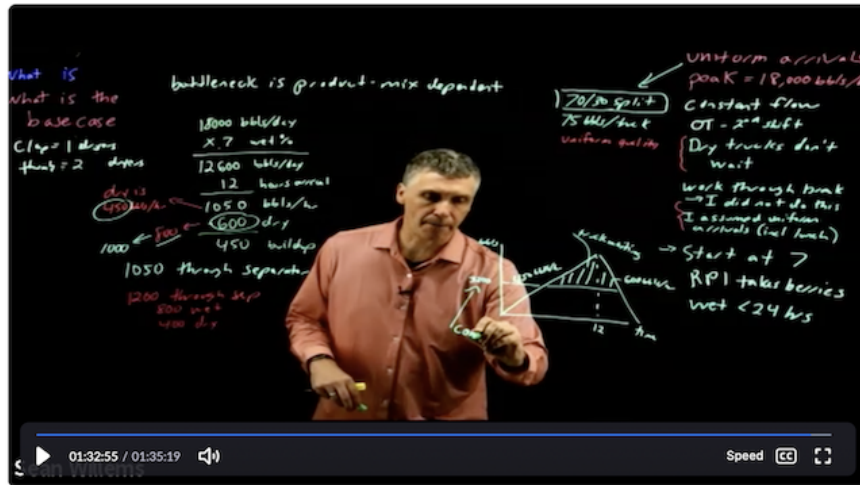


Figure 8: The lightboard station integrates the instructor into the whiteboard more immersively than its on-campus equivalent.

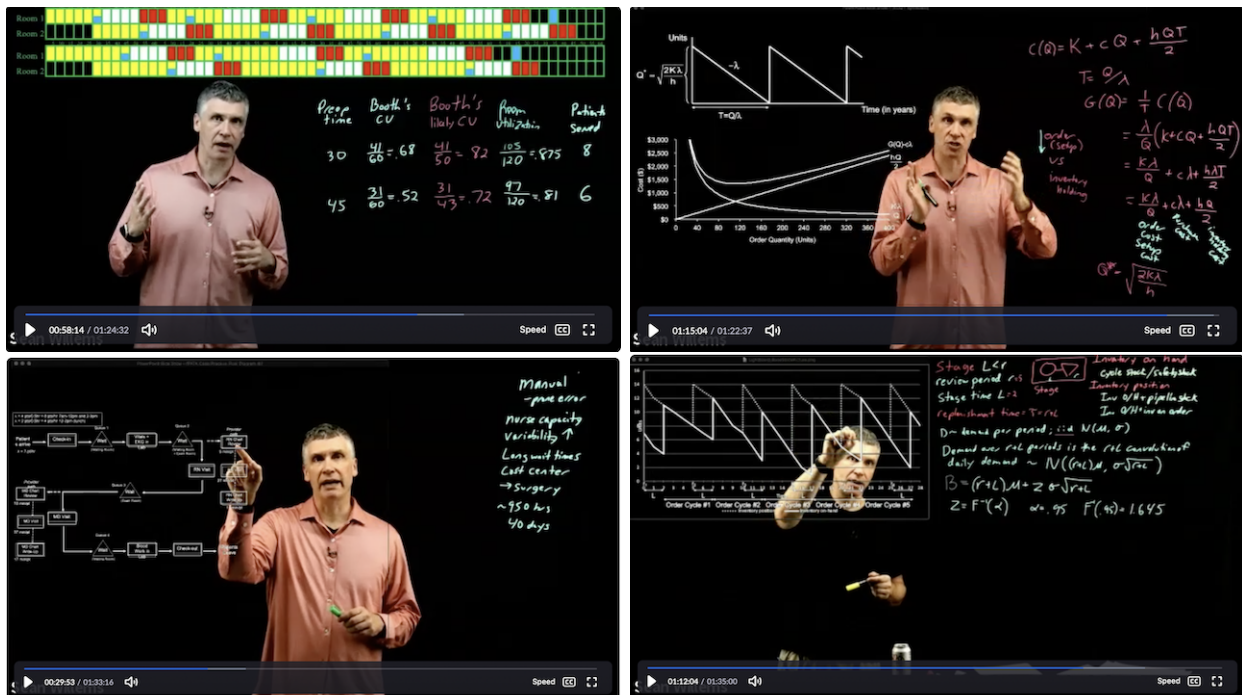


Figure 9: The lightboard station can achieve many of the modalities of the talking-head station with the notable difference that the instructor is always visible and part of the material in view.

The lightboard station can achieve many of the same modalities as the talking-head station. The primary difference is the way in which the instructor and class interact with PowerPoint slides, PDFs, and spreadsheets. At the lightboard station, the instructor is part of the material being

presented. This requires some additional planning to properly orchestrate. Examples of these modalities are included in Figure 9.

The lightboard station requires the same input devices as the talking-head station, as shown in Figure 10. While the instructor will surely spend time writing on the lightboard and interacting with students, there is a keyboard and mouse to show computer content and a Stream Deck to automate the movement between modalities and camera stations.



Figure 10: The lightboard station includes its own keyboard, mouse, and Stream Deck in order to move between different teaching modalities.



Figure 11: A computer on casters acts as the central nervous system, connecting both camera stations and moving between them as necessary.

Operating two stations at once does create some logistical challenges during class. There

are three monitors: two confidence monitors and one computer monitor. There will surely be times the instructor will want to put the Zoom window on the active station’s confidence monitor. This can be automated through software but it still requires planning to move between stations. The computer and its monitor, pictured in Figure 11, are on a rolling stand so they can be moved between stations. The lightboard station also operates best in darkness (other than the lightboard’s presentation lights), so lighting has to be managed between station transitions. The bottom line is teaching from two stations significantly increases the coordination and planning required. The Stream Deck, shown in Figure 12, is instrumental in allowing the instructor to rapidly switch teaching modalities with the press of a single button.



Figure 12: The Stream Deck allows the instructor to change teaching modalities at the press of a button.

3 Equipment List For My Home Studio

More than any other paper I have written, this paper has generated many discussions with faculty members outside my research domain. The number of people that have contacted me after receiving the working paper from a friend has been crazy, although in a good way. I ended up writing this document because colleagues would ask questions after seeing the studio on Zoom. I am not implying that this is the best studio or the right studio to replicate. I view this studio as pushing the boundaries of what a home studio is capable of doing. In most academic fields, we understand there are diminishing returns to scale. To achieve each percentage of improvement requires ever-increasing investment. The majority of the equipment required for the talking-head camera station described in this document can be procured for less than \$1,000, as documented in Appendix A.

This section presents the equipment I selected for my home studio. My primary criteria for

equipment selection were robustness, minimal configuration required, and availability. Prior to April 2020, I did not know anything about lighting, sound, or video, and I wish that was still true. I am an academic, not an audiovisual expert. I did not want to learn all the minutiae required to perfect a home studio, but one quickly learns that understanding all the facets of the studio layout require a significant investment of time and effort. Most of the equipment in this list is prosumer equipment, not what a professional video production is going to use, but much more than what an amateur run-and-gun vlogger would use.

I would not claim that this is the “best” equipment, nor is it the universally “correct” equipment for every setting. Within six months surely some of this equipment will already be discontinued and unavailable. I mention the specific pieces of equipment so that the interested instructor can see exactly what I chose, and use it as a jumping-off point for their own decisions. All prices are current as of August 2020 and do not include taxes, shipping, or any discounts. Due to the supply chain challenges imposed by COVID-19, some of the items are backordered.

3.1 Camera, lighting, and sound

Camera, lighting, and sound often draw the most attention when setting up a home studio.

- **Canon EOS RP Mirrorless Digital Camera Body \$999**

The Canon EOS RP is a photography-first digital camera and not a video-first digital camera. As such, this choice might seem controversial. The primary selection criteria used here was the set of lenses it supports, in particular the 85mm lens below.

- **Canon RF 85mm f/1.2L USM DS Lens \$2,999**

This 85mm prime lens produces an amazing depth of field, separating the instructor from the background. It is admittedly very expensive but its bokeh effect sets the mood for the studio. It is fair to say the entire talking-head station was designed around this lens.

- **Sennheiser AVX-MKE2 SET Digital Camera-Mount Wireless Omni Lavalier Microphone System (1.9 GHz) \$899**

This lavalier microphone system was similar to the system employed in the university studios familiar to the author.

- **Sound Devices USBPre 2 - Microphone Interface for Computer Audio \$895**

The preamp sits between the microphone and the computer. This device is hardware based, so it just is more bulletproof than other options. Also, its audio meters are very easy to read and make setting the gain totally idiot proof. Depending on one's use case, a better choice might be a different product like the [TC-Helicon GO XLR](#), or possibly the [Blackmagic Design ATEM Mini Pro HDMI Live Stream Switcher](#).

- [Elgato Cam Link 4K](#) **\$130**

The Cam Link allows the digital camera to operate as a web camera in [Open Broadcaster Software](#) and [Zoom](#).

- [Elgato Key Light four](#) at **\$199 each**

Two of these lights placed in front of the instructor at 45-degree angles illuminate the subject with soft light while two in the back provide backlighting and fill lighting.

- [Canon EOS RP Mirrorless Digital Camera with 24-105mm Lens](#) **\$2,099**

The same camera body is used for the lightboard station but the lens is a little more forgiving than the talking-head station's lens to reflect the reality that the camera for the lightboard needs to be moved more to fully capture the board.

3.2 Additional studio elements

These elements are also part of the home studio, and critical to its operation.

- [Height Adjustable Lightboard System, Extra Large \(95"\)](#) **\$8,700**

The single most expensive item was the [Lightboard](#) produced by [Revolution Lightboards](#). Furthermore, this is not an easy item to move, so getting it to the second floor required hiring glass movers. Every detail of the design is thought through, so from the instructor's perspective this is plug-and-play, which is wonderful and a huge timesaver.

- [The Lightboard Control Center-Standalone](#) **\$1,890**

The lightboard control center (LCC) takes care of all the hardware required to operate the lightboard with or without a computer. For the setup in this paper, it allows the lightboard to look like any other camera source in OBS.

- **FLEXISPOT Electric Height Adjustable Standing Desk 48" Wide \$300**

The standing desk serves as the physical command center for the talking-head station, allowing the instructor to teach as they do on campus.

- **Bali Cut-To-Size Room Darkening Shades \$25 per window**

Controlling light is critical to the studio's success. Room darkening shades are required to make the studio lighting the only light source.

- **Stream Deck XL two at \$199 each**

The Stream Deck XL is a USB input device that can be configured to control Zoom and all scene changes in OBS with one-touch buttons. It is invaluable to seamlessly move between teaching modalities. Having one for each camera station allows the instructor to move quickly between stations, and between modalities at a station.

- **Ipevo VZ-R HDMI/USB Dual Mode 8MP Document Camera \$205**

A robust plug-and-play document camera, although some instructors might prefer an iPad used with an application like Notability, or a drawing tablet with annotation enabled.

- **Manfrotto Mini Floor-to-Ceiling Pole (Silver) two at \$59 each**

Proper cable management, and routing, has a huge impact on the functionality and day-to-day enjoyment of the studio. My bias is to elevate cables instead of running them along the floor. If they are on the floor, they invariably get kicked and connections can come loose. Running cables from pole to pole requires planning but the outcome is a much more permanent and secure design. At least two poles are needed, one by the computer, and one by the camera for the talking-head station. Although depending on the lightboard's placement relative to the other items, a couple more might also be needed.

- **Really Right Stuff Multi-Clamp Kit with BC-18 Micro Ball Clamp two at \$225 each**

This clamping system attaches to the Manfrotto mini floor-to-ceiling pole and allows the camera to be attached to the pole. This is very convenient both for wire management and minimizing the footprint required for the cameras.

- **Assorted cables \$500**

Some additional cables (extension cords, HDMI cables, surge suppressors, USB cables) will surely be required to make everything fit in the confines of the home studio.

3.3 Optional studio items

- Dedicated studio computer

A dedicated studio computer is a useful luxury, especially if the instructor will also be using the studio not only for Zoom sessions but also to record video. OBS can consume four processors on its own so six cores or more will be useful. A desktop machine is preferable to a notebook. Without a desktop, several USB hubs will be required. There are also more possibilities to quiet a desktop machine.

- Confidence monitor for talking-head station

The confidence monitor for the talking-head station should be as large as possible. I find it useful to have this monitor contain both the Zoom gallery view and the OBS studio. With an 85mm camera lens, if this monitor is placed under the camera the monitor will be approximately 11 feet in front of the instructor.

- Confidence monitor for lightboard station

At the lightboard station the Zoom gallery view is on the computer's screen so the confidence monitor for the lightboard studio only contains the OBS scene being broadcast over Zoom. As such, this monitor could be smaller than the confidence monitor for the talking-head station. With a 30-60mm camera lens, the monitor will be approximately nine feet in front of the lightboard's class.

- Manfrotto backgrounder holder system

The lightboard works best with an all-black background. I created a minimalist background holder with more [Manfrotto Mini Floor-to-Ceiling Pole \(Silver\)](#) that used a [Manfrotto 2941 Mini Clamp](#) to attach the [Manfrotto 272B Adjustable Background Holder \(108"\)](#) which held [Savage Widetone Seamless Background Paper \(#20 Black, 107" x 36"\)](#).

- Tripod and ball head

A tripod and ball head can be used to hold the camera instead of a Manfrotto mini floor-to-ceiling pole. However, I quickly decided against a tripod when I kicked it over by accident early in the design process. That said, especially if one is building the studio quickly, a tripod and ball head allow the instructor to quickly frame shots and determine the right placement for all the studio equipment. There are many kinds of tripods, including the [Really Right](#)

Stuff TVC-24L Series 2 Mk2 Carbon Fiber Tripod (Long) with the associated Really Right Stuff BH-40 Ball Head with Full-Size Lever-Release Clamp

4 Reflections After Eight Weeks Of Teaching

What is interesting about a studio like this is there are a lot of moving parts, but none of them are particularly complicated. That is, they are all off-the-shelf technology we interact with every day. The two challenges to overcome are integrating them into a residential space, and developing a teaching plan that best uses each component. Integrating them into the space is nontrivial because (assuming the instructor is not an audiovisual expert) small tweaks, like moving a camera five inches to the left, will affect desk placement, lighting position, sound levels, the place where the instructor should stand, and on and on. There are just so many knock-on effects from changing any one component that integrating the technology components is time consuming and tedious. Even worse, this technical integration does not improve teaching quality. It only takes the studio to the point where it is comparable to an on-campus classroom. The challenge of developing a teaching plan that best incorporates each modality of the studio is the more important challenge to overcome. It is what the student experiences from the studio. The best way to employ this technology is a nontrivial task because it does not match how the instructor teaches on campus. It has all the requisite challenges of learning a new teaching format.

The following insights are apparent after teaching in the studio for eight weeks.

Body position directly correlates with teaching energy The most important learning is also the most obvious learning. I need to teach in the position that matches my on-campus teaching. Since I stand in the classroom, I need to stand in the studio. There is a direct correlation between my posture, when standing, and my energy teaching the class.

The TA is absolutely critical to the classroom experience Every faculty member knows how valuable teaching assistants are. In the online setting, the TA is even more critical. In my on-campus classes, the TA's presence is good to have because they are available if the students have any administrative issues that can be handled by the TA, the students can build rapport with the TA before or after class, and the TA is better able to answer student questions offline, because the TA has experienced the class with the students. In the online class, I need to have the TA

because the TA's role is not a passive observer but an active manager. The TA is the air traffic controller for the class session. First, the TA arranges who talks next, keeping track of who has already talked and who has not yet talked. Second, the TA is able to handle all sorts of small issues (students saying their Wi-Fi is not working, etc.). If I had to be in charge of these issues, it would take me another five or ten minutes in class and I would not do it nearly as well as the TA.

The obvious downside of online learning from the TA's perspective is they work much harder during the class session. The less obvious downside is they remember virtually no content from the online class itself. They are simply too busy managing the participants to pay any attention to the actual material being covered in the class.

Everything takes longer in the online synchronous format Our on-campus classes are 80 minutes. I cannot teach the same content in the online synchronous format that I teach on campus in the same amount of time. Even with an amazing TA coordinating the student discussion, there are inherent inefficiencies and delays in the online version. We tightly choreograph student dialogue, but it still takes an extra 5 to 10 seconds on each end. We invariably lose 30 seconds each class when someone fails to unmute. That adds up to minutes for each class.

Equally important, the instructor is not able to read the room and speed up if the class is running behind schedule. The ebb and flow of pacing that is so easy to adjust in person is nearly impossible to manage as seamlessly online. I think I really need 95 minutes online to deliver the on-campus content of an 80-minute class, if I would mimic the on-campus format when teaching online.

Content coverage and delivery needs to be reimaged Related to the previous point, since I am slower in the synchronous online format, I needed to modify my material to achieve the same learning objectives in the same amount of time. While I am as resistant to change as anyone, this was not as hard as it seemed, and I was able to accomplish this without shifting material offline to be completed before class. Instead, I rigorously reevaluated each session's material to determine what was nice to include but not necessary to include.

I often found myself teaching the session's material in a different order than I taught it on campus. I started by thinking of the session's major concepts as items to fit in a knapsack, and then solved the resulting optimization problem to maximize all the items in the knapsack, while

still presenting the concepts in a coherent fashion.

Students are resilient and build a terrific culture The students own the classroom experience and improve it. While I knew this would be true, I did not know exactly how it would manifest itself, especially when the students are not in the same location, with much less personal interaction compared to the typical on-campus experience. Over and over again, the students impressed me with how cohesive a culture they formed.

For example, I make a big deal about always staying “in the moment” when in class. Now I rely heavily on the hand-raise feature of Zoom to start students asking and answering questions. After the third class, the students adopted an innovation where each student would lower their virtual hand whenever any other hand was selected. This made every raised hand a conscious decision, and it forced students to stay in the moment, versus pulling the class back to a comment that might be five minutes old. This is only one of many such innovations the students made as the course progressed.

Making personal connections takes time and effort Even with all this great technology, the student experience suffers due to the lack of physical interaction. At some point in most classes, the professor has to cut off or redirect a student who is saying something that is off-topic. It is often a great point, just one not made at the right time; or the point has already been made, and the class would benefit from the discussion ending. In the classroom, the professor can recognize whether the student thought this was a big deal or not. If they did, the professor can catch them on the way out, and make clear it was not a big deal. That really can’t happen in the same way online. When students go back on mute, they are lost in the Zoom gallery, and the pictures are too small to see much facial expression. It dehumanizes the interaction a bit, and that difference matters. We address this by over-communicating with students after class. Again, the TA is an amazing asset here. The TA keeps track of these cases in class so the instructor does not have to go back and look over the video. We can then reach out to the student immediately after class and check in to make sure they are okay.

The instructor cannot fully unplug and focus on teaching When I teach on campus I turn off all my devices before I begin teaching. When teaching online, I need to keep some communication channel open with the TA so I can be made aware of any technical difficulty that might materialize

during the class. The most common example would be if my connection has frozen, or if the audio is out of sync with the video. This is another distraction to monitor during class, and it does take some mental energy that would normally be fully allocated to teaching.

The residential setting causes some anxiety The reliability of a residential studio is simply not as great as the on-campus infrastructure. This causes anxiety for the instructor and the students. Universities have backup power, and everyone is in the same location, so they all share the same conditions. Having everyone spread apart is a real-world demonstration of Murphy's Law. Someone is always losing power or suffering from a slow Internet connection. One day, the TA's apartment building had an electrical fire that took the TA offline for 30 minutes. This does add some anxiety to the teaching process because the delivery system simply is not as robust as the on-campus infrastructure.

Choreography becomes second nature In the early class sessions I consciously tried to change screen views every few minutes. Since it was all new to me, I invariably made mistakes. More than once, I spoke to an Excel analysis that was not on the screen. As time went on, I got better and better at managing these transitions and within a few weeks they became second nature. Fluidly moving between modalities replicates the on-campus experience, and it makes each transition much more natural.

The on-campus product will improve as a result of synchronous online teaching An unexpected benefit of synchronous online teaching is that I am confident this will improve my on-campus teaching. The need to tightly choreograph my timing in this online format has forced me to change and improve content that I thought was already good enough. If the material was only going to be delivered on campus, the cost to improve it would not offset the time required. Teaching online forced this reexamination and improvement.

5 Conclusion

Examples of student feedback taken verbatim from the Summer 2020 evaluations include:

- (instructor's) virtual set-up should be replicated by every ... professor - it made the virtual

classroom feel very personal and very smooth!

- (instructor's) teaching method is awesome. Himself and his class aside, the mechanics of how he runs the course should be a faculty best practice.
- ... amazing job at generating engagement in class.

As one would expect, there is still room for improvement in this online synchronous format:

- I think the course did a good job adapting to the digital format although the cases were still not as stimulating as they would have been in person ... Overall excellent course and awesome job and seamless delivery in the digital environment.

This document describes the design requirements for a video studio with two camera stations that attempts to recreate the teaching modalities that an instructor employs in a graduate-level business school course. Given the effort to reimagine one's teaching approach, many of the benefits of the on-campus course can be achieved in an online-synchronous format.

Acknowledgements

I could not have accomplished this studio without the help I received from the following people: Jim Cain, Senior Educational Technology Consultant at MIT's Office of Distance Learning, gave me the confidence that this kind of studio could be successfully operated from home. Dwight Campbell, Senior IT Technologist at the Haslam College of Business (HCB) Technology Integration Services, provided hardware advice. Mark Collins, Distinguished Lecturer of Marketing at UT's HCB and Director of HCB Office of Technology-Enhanced Education (TEE), encouraged me to write up these studio designs more formally. Jason Greenway, IT Specialist at HCB TEE, helped develop the integration plan between the studio hardware and software. Brian Stevens, Senior Lecturer in Business Analytics & Statistics at UT's HCB has done an incredible job moving the core undergraduate statistics course online; while his setup is quite different than mine, Brian provided much advice and brainstorming. Kevin Koch and Trent Moeller at Revolution Lightboards went above and beyond the call of duty, not only advising me on the right lightboard configuration but providing significant design and integration advice to make the lightboard fit into the studio's overall workflow.

Most of all, I need to acknowledge the assistance of Mark Brennan, my summer 2020 teaching assistant. I knew Mark in both a TA and research capacity before summer 2020. My familiarity with, and trust in, Mark was an integral reason I could maximize the teaching potential of the studio on such short notice.

In preparation for fall 2020, Andrew W. Lo, the Charles E. and Susan T. Harris Professor of Finance at the MIT Sloan School of Management, has been a great partner codifying these thoughts into learnings that can be broadly adopted.

A Minimally-Sufficient Equipment For Single Camera Talking-Head Studio

While the two-station studio outlined in this paper would be impractical for many faculty, I believe there are lessons to draw from its design. A simplified talking-head station would achieve many of the benefits of this studio at a fraction of its cost. With that in mind, these elements form the core of the talking-head station:

- **Rode Wireless GO Compact Digital Wireless Microphone System \$199**

A robust, yet simple, wireless microphone system.

- **Elgato Key Light Air two at \$130 each**

Two lights placed on the desk facing the speaker can fully eliminate shadows and present a much more pleasing picture.

- **Magnus VT-300 Video Tripod with Fluid Head \$80**

A tripod is necessary to stabilize the camera and keep it in a fixed location relative to the instructor's desk. As of August 2020, this was the most popular tripod sold by B&H under \$100.

- **Stream Deck \$150**

The Stream Deck is a USB input device that can be configured to control Zoom and all scene changes in OBS with one-touch buttons. It is invaluable to seamlessly move between teaching modalities.

- **Ipevo VZ-R HDMI/USB Dual Mode 8MP Document Camera \$205**

A robust plug-and-play document camera, although some instructors might prefer an iPad used with an application like Notability, or a drawing tablet with annotation enabled.

- **Assorted cables \$100**

Some additional cables (extension cords, HDMI, surge suppressors) will surely be required to make everything fit in the confines of the home studio.

The camera is a highly variable cost in this setup. Some faculty have spent \$250 on a high definition webcam like [Avaya IX Huddle HC020 Full HD Web and Video Conference Camera](#) while other faculty have spent \$600 to \$800 on a camera like the [Sony Alpha a5100 Mirrorless Digital Camera with 16-50mm Lens](#). While this kind of digital camera represents an enormous upgrade in picture quality compared to any webcam, it also requires a set of accessories like the [Sony AC Adapter for Select Sony Cameras](#) and the [Elgato Cam Link 4K](#) and possibly the [Sigma 30mm f/1.4 DC DN Contemporary Lens for Sony E](#).

There is also ample opportunity to substitute the items on this list with equipment the instructor already owns. For example, the document camera could be replaced by an iPad or a tablet or whiteboard software. I am aware of several cases where faculty have employed the ideas in this document and outfitted a talking-head station for less than \$800.

B Online Resources To Learn From

The intersection of *content creators* and *producing content relevant to faculty* is incredibly small. Most online content is marginally useful to academics moving from traditional on-campus teaching to online-synchronous teaching. The majority of online creators are lifestyle brands. There is nothing wrong with that. They are producing a cinematic and engaging experience. They are not trying to teach substantive content. Similarly, run-and-gun vloggers produce arresting content that has no direct analog to academic teaching.

I have found the following resources to be educational both in terms of educating me about available products, as well as how best to use those products. I want to emphasize that a typical academic's use case differs from even these creators. For example, I think an academic will be much more concerned about noise and out-of-the-box use than these creators. I am not sure if that is

because they shoot their videos in more commercial settings, versus a typical residential space, or if fixing problems in post-production is second nature to them. I do find that I need to employ some level of skepticism when listening to their product reviews, but I also believe there is much to learn from the following creators.

Curtis Judd has great videos on light and sound. Everyone reading this article can learn from Curtis' YouTube channel. The material presented is incredibly relevant and consistent with how most academics will teach.

Gerald Undone has detailed and thoughtful product reviews. The equipment choices are highly likely to be equipment the reader of this article is considering buying. The YouTube videos are also highly informative and information-dense in a good way.

Matti Haapoja has helpful tutorials demonstrating the workflow required from initial creation to final production. While the focus is admittedly more cinematic than the average on-campus class, the discussion moves quickly enough that one can see the relevance to an academic use case.

Potato Jet, i.e., Gene Nagata, has incredibly informative product reviews that also demonstrate the product being used in the real world. These videos often integrate several pieces of technology in a manner that lets me better map the elements into my home studio; for example, determining what size lens works best in a given space.

Podscastage, i.e., Bandrew Scott, is a no-nonsense information source on microphones and the importance of using microphones properly. The YouTube product reviews are useful, but the tutorials and FAQs are even more valuable to the typical academic that needs to get up to speed quickly.

References

Lo, A. W., B. J. Stevens, S. P. Willems. 2020. Tutorial: configuring Open Broadcaster Software (OBS) to support online-synchronous teaching. *Working Paper* 20 pages.