5-2021

Improving student success and engagement in virtual and hybrid classrooms.

Sydney Fogo
University of Louisville

IMPROVING STUDENT SUCCESS AND ENGAGEMENT IN VIRTUAL AND HYBRID CLASSROOMS

By

Sydney Nicole Fogo
B.S., University of Louisville, 2020

A Thesis
Submitted to the Faculty of the
J.B. Speed School of Engineering of the University of Louisville
in Partial Fulfillment of the Requirements
for the Degree of

Master of Engineering
in Civil Engineering

Department of Civil and Environmental Engineering
University of Louisville
Louisville, Kentucky

May 2021

IMPROVING STUDENT SUCCESS AND ENGAGEMENT IN VIRTUAL AND HYBRID CLASSROOMS

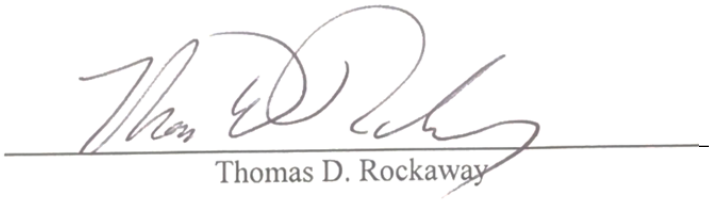
By

Sydney Nicole Fogo
B.S., University of Louisville, 2020

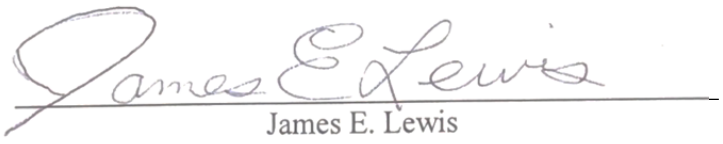
Thesis Approved on

April 19, 2021

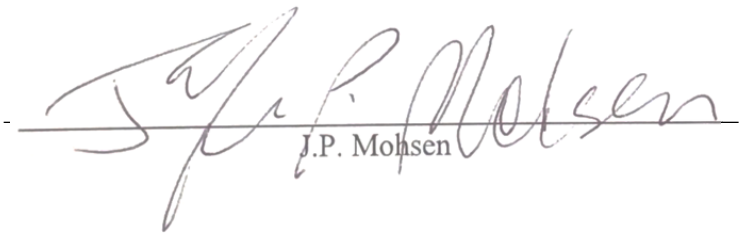
by the following Thesis Committee:



Thomas D. Rockaway



James E. Lewis



J.P. Mohsen

ACKNOWLEDGEMENTS

I would like to thank Dr. Thomas Rockaway for his patience and his guidance during the process of this thesis. Your support was greatly appreciated. I would also like to thank you for your guidance outside of my thesis throughout my time in the Civil and Environmental Engineering Department at the University of Louisville.

Thanks also to Dr. James E. Lewis and Dr. J.P. Mohsen for their time and assistance as members of my thesis committee. In addition, I would like to thank all of the faculty of the Civil and Environmental Engineering Department for shaping my experiences here more than you may realize.

Finally, thank you to my family and friends who have supported me through my entire time at Speed School and beyond. Particularly to my parents and Alex, as your love and encouragement have made me who I am today. You mean more to me than I can express.

ABSTRACT

IMPROVING STUDENT SUCCESS AND ENGAGEMENT IN VIRTUAL AND HYBRID CLASSROOMS

Sydney N. Fogo

May 9, 2021

The following thesis examines virtual classes from the University of Louisville in the Fall 2020 semester to discover points of weakness relative to keeping students engaged in online courses.

Three surveys were taken by a select group of participants over the course of the fall semester in order to collect student opinion on specific classes. Interviews were held with a subset of students from the group of participants and also with professors who taught the study's participants in the fall of 2020. Their responses and conversations were used to determine possible areas of improvement for virtual classes.

This information was then used to develop suggestions for improving the classes referenced in the surveys; the recommendations can be generalized for usage in classes at other institutions. The research conclusion establishes guidelines for examining and refining any virtual or hybrid classes in the engineering field.

TABLE OF CONTENTS

PAGE

APPROVAL PAGE……ii
ACKNOWLEDGEMENTS…….. iii
ABSTRACT…….. iv
LIST OF FIGURES……vi
INTRODUCTION…….. 1
RELATED RESEARCH…… 3
PROCEDURE……... 11
RESULTS……. 14
OBSERVATIONS AND DISCUSSION…….. 33
CONCLUSION……. 43
REFERENCES…….. 46
APPENDIX I…… 48

LIST OF FIGURES

FIGURE PAGE

1. Comparison of Interaction Between Online and Face-to-Face Settings in the Classroom (Ni 2013)……. 6
2. Response to Survey Question: Which Synchronous Platform Do You Prefer?…. 16
3. Response to Survey Question: What is Your Ideal Manner of Notetaking?…….. 20
4. Response to Survey Question: Which Asynchronous Platform Do You Prefer?... 48
5. Response to Survey Likert Scale: Blackboard Collaborate is a Good Tool for Virtual Class Meetings and Group Work……... 48
6. Response to Survey Likert Scale: Microsoft Teams is a Good Tool for Virtual Class Meetings and Group Work…… 49
7. Response to Survey Likert Scale: Live Lectures (Virtual or In-Person) are Vital to My Understanding and Engagement in College Courses.…….. 49
8. Response to Survey Likert Scale: All Classes with a Virtual Component Should Provide Video Recordings of the Lectures.…… 49
9. Response to Survey Question: For Classes That Require an Even Mix of Theory/Concept and Examples, What is Your Preferred Way to Learn?……... 50
10. Response to Survey Likert Scale: In-Class Assignments and Explicit Examples are Vital to My Understanding of Class Assignments. …… 50
11. Response to Survey Question: Which Grading Platform Do You Prefer?……. 50

12. Response to Survey Likert Scale: I Would Like to Have Some Review Session in Every Class Before an Exam…….. 51
13. Response to Survey Question: Do You Prefer Distance Ed Courses that Post Material Weekly or Courses that Post Material Multiple Weeks in Advance (2+)?…… 51
14. Response to Survey Likert Scale: Platforms Like Kahoot, Quizlet, and Mentimeter are Good Tools for Engagement.…… 51
15. Response to Survey Likert Scale: Engagement Opportunities (as Described in the Previous Question) are Vital to My Understanding and Engagement in College Courses……... 52
16. Response to Survey Question: Have You Used Any Form of Discussion Board in Any of Your Classes that Professors or TAs Also Have Access to? This Can Be Any Team's Chat, a Discord Channel, a Blackboard Discussion Board, etc……. 52

I. INTRODUCTION

In the Spring of 2020, as the COVID-19 virus spread rapidly in the United States, universities across the nation were forced to shut down campuses and move classes online. At the time, a large portion of administrators and instructors hoped they would be back on campus for the fall semester. As it became clear that this was not the case, classes were adjusted to be delivered virtually. However, as many universities' first full online semester progressed, students and instructors alike began to struggle with online courses.

This thesis studies classes offered at the University of Louisville in the Fall 2020 semester to discover what aspects of virtual learning make it difficult for students to engage with their online classes. The courses discussed in this paper are separated into the following categories: asynchronous, synchronous, hybrid, and remote. An *asynchronous* course is one in which there is no live interaction for the class—all class materials are posted to a learning management system or other online platform for students to download and view. A *synchronous* course has lectures live, though these may take place in person or virtually. *Hybrid* courses have both in-person and virtual options for class interactions such as lectures. A *remote* course is synchronous but entirely virtual, with no in-person components.

The purpose of this thesis is to determine what aspects of virtual and hybrid courses are causing difficulty for students and instructors. Based on these observations,

suggestions for improvements to online courses have been developed. Though the research will focus on certain courses within a single university, the recommendation will be based on specific aspects of classes that can be applied outside the platform and university-specific boundaries of this study. It is important to note that the results of this research are based on a small pool of participants all from the same college within the University of Louisville, and therefore has limitations to the range of experiences addressed.

II. RELATED RESEARCH

Research in the area of online learning has been undertaken for the last couple of decades as internet access has become more normalized and online classes have become options offered to everyone. Though much of the research studies the viability of such methods of learning, many studies in the last year have focused on improvements that can make virtual classes more effective as well as identifying the attributes of classes that facilitate achievement.

A. Comparing Online and In-Person:

Much of the early research concerning online classes focused on comparing traditional classrooms and online courses. Many people questioned the ability of online courses to match the learning opportunities provided by traditional courses (Arias 2018). When online courses began to appear in universities as a more common option for taking a course, many anticipated that accessibility would be a significant benefit; however, they were generally more expensive than traditional in person courses, which diminished the accessibility that many had hoped for. In addition, online courses were seen as requiring a higher level of effort from educators and students alike. Students were required to maintain more responsibility and develop professional skills more quickly without the

same amount of guidance that traditional courses offered. Educators were tasked with a greater amount of preparation and maintenance on course materials (Arias 2018).

In addition to the field of research being relatively new, the problem of defining the limits of an online course made studying and comparing online courses to traditional classroom courses relatively difficult. Online courses ranged from those that simply allowed material to be accessed through online portals while lectures could be in-person to ones that had no meeting time or face-to-face components whatsoever. Some researchers overcame this obstacle by choosing to study a course that was offered in two different instruction methods by the same university; one labeled an online course and the other a traditional, in-person style. Many early studies showed significant decrease in student GPA, retention, and future achievement within the classroom when taking an online course (Arias 2018).

Many of these observations regarding grades were countered by other theories. The most notable addendum was that students who performed well in literacy and writing often achieved at the same level in online courses as they did in their traditional classrooms. However, students who struggled even in traditional classrooms faced notably larger hurdles when adapting to online courses. Another limitation of early studies found that what may have been considered under-performing in online courses was only due to students adjusting to online formats and the needs of online classes when they had previously not been exposed to them (Kirtman 2009).

Research completed at California State University—San Bernardino by Anna Ya Ni (2013) examined several courses with both online and face-to-face classroom variations during the same semester. It was found that in some classes the discrepancy in

percentage of failing students could be as much as 8 percent, but in others, the failure percentage was nearly identical. These sentiments are echoed in many other studies, and the conclusion drawn by many researchers is that discrepancies in grades and student retention in online versus in-person classrooms can be largely attributed to the obstacles discussed previously. In several areas of research, it was suggested that "online interaction can be used to enhance learning, especially for students who tend to be reserved in the classroom setting" (Ni 2013).

Ni (2013) specifically chose to focus on the areas of interaction and student performance, as many researchers have found them to be linked. By comparing types of interaction seen in the two different settings, one can discern if there is truly a deficiency in interaction and engagement in online courses. Although online courses are typically viewed as isolating, it was found that, though the methods of interaction are notably different, there are several ways to allow increased interaction in the virtual setting, which open channels of engagement to allow for a fuller, more successful online course (Ni 2013). Figure 1 below shows a comparison of interaction in the different course models:

Table 1.
Comparison of Interaction Between Online and Face-to-Face Settings

	Online	Face-to-Face
Mode	Discussions through text only; Can be structured; Dense; permanent; limited; stark	Verbal discussions: a more common mode, but impermanent
Sense of Instructor Control	Less sense of instructor control; Easier for participants to ignore instructor	More sense of leadership from instructor; Not so easy to ignore instructor
Discussion	Group contact continually maintained; Depth of analysis often increased; Discussion often stops for periods of time, then is picked up and restarted; Level of reflection is high; Able to reshape conversation on basis of ongoing understandings and reflection	Little group contact between meetings; Analysis varies, dependent on time available; Discussions occur within a set of time frame; Often little time for reflection during meetings; Conversations are less likely being shaped during meeting
Group Dynamics	Less sense of anxiety; More equal participation; Less hierarchies; Dynamics are 'hidden' but traceable; No breaks, constantly in the meeting; Can be active listening without participation; Medium (technology) has an impact; Different expectation about participation; Slower, time delays in interactions or discussions	Anxiety at beginning/during meetings; Participation unequal; More chance of hierarchies; Dynamics evident but lost after the event; Breaks between meetings; Listening without participation may be frowned upon; Medium (room) may have less impact; Certain expectations about participation; Quicker, immediacy of interactions or discussions
Rejoining	High psychological/emotional stress of rejoining	Stress of rejoining not so high
Feedback	Feedback on each individual's piece of work very detailed and focused; Whole group can see and read each other's feedback; Textual feedback only; No one can "hide" and not give feedback; Permanent record of feedback obtained by all; Delayed reactions to feedback; Sometimes little discussion after feedback; Group looks at all participants' work at same time	Less likely to cover as much detail, often more general discussion; Group hears feedback; Verbal/visual feedback; Possible to "free-ride" and avoid giving feedback; No permanent record of feedback; Immediate reactions to feedback possible; Usually some discussion after feedback, looking at wider issues; Group looks at one participant's work at a time
Divergence /Choice Level	Loose-bound nature encourages divergent talk and adventitious learning; Medium frees the sender but may restrict the other participants (receivers) by increasing their uncertainty	More tightly bound, requiring adherence to accepted protocols; Uncertainty less likely due to common understandings about how to take part in discussions

Source. Adapted from McConnell (2000).

FIGURE 1 – Comparison of Interaction Between Online and Face-to-Face Settings in the Classroom (Ni 2013)

B. Methods of Making Online Courses Successful:

As online courses became a greater part of learning in academia, research shifted from the viability of online learning to assuring that they were as successful as traditional courses. One of the first outcomes that came from such research was the realization that some courses lend themselves to online learning more than others. Lecture-based subjects and those that allow for self-study are easier to move online than applied research or interaction-based courses (Ali 2020). However, many courses provided greater accessibility to both traditional and non-traditional students seeking degrees in all areas of study if they were provided in online formats. Research that followed often focused on particular aspects of these courses in order to determine their effectiveness.

Examining the impact instructors have on students and the success of university courses was a component of many studies. As was expected, interaction of instructors with students increased the performance of students on several levels. If professors designed courses to include effective engagement opportunities, students were more likely to interact with the subject matter and show greater participation in the classroom (Ma 2015). However, in recent years, as instructors with significant experience in only traditional methods of teaching have shifted to teaching courses online, it has become clear that properly training and supporting all online staff is imperative (Ali 2020). Instructors properly trained in the methods for online courses are better able to integrate technology into their classrooms, which has been shown to increase student engagement and the achievement of learning outcomes (Ma 2015).

To understand the impact technology has on student engagement, researchers questioned of whether other strategies that contribute to achievement in traditional

classrooms would be similarly effective in online courses. Areas of focus included metacognition, time management, and interaction with others in the course. In many studies, metacognition has been found to be imperative to student success in the classroom. By understanding not just what they are learning, but how they learn, students are better able to prepare themselves for the classes, increase the efficacy of their study time, and improve their grades (McGuire 2020). While this method and others such as time management and application of critical thinking are shown to have positive correlations with student performance in online classes, the effects were noted to be weaker than in traditional courses (Broadbent 2015). The area with perhaps the largest impact on success in online classes was peer interaction. This reaffirmed earlier research, which identified that interaction has a significant effect on student engagement with courses. Though different techniques are applied in online courses, any opportunities for peer learning can cause notable differences in the performance and understanding of students (Broadbent 2015).

C. Student-Focused Responses During the Pandemic:

Other research, particularly that which began around and after the shut-down of many universities' campuses due to the COVID-19 pandemic, focused on students and their needs from and contributions to virtual classes. Many universities began to compile and share resources with students that would allow them to increase their success while studying from home. Many of the resources emphasized four general areas in which students could adjust to prepare for online courses: planning, organization, focus, and communication.

As students have to take on many new responsibilities, being able to create and keep a schedule can have significant impact on productivity ("Time" 2021). Having platforms or applications that keep track of homework, due dates, and course materials is essential to success. Understanding the overlap in scheduling and assignments allows for a more structured schedule, particularly if students adapt their plans as the semester progresses and they get a better understanding of the requirements all of their classes have (Densberger 2020).

Unfortunately, with the circumstances of the pandemic forcing many universities to close or restrict campus access, students also struggle to find the time and space to focus on their work—especially if they have roommates or live with family. In cases such as this, universities have encouraged students to set boundaries with those sharing their space or, if possible, make a space that is solely for them to use when focusing on classes (Densberger 2020). With these constraints, instructors must afford leniency and demonstrate understanding to work with students who are struggling, and have lines of communication available for students to express their needs (Rapanta 2020). Universities providing these types of resources are not just giving students advice to improve their experiences, but allowing students as well as professors to take an active role in adapting to the changing of class delivery methods. Asking students to make changes or be open to growth and offering opportunities to refine skills such as time management and self-discipline can make a vast difference in how well they adjust to the new academic environment.

However, some researchers decided to approach student-centered classroom design from the other side of the classroom. They ask that instructors focus on "listening

carefully to what students are saying about their experiences" and adjusting class expectations in order to fit the circumstances and realistic needs of a course (Rapanta 2020). In much the same way as students having constant interaction with peers can increase their ability to focus on classes, instructors working with other faculty to improve and adjust online courses throughout the semester can improve the overall classroom experience.

In a specific article in the Postdigital Science and Education journal, professionals in the field of education give feedback on how professors can navigate and adapt to the new challenges online learning poses (Rapanta 2020). Conclusions drawn from this article and others state that having a student-centered design that brings in aspects of interactive learning and social activity is the key to successful classes (Rapanta 2020). Communication is not important only on the side of the student, but also on that of the professor. Making sure that all learning styles are accommodated and that students are able to actively engage with the material increases student achievement in online forums.

III. PROCEDURE

Research began in the Summer 2020 semester with the examination of a civil engineering statics course (referred to as CEE 205). CEE 205 had a roster of almost 250 students. The data collection for the summer semester consisted of a single survey sent to members of the course at the end of the semester. The survey asked students to rank various parts of their virtual learning experiences and give feedback on what could be improved. When the responses were reviewed, it was clear that the information obtained would not be sufficiently useful in guiding the suggestions this thesis intends to produce.

Instead, the data and experience taken from the summer semester were used to structure the collection of data for the Fall 2020 semester. There were two main differences in the survey processes of the two semesters. The first was that the fall surveys would be a series completed at three different times throughout the semester in order to gain a fuller picture of the student experience in virtual and hybrid courses. The second was that, instead of sending the surveys to a large group of people and asking for anyone to respond, a select group of participants would be gathered at the beginning of the semester who would agree to fill out all three surveys. This specific adjustment would allow for a more consistent number of responses and a longitudinal study rather than a cross-sectional one.

At the beginning of the fall semester, an announcement was sent to students in several engineering departments at J.B. Speed School of Engineering that invited them to participate in three surveys throughout the semester on a volunteer basis. Forty-five students responded to the email and agreed to participate. The selection of students was from multiple engineering departments and classes. On average, thirty students participated in each survey. Of those who responded to the surveys, five were freshmen, twelve were sophomores, eleven were seniors, and eight were master's students. No juniors participated, largely because a majority of juniors spend their fall semester on a co-op rotation, and are therefore not taking classes.

The three surveys were spaced to happen one month into the semester (at the end of September), two months into the semester (at the end of October), and during the final weeks of the semester (in early December). The data collected from the summer semester established the three original areas of focus for the first survey: lectures, assignments, and engagement. The second survey consisted of continuations of questions from the first, as well as new lines of questioning brought about by the responses to the first survey. The final survey did the same with input from both the first and second surveys.

The surveys consisted of a range of question types. The most common question types were short answer questions. Likert scale, multiple choice, and true/false questions were also asked in order to obtain quantitative values on certain topics within the research. At the end of each survey, open-ended essay questions allowed students to note any further comments they had on the topics discussed within that survey or related to virtual learning. While the original intent was to understand participant feedback relative to lectures, assignments, and engagement, there were a significant number of responses

regarding learning platforms. Therefore, the data collected from the surveys was divided into four main themes. These four aspects will be discussed separately in the results chapter of this thesis.

In order to allow more conversational discussion of the survey topics and results, interviews were scheduled with both instructors and students to supplement the surveys. All students involved in the survey process and any instructors who had students participating in the surveys were invited to participate in the interviews. Five students and four professors scheduled and attended an interview. In the interviews, students were asked to clarify points they made in the surveys or elaborate on responses to survey questions. They were also informed of some of the conclusions being drawn in this thesis so they could respond to the suggestions. During the interviews, instructors were asked to balance student opinion with their own views on the survey topics. In addition, they were asked to give feedback on the suggestions students had made and the conclusions being drawn in this thesis.

IV. RESULTS

A. Platforms

The platform or platforms on which a virtual class is run can have a drastic impact on the success of students. This research looked into the platforms used by classes at J.B. Speed School of engineering during the Fall 2020 semester and the opinions of students regarding those platforms. The most heavily discussed platforms are Blackboard Collaborate (a feature of the learning management system (LMS) used by the University of Louisville), Teams (or MS Teams, a Microsoft application), and Panopto (another feature of Blackboard).

For their synchronous classes, students preferred Blackboard Collaborate and MS Teams. There was variable response on which platform had fewer glitches in the audio, video, and chat. 66.7% of students believed Collaborate was a good tool for lecturing, but 15.1% disagreed. The two largest considerations in favor of Collaborate were its easy access as the LMS for the university and its breakout group feature.

Regarding Blackboard Collaborate, one student said, “it’s the easiest to find in each class” due to the familiarity students and instructors alike have with it already. Another student said they preferred Collaborate because it allowed them “to have all [their] class information on one platform” rather than using multiple tools. In addition to

easy access, students highlighted features such as the whiteboard options instructors can use to allow students to write on the projected screen and the breakout groups. The breakout groups, in particular, were helpful for having in-class group work. Unlike Teams, these breakout groups can be created with relatively little setup by the instructor, and students remain in the main chat room to receive announcements even while they are in their small groups.

Despite missing these particular features, Teams had better overall preferences, as 90.9% of students believed Teams was a good tool for lectures, and there were none who disagreed. The "all-in-one" style of Teams and the interactive chat were the aspects of the platform students focused on the most. Teams is not just a platform for holding meetings, but can also be directly linked to several other Microsoft applications. It has calendar and Outlook email easily accessible, and the ability to upload files into Teams channels. One student specified that "Teams has the chat feature, file upload, and screen control function that [they] see as essential to any good virtualization platform."

The chat feature mentioned refers to both the in-class chat during meetings and the accessibility of chat rooms outside of class. Many users found the in-class chat more engaging than those of other platforms because participants can "react" to the messages of other attendees. Chats remain available to view or comment in, even outside of classes (or meetings). If a team is created, there can be several channels that allow for focused discussions outside of meetings or among smaller subsets of the larger team.

Despite a larger percent of people agreeing that Teams is a good lecturing platform, when asked what lecture option they preferred, of the surveyed students who

liked virtual platforms (81.8% of the total surveyed group), 51.8% chose Blackboard Collaborate at their first choice, and 48.2% chose Teams.

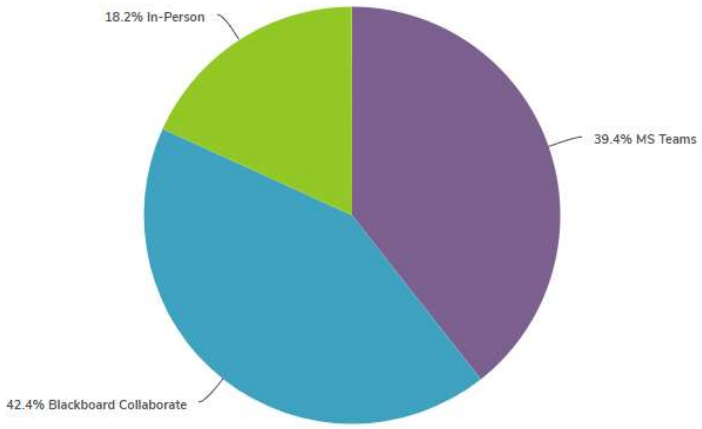


FIGURE 2 - Response to Survey Question: Which Synchronous Platform Do You Prefer?

One of the large concerns of students that may have had an impact on those statistics is the fact that Blackboard is the university's LMS. Using Teams meant having multiple platforms to contend with, and 60% of students found the use of multiple platforms (both within the same class and across multiple courses) to be distracting or annoying. 16% acknowledged that it made sense to use different platforms in different classes because there were varying needs between courses that can be better accomplished by a platform other than the university-wide LMS.

A compromise several students pointed out was having one platform that acted as the main reference point. This platform would have all the information regarding where to access lectures, where to find and turn in assignments, and the relevant upcoming dates. There were several classes that implemented some variation of this idea, and all students who had been in those classes said it helped them organize the needs of that

class and stay focused better than classes with information posted across multiple platforms.

Asynchronous classes had a different set of platforms to examine. However, Panopto, which is a video sharing platform used through Blackboard at the University of Louisville, was the favorite. For asynchronous lectures, 63.6% of surveyed students thought it was the best platform, while 18.2% preferred narrated PowerPoint slides, and 12.1% preferred other recorded video formats. The most common response was that Panopto "emulates a real class more than a PowerPoint with voice added," which was the ideal model for students' asynchronous classes. In Panopto, instructors have the option to share handwritten and virtual notes simultaneously or record themselves lecturing in time with the screen they are sharing.

Another often noted feature of Panopto that students enjoyed was that the video can be played at different speeds, allowing students to slow down the video for material they need longer to write down or speed up the video if they feel the instructor is speaking slowly. YouTube and Teams recordings also have this feature. Panopto also has "milestones" at certain points in the video (often at evenly spaced times depending on the length of the video), which appear as screen captures at the bottom of the page. Using these, a student can more easily find the part of the video they are looking for and simply click the milestone to return to it. This is an option similar to a PowerPoint feature which students enjoyed, but neither YouTube nor Teams has similar functionality.

Panopto, YouTube, and Teams recordings all have a feature that allows the ability to pause and play or rewind narration. This feature is not available in PowerPoint. In narrated PowerPoints, the narration for a single slide is grouped in a single recording;

stopping the narration will cause it to start from the beginning when it is played again. If the PowerPoint is not in presentation mode, the viewer can scroll through the timeline of the narration to try and find a particular spot, but the voice-overs cannot be paused or rewound the same way as in the video options.

However, some students liked the forced stopping points in PowerPoint presentations, as they were able to re-watch all of the information pertaining to the slide they were on without the next one starting automatically, as happens on the video-based platforms. Another positive aspect of the PowerPoints, students pointed out, was that it is "easier to go back in a PowerPoint and see notes as opposed to having to listen to a video and stop it to find equations." In cases such as these, the PowerPoints provide an outline of the topics and notes for the lecture, which many students find easier to follow. This idea will be discussed further in the Lectures section of this thesis.

B. Lectures

Since lectures are such a large part of students' learning experience within a course, the style of the lecture and the supplements used to make it more engaging can drastically affect the classroom experience. One of the aspects of lecture heavily focused upon in the surveys was notes—specifically, how much material students should be given before the lecture. Students said the notes they were given ranged from fully annotated PowerPoints or outlines of notes to a brief description of the day's topic or nothing at all. In online lecture formats, many students felt that having some guide for what the day's topic would be was extremely useful. Even a basic schedule of course topics can help

students make connections between ideas in different classes and help them plan out what to expect for the semester.

In the surveys, 70% of students preferred to have some type of notes given to them, though the amount of information they wanted to be provided varied. The most common response was a preference for an outline of the notes (in the form of a PowerPoint or a notes sheet) that could work as a 'fill-in-the-blank' option rather than being given fully annotated PowerPoints or no guide at all. This was especially true for asynchronous courses, where one student commented that "having to pause and play videos repeatedly" in order to write out all of the notes and diagrams made them "feel like the video lecture is hours longer than it is." In addition to making the process of note-taking easier on the students, being able to "see the professor engage with the notes" by writing out examples or filling in information as the students copied it down made them feel more engaged with the videos.

30% of survey participants preferred to hand-write all or most of their notes. The students who chose this option said that writing everything helped them retain more information. One student remarked that if all notes were received outside of "the lecture without attending, [they] won't watch [the lectures]. Having to write down examples with the professor helps [them] remember the content better." Remembering examples by writing them down was a common theme in students' recommendations. They felt that completing example problems in class in time with the professor helped them "actually see the thought process that goes into solving them." A student who liked to be given outlines of the notes stated, "It is also better if instructors do not give the solutions to

their example problems before the lecture" as not having the solutions provided would "motivate students to write down the information."

The most remarked reason for wanting at least some of the notes to be provided was that students worried about missing material and not having time to understand it if they were rushing to write down everything being said. Being able to listen to the professor speak and having PowerPoints where they can write "my own notes on them and have some of the teacher's notes" as well allowed them to take in the material better by focusing on the instructor's lecture rather than just the notes they have to copy. To balance this in areas such as example problems where students prefer to take the notes themselves, "having the professor do the handwritten notes… 'slows' the class down and allows for better understanding of the content" because it gives students time to process the work as they copy it down.

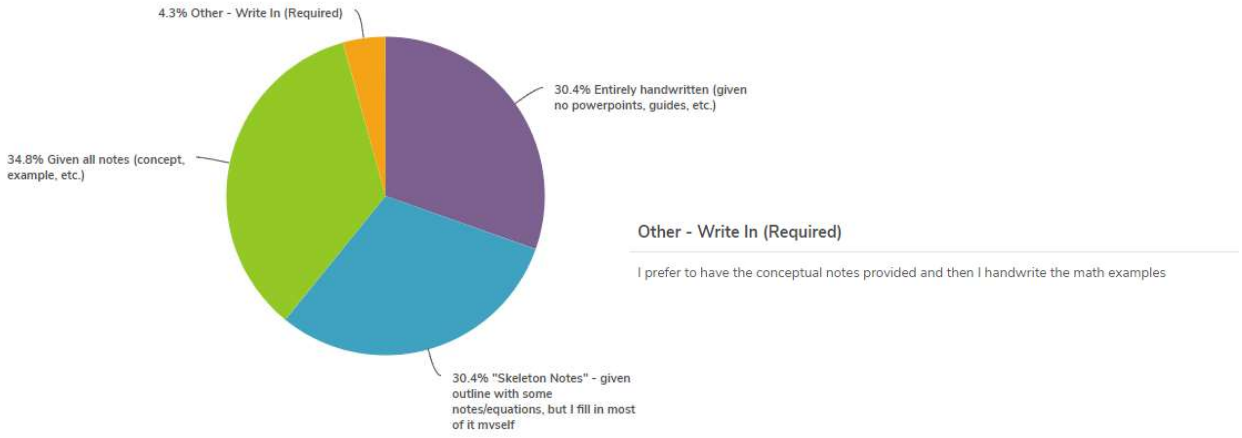


FIGURE 3 - Response to Survey Question: What is Your Ideal Manner of Notetaking?

Finding a way to balance concepts and examples was also an aspect of lectures students found important. Focusing solely on concepts made it difficult to apply equations when they had to complete homework or exam questions. Having too many examples caused a disconnect with the material they were learning as they are not given enough context through theory to understand it. Being able to have some interaction with the material—through example problems or group discussions—helped them continue to be engaged with the content. 52% of students preferred learning about theory before working on examples, stating that it helped them "ultimately, better understand the examples and problems." 39% of participants preferred the reverse, the reasoning being two-fold: some students preferred learning examples first because they "struggle to learn things conceptually and then apply the concepts to math," but by reviewing at least one example first, they were able to relate it to the concepts afterwards; others preferred examples to be the first part of a lecture because it seemed to them that "the application is the most important part of the class, since it's what [they] are tested over and what [they] should take away" from the course. Being sure that they know how to put the application into practice allowed them to focus on understanding the concept. The remaining 9% wished there could be separate days dedicated to concepts and examples, as it would allow them to 'switch gears' and be prepared for the necessary interaction and notes, depending on the day.

The last aspect of synchronous lectures students reflected on was the accessibility of lectures after they are complete. For virtual classes, this survey asked the question: should virtual lectures be recorded and posted for students to access? 97% of students believed virtual lectures should be recorded, as it often required very little extra set up for

the instructor, and it would allow them to return to the recording and re-watch lectures for material they had missed or not understood during the live session. It would make finding answers easier for students, and require less repetition on the part of the instructor.

However, many instructors brought up the concern of attendance and class participation. If lectures are provided as recordings after class, how could students be convinced to attend class during the live session? The need to balance accessibility with accountability was the main concern for these instructors, for which there are a few features of synchronous lecture platforms that may help. If attendance and participation are a necessary part of the course, many platforms allow simple ways to download a list of attendees, and attendance could be counted as part of the course grade. In addition, for many classes where participation is an important aspect, students would miss the learning benefit of that experience if they did not attend live. Incorporating breakout groups, in-class discussions, and other engagement opportunities would encourage students to join the live class to participate. These elements will be discussed in later sections.

A facet of lectures and material that relates primarily to asynchronous classes is the posting schedule. The most common request students had of asynchronous instructors was that everything be posted on a regular schedule. One student said, “If I know a professor will always assign HW Wednesday, for example, I can add that to my schedule. The same is applicable for assignments given 2+ weeks ahead of time.” What frustrated students, however, was when instructors “randomly assign[ed] HW and allow[ed] a week or less to do it.” Many people take asynchronous classes for the flexibility of schedule, which diminished when there is a limited time to complete assignments.

57.6% of students preferred when asynchronous courses posted materials two or more weeks in advance of due dates or the week in which the material would become necessary to view. These participants felt this method allowed them to plan ahead in their schedules, so they can "estimate how long [they]'ll need to spend on that class in advance." By doing this, they would be able to balance their busy weeks in other classes by getting ahead in their asynchronous course. In addition, as mentioned previously, many students who choose asynchronous courses do so for the freedom to do the work as it fits in their schedules, and having the material ahead of the week it needed to be completed gave them additional flexibility. However, this method would require more work for instructors before the semester began, in order to have multiple weeks of material posted ahead of time. For instructors who use the same material (slides, notes, or videos) for multiple semesters of the course, it might be simpler.

In contrast, 42.4% of students preferred material to be posted on a weekly basis. The main two arguments in favor were that it "discourages procrastination to have weekly assignments" and that having too many assignments posted at once causes students to feel overwhelmed. One suggestion that could help with these is if an instructor prefers to post material as larger batches, the material could be separated into weekly folders. This would provide organization and still keep the pacing of a week-by-week posting schedule. Another benefit of posting materials on a weekly basis is that instructors who are teaching a course for the first time or prefer to re-record or personalize the videos for every semester would have a less front-loaded work requirement.

C. Assignments

The third question addressed in this research was how to prepare students for homework and other assignments, as well as how to give them feedback. Students gave feedback on which methods they felt they learned the material in a way that provided the best preparation for them to complete their homework. 91% of surveyed students felt that completing example problems in class while the instructor was present for guidance and answering questions was vital to their ability to complete similar problems later. This could be done either as part of the lecture or within small groups as in-class assignments. Instructors, when asked about the same issue, stated that there must be a point where students learn to take the concepts they are taught and use that knowledge to determine how to work out problems on their own. Doing this themselves ensures that they know why they are doing the problems and how the equations relate to the theory, rather than just learning the patterns of examples to reuse on similar problems later.

One instructor at the University of Louisville felt that this transfer of responsibility for connecting theory to example worked best when she facilitated it during class. While she agreed that it was vital that students make those connections themselves to increase their understanding of the material, she also believed it was her job to help them do it. By providing examples in class, she wasn't cheating them out of their learning, but rather teaching them how to decide what steps are necessary to solve a similar problem they might be asked to complete on a later assignment. This professor uses many in-class quizzes or examples, but focuses on participation and allowing the students to figure out what they know rather than taking a grade. She believed that having "low stakes opportunities for [students] to practice is important." Research with

professionals in the online learning field agree that “good teachers are mediators between the content and the learners” rather than just the deliverers of material (Rapanta 2020).

The same professor had significant insights on the topic of review sessions. In every one of her classes, she holds review sessions for her exams—either by dedicating a class period or posting a recorded video of the session. It helps students to have “a specified time to work with [her] on the review… but it also gives them a bit of a break between the last piece of content and the exam.” While this is an opportunity 95.6% of students felt would improve their experiences in class, other instructors had some reservations. The largest was that this would require them to take time out of their regular class schedule to hold review sessions and still teach all of the material planned for the semester. For instructors where this is the only reservation, options like having teaching assistants (TAs) hold exam reviews outside of class time or posting a simple document for students to review as they prepare for the exam may be feasible alternatives. One professor stated that he doesn’t like to hold review sessions because “every time that [the students] come to class is review for the exam,” which he emphasizes at the beginning of the semester. In these cases, finding a way to remind students of what they should study for the exam without having a ‘review’ might be a compromise that is easy for instructors to add and beneficial for the students.

After an assignment is turned in, a different concern arises: what amount and type of feedback is the best for students. Whether courses are synchronous or asynchronous, it is imperative to find grading platforms that lend themselves to giving the best feedback while not over-taxing instructors and graders. Especially as classes move online and there are fewer opportunities to speak with instructors or classmates about assignments,

students feel that they need more detailed feedback than in a traditional setting. Many students said specifically that they "would like to see the [correct] answers with work" instead of just getting points marked off for mistakes with little feedback on how to correct it. Students feel that a lack of feedback leads them to continue to make similar mistakes on later assignments or not grasping the ideas well enough for the following courses.

Particularly in asynchronous courses, where students have no opportunity to ask an instructor questions or review homework in class by request, an answer key would seem to be the easiest solution unless the instructor is willing to post a video reviewing the correct answers to the homework. However, answer keys bring up several concerns by instructors. The first is similar to the previous concern that walking through too many in-class examples would only teach students how to solve those specific problems instead of applying the concepts. If answer keys are provided, will students really learn how to correct their mistakes, or just look at the correct answer and try to copy the same steps on future assignments, even when they have different requirements? Many students stated that having answer keys to correct their assignments would help them make the connection to concept because they could learn the logic. Without the answer key, they would struggle to determine what precisely had gone wrong in their original work.

The second concern is that providing answer keys can open the door for cases of academic dishonesty in later semesters. If the instructor reuses the assignments, students who download the answer key could pass it on to people taking the class in later semesters. This would not only be dishonest but would also keep the next years' students from learning the material themselves. Given these concerns, it is necessary to balance

giving students feedback that helps them learn with giving a level of detail that can hurt students' understanding of material by causing them to rely on memorization.

Another issue many students focused on was the time frame in which assignments were returned. When classes moved online and instructors had to start devoting more time to preparing classes and learning new platforms, participants found that many of their assignments took an excessive amount of time to be graded and returned. In most situations new homework, projects, and tests build upon previous assignments. The absence of feedback made it impossible to know if they actually understood the material as well as they thought they had. Once again, students suggested the use of answer keys, which could be posted and allow students to review their answers on their own before the instructor returned graded assignments.

Finding a balance between instructor concerns and student requests can be difficult in these situations, but there are several grading platforms that could assist in grading assignments faster or giving more feedback without significantly increasing the amount of effort from the grader. Students had very little preference between the grading platforms asked about so long as a good amount of feedback was given. Instructors therefore have more freedom to try out the different platforms and choose the one that works the best for them without fearing that it will lack the necessary features for students to understand and fix their mistakes.

D. Engagement

The final topic explored in this thesis is how to keep students engaged in their classes, as increased interaction with the subject matter and peers has been shown to

increase student success. The first aspect of a course that should be considered when trying to increase engagement is lecture. The range of adjustments that can be made to lectures vary from very simple changes to far more involved methods to supplement material. One of the simpler aspects could be adding call-and-response segments to a lecture, where students can be asked to answer questions about the concepts or even work out an example problem as a class. These adjustments are fairly easy ways to increase student interaction with material. They would work especially well in classes that are heavily focused on calculations as a way to break up the monotony of examples, especially if these types of classes would struggle to integrate more elaborate engagement opportunities.

One opportunity that requires a moderate amount of effort includes using features already present on the lecture platform or bringing in separate platforms. Synchronous lecture platforms like Blackboard Collaborate have options too allow students to draw or type on the screen being shared by the instructor, which could be used for sharing questions or writing out equations and examples. These features are some of the simpler inclusions of engagement opportunities that require little setup on behalf of the instructor, but can have a significant impact on student interaction and engagement with the course material.

Other opportunities can include things such as Kahoot, Quizlet, or Mentimeter, which can be used to host games, quizzes, or competitions during the lecture. These typically entail preparation in advance of the lecture, and therefore require much more effort on the instructors' behalf. However, they could be extremely beneficial in certain courses. They have the ability not only to increase engagement during class but also

improve students' understanding of the material. One University of Louisville professor shared positive experiences with Mentimeter. They stated that while preparing for a class, the instructors of the course "were still looking for something that [they] could have all students participate in" because it was a large course with a mixture of online and in-person students. Mentimeter offered the ability for students to log in no matter where they were viewing the lecture and participate in anonymous quizzes or review games. The professors appreciated that fact that features such as these allowed the instructors to "get a better sense of what students know and don't know, and spark discussion to get a sense of" students' understanding of the material.

Unfortunately, many of these engagement opportunities are impossible to integrate into asynchronous classes. Several students commented that is was helpful when instructors broke up their online lectures by including a designated stopping point. Some instructors did this by splitting up lectures into several small videos, so that students would be able to watch a complete video in times that better fit into their schedules rather than having to start and stop longer videos when they could only watch for half an hour at a time. In order to integrate more easily into calculation-based classes, other instructors broke up lectures by going over concepts and examples, and then asking the student to stop the video and try to do the next example themselves. After the student worked out the example, they could restart the video. This creates an environment that feels more like in-class work as students get the chance to apply what they have learned, and then have their understanding confirmed by the instructor walking through the steps of the problem in the video after the stopping point. Trying to find other ways to break up lectures and

engage students in asynchronous class videos may be an area to study further in future research.

The lectures are such a large part of online courses that it is important to find ways to engage students through them. However, engagement outside of the classroom is just as important and can be largely explored by opening different avenues of communication. Items like online discussion boards or class channels on platforms like Teams can offer constant communication options where students can speak with both their classmates and their instructors. 61% of students said they had used discussion boards in their classes when they were available. Many of those who did not have the option of a discussion board felt they would have liked to have had the option. They saw discussion boards as an easier way to ask for clarification on assignments or questions about lectures, especially in cases where multiple students might have the same question. In these situations, it can also decrease the time instructors must spend answering questions, because students with questions already asked by someone else can find the answers on the discussion board or chat room. If the instructor wants to allow it, discussion boards and chat rooms are also areas where students can answer each other's questions and form other channels of peer-interaction.

Since these avenues of communication can also serve asynchronous classes, they can be valuable for students who need questions answered when they aren't able to ask them in class or when there is a topic they would like to be clarified in a future class lecture video. The one notable addendum to providing channels such as these is that instructors should clarify their designated use and means of accessing it. By doing so, it

will guarantee that the tool is used appropriately and also remind students that it is available.

One professor who used Teams to create class channels for students said she would like to see it "be kind of a more community-wide used platform where students could ask questions and they could answer each other's questions and [the class TAs] could go in there… as opposed to… more of a one way… instructor to student" form of communication. When asked why she thinks students don't always use these features when they are provided despite the fact that they ask for them to be available, she noted that there is likely "an intimidation factor" because students don't want to single themselves out by asking a question they think is unimportant. She believes there is a learning curve for adjusting to the applications of open communication to improve students' comfort level and allow for a more regular use of them as the semester progresses.

Of course, there are other ways to get students to communicate with each other, which can lead to them answering each other's questions without needing the instructor to form a discussion board or chat room. Prompting students to form study groups or using breakout rooms in lectures can be useful, not just for in-class interactions, but also for facilitating learning the material as discussed previously. Giving students the first step of connecting with their classmates can help them work together to solve issues and answer questions outside of class, which has the added effect of improving communication and problem-solving skills, which many instructors emphasize are necessary outside of academia.

The most straight-forward ways of communicating with students, however, are the ones already used in most courses, such as emails, in-class questions (whether verbally communicated or via a virtual lecture chat), and office hours. Unfortunately, the same element of intimidation referenced earlier also applies to these means of communication. One professor said she wished she could find a way to help students "to understand that [she's] reachable and willing to help." The largest obstacle to helping students learn in the online courses she had taught was that students were less likely to reach out when they were struggling without the forced interaction of a traditional in-person course.

While these classic forms of communication are the simplest to implement and often those that the instructors are already the most familiar with, they lack certain benefits of full-course communication and peer interaction. However, they are the ones most instructors are turning to and want to improve upon. The best approach instructors have suggested is that the repeated reminder that they are available via email or office hours will marginally increase the traffic flow in those areas.

V. OBSERVATIONS AND DISCUSSION

By analyzing the results of the surveys and discussing them with students and instructors during interviews, some simple options for improving student engagement in virtual and hybrid classes can be suggested for consideration by instructors. The observations made below are meant to be generalizations that can be applied to various platforms and courses in different universities nation-wide.

A. Platforms

The choice of platform largely depends on the mode of the course (synchronous, asynchronous, or hybrid) and the material being taught. In synchronous classes, students benefitted from having easy chat options during their lectures, the consolidation of class materials, and peer-learning models. Class material consolidation could stem from the use of the university LMS or of a platform that allows integration of other applications to supplement the main platform. For some peer-learning models, classes that encourage or require higher levels of interaction might need to look into more advanced chat room options, through which students are able to chat outside of lectures or react to other messages inside and outside of the lectures.

Table I below shows the synchronous lecture platforms commonly used at the University of Louisville and the features each one possesses:

TABLE I

SYNCHRONOUS LECTURE PLATFORM COMPARISON

Synchronous Lecture Platforms			
Platform / Features	Blackboard Collaborate	MS Teams Recording	Zoom
Chat	X	X	X
Chat Reactions		X	X
Screenshare	X	X	X
Student-Screen Interaction	X		
Breakout Rooms	X		X
Mail/Calendar Integration		X	

Asynchronous classes, in comparison, benefitted more from video controls such as pause, rewind, and speed control, and the ability for the video format to emulate in-class learning. To achieve the comparison to the classroom setting, students preferred videos with slideshows or written notes in which the instructor narrates the information over ones students must read through on their own, with no instructor input.

Table II below shows a comparison of several asynchronous lecture platforms and their available features:

TABLE II

ASYNCRONOUS LECTURE PLATFORM COMPARISON

Asynchronous Lecture Platforms				
Platform / Features	Panopto	MS Teams Recording	YouTube	Narrated PowerPoint
Camera and Screenshare	X	X		
Speed Control	X	X	X	
Captions or Transcript	X	X	X	
Pause/Rewind	X	X	X	
Milestones	X			X
Notes Provided				X

To find the best platform for a course, the instructor should consider which features they believe are necessary to the style of teaching and material of the class. If in-class group work is important, they should consider using a platform with breakout rooms or a comparable feature that allows students to work in small groups away from the main meeting room. One professor interviewed believed the best way to make sure the course was successful on any platform was "making sure that it's easy for the students to find what they need." In some cases, this may mean using multiple platforms for the different aspects necessary to a class (lecture, assignment submission, grading), and in others, it may require the instructor to simply use the platform they are most familiar with in order to ensure smooth function of the course.

B. Lectures

Regarding lectures, the main consideration should be the amount and schedule of material provided to students. The largest part of that aspect comes from deciding what, if any, notes will be given to students ahead of time. Based on the balance of concept and application, it is important to understand how students best absorb different topics. If students learn the application of math or engineering best by practicing it, leaving the examples from class blank for students to fill in during the lecture might be the best option. However, if they need to engage with the theory of a topic in a discussion-based manner, providing the basic information for class concepts could allow students to focus on participating and interacting in class rather than being worried about if they are missing any information as they write out all of their notes.

Another factor of this question is video recordings of virtual synchronous lectures. In the same way that providing notes might allow students to focus more on the discussion and information as it is being taught during the lecture, a video could allow them to participate in class as they know they will have the recording to return to at a later date to copy down any notes they may have missed. Contradictorily, knowing that they can access the material outside of the lecture time may lead to students not attending synchronous lectures or participating in class. However, these specific concerns can be balanced by some form of in-class assignment or attendance if the instructor believes active attendance of lectures to be a necessary part of their course.

For asynchronous classes, it is important to provide the information and materials to students on a regular schedule, with both posting days and due dates being consistent throughout the semester. The instructor should decide, however, if they would like to post

class information week-by-week or multiple weeks of material at a time. This consideration should largely be based on the amount of material the instructor has at the beginning of the semester, the amount of time each week they will have to put into creating class content, and the way the class is run for assignment submissions and lecture viewing.

Though lectures are the main source of student learning in a course, it is also important that instructors consider supplementary materials. One professor who participated in this research said that she knew students used online videos from other sources outside of class to help them learn the material they were struggling, and she encouraged them to do so. Many of the supplementary videos provided a level of technical skill or animation that, while useful for getting students to retain the material, were not able to be included in her own videos. Though she wished she could gather a list of videos that could be useful to students, she just did not have the time or abilities to do so. Instead, she suggested that if she could "get all of [her] students from the last five years in a room and say, 'When we learned this, what did you use, and how did you learn it? What was most beneficial?'" then she felt she might be able to vastly increase students' understanding of the material. Particularly in online courses where the instructor cannot always be available to answer questions (or in asynchronous courses where there is no live interaction), having such a list of videos or other supplementary instruction for students to turn to if they are struggling could be an incredibly useful option to include.

C. Assignments

Preparing for and responding to assignments is an important part of instructor feedback when students are learning new material. When students have covered concepts and applications during lectures and are given the chance to show what they have learned in homework, exams, or other assignments, the information is often retained better. A vital part of this learning process is using example problems in class to help students feel prepared for their assignments. If students have not been exposed to the types of problems they are tested on, they often lose interest or determination in a course. One of the largest setbacks students focused on was feeling unprepared for assignments and examinations in their online courses.

Instructors might also consider some form of review for their exams to help decrease student anxieties. From the simplest form of reminding students of the topics that will be covered, and the examples from class or homework that relate to those topics, to more complex study sessions held by the instructor or TA in or out of class, students overwhelmingly responded that they feel like some kind of review would increase their performance on exams.

In addition to understanding material before the assignment, being able to understand mistakes after receiving grades was another concern of the surveyed students. Particularly for instructors who were used to hand-grading materials, the online grading methods were not providing as much feedback as students needed. In order to balance this need for more information with the already full workloads of instructors, finding a suitable grading platform could prove to be valuable. In Table III below, several grading

platforms are compared based on features that can make it easier to grade assignments and provide plenty of feedback.

TABLE III

GRADING PLATFORM COMPARISON

Grading Platforms				
Platform / Features	Blackboard	Gradescope	Crowdmark	Paper/Emailed Copies
Comments	X	X	X	X
Built-In Rubric	X	X	X	
Grouped Grading		X		
Question-by-Question Grading		X	X	
Image Insertion	X		X	
Synched LMS Upload	X	X	X	

If, even with more feedback on their assignments, students are still struggling with understanding their mistakes and being able to fix them on future work, considering options such as in-class review of specific homework problems missed by a large percentages of students or answer keys would be the next step. Despite concerns about providing the answers to students, leaving them without the ability to correct their work can severely impair their understanding of the material.

D. Engagement

Engagement is a two-fold aspect of courses, both online and in-person: in-class and outside of class. In-class engagement is seen readily in synchronous courses where students can ask questions, work with other students, and respond to the professor while they teach. However, with virtual classes, even synchronous attendance can feel as though it is lacking the desired level of engagement. In these courses, adding opportunities for group work, call and response lecture periods, or something more complex, such as an outside application that allows for game-like review in class, can increase student interaction with each other, the instructor, and the material.

In asynchronous courses, it is more difficult to add engagement, as students are often doing the work and watching lectures alone. However, finding ways to break up class videos or asking students to complete examples on their own before showing them in the lecture can allow a level of interaction with the material.

Outside of the lecture, establishing avenues of communication is imperative. Students being able to contact both the instructor and other classmates can greatly increase the engagement they have with the course. Though it can be difficult for students to reach out when they are struggling, repeated reminders of these options for communicating with the instructor, TAs, or classmates, as well as clear information on where to access and how to use them, can make them seem less daunting.

E. Student Strategies and Suggestions

Though the set-up and operation of online courses are a large part of their success, students also have a role to play in staying engaged with and interested in their classes. In the course of the surveys and interviews, students and professors were asked to give advice on how students can do so. The most repeated item was that scheduling and organization are vital parts of being successful in college, but even more so in virtual classrooms, especially when weekly schedules aren't always consistent. Some students said they "always try to work ahead" when they have the opportunity, so their class assignments don't pile up. Others had the opposite approach. Looking too far in advance was overwhelming, so they advised other students to "take it week-by-week" to keep the scheduled work to a more reasonable amount of time. Each student should find the best method for themselves, but no matter which piece of advice they choose, the overarching theme was "be ready to hold yourself accountable" for all of the work and responsibilities of the classes.

For students new to online classes, the biggest change they are required to make is finding a place to dedicate to their schoolwork. Having a space to focus can be difficult if students are living with family or roommates, but being able to dedicate time and space solely to schoolwork can improve efficiency and performance whether listening to lectures or taking exams. One student advised that others "treat it like regular school" by making sure they were dressed, positioned, and listening as though they were in a regular classroom, as it helps them engage with the material.

As universities continue to balance accessibility with safety, many parts of campus life are shut down. But interacting with other students and university resources

can help ensure students have all they need to succeed in school. Many students encouraged their classmates to "use everything at [their] disposal," whether it be joining study groups, emailing professors, or participating in student organizations. Having a support system can make the process of taking college courses vastly easier, and that doesn't change when it comes to virtual classes.

Finally, a few professors had some key insights. One emphasized that students "have to take a more leading role in [their] work." Especially in her asynchronous courses, she found that students were not leaving enough time to ask questions or get help with their assignments. Scheduling extra time into study sessions and homework plans can allow students to reach out to classmates and professors for help. Another focused less on the physical aspects of participating, and more on the mental. "What you really want is… someone who's highly motivated and just wants to learn," she stressed. "Those are the people who are going to be successful" in their courses and in their fields.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

Though more research into virtual courses, their impact on students, and their promise for future education is necessary, many conclusions can be drawn from the findings and data analysis of this thesis. Surveys and interviews of students revealed that, in the areas of lecture platform, lecture style, assignment preparation, and engagement opportunities, there is much room for the growth of virtual and hybrid courses. Focusing on each of these aspects separately and examining the feedback of students with input from their instructors allowed an outline for areas for improvement in these courses.

Choice of lecture platform can be improved upon by considering several features offered that allow for aspects of courses, such as peer-learning or student interactions in class, to be a more central focus. Giving students access to certain class material may improve their ability to connect with the content of the course. Instructors should make decisions about what should or should not be provided for their course based on balancing students' in-class participation with their needs to reach better levels of understanding. Preparing students for assignments and exams can take many forms, and being sure students are provided with examples and review can vastly improve their classroom experiences. For instructors, finding a grading platform that allows them to

give enough feedback that students can understand and correct their mistakes while not requiring superfluous work on the instructor's behalf can assist in many aspects of returning and responding to assignments. Lastly, helping students engage with their courses, from using supplementary lecture applications to keeping channels of communication available and active, will improve their overall performance in their classes.

B. Recommendations

The main two limitations of this thesis are the time and span of the data collected. As it only surveyed 45 students and four instructors, all from the same college within the University of Louisville, this research is restricted in scope. Students in different areas of study or at other universities may feel differently about many of the items presented in this thesis. If allied research was to be completed, having a larger number of participants from varying institutions and majors would be recommended. In addition, being able to carry out data collection for a longer period of time, perhaps spanning several semesters, would allow the opportunity to see more variation in virtual classes and a growth in the experience of students and instructors who take and teach them.

Though this research focused on four main areas of virtual and hybrid courses that have a large impact on student success and engagement, focusing in on one of them may allow for more thorough conclusions to be drawn. Testing the different engagement opportunities proposed in this thesis over several semesters could lead allied research to examine the impact they have on students of various majors and the amount of time it requires from instructors. As other research has done, linking any of the four areas of

concern from this thesis to student performance would lead to more detailed explanations of the long-term success of the suggestions laid out here.

REFERENCES

Ali, Wahab. 2020. Online and Remote Learning in Higher Education Institutes: A Necessity in light of COVID-19 Pandemic. *Higher Education Studies; Vol. 10, No. 3,* 16-25.

Arias, J.J., Swinton, J., Anderson, K. 2018. Online Vs. Face-to-Face: A Comparison of Student Outcomes with Random Assignment. *E-Journal of Business Education and Scholarship of Teaching Volume 12 Issue 2,* 1-23.

Broadbent, J., & Poon, W. L. 2015. Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review. *The Internet and Higher Education*, 27, 1-13.

Katie Densberger. "Distance Learning Help: Success as a Work-from-Home Student." *University of Virginia Total Advising.* March 12, 2020. https://advising.virginia.edu/resources/coronavirus-homestudy. March 10, 2021.

Kirtman, Lisa. 2009. Online Versus In-Class Courses: An Examination of Differences in Learning Outcomes. *Issues in Teacher Education Volume 18 Number 2,* 103-116.

Ma, J., Han X., Yang J., Cheng J. 2015. Examining the necessary condition for engagement in an online learning environment based on learning analytics approach: The role of the instructor. *The internet and Higher Education,* 24, 26-34.

McGuire, Saundra Y. 2020. Teach Students How to Learn During the Pandemic: Metacognition is the Key! PowerPoint Presentation.

Ni, Anna Ya. 2013. Comparing the Effectiveness of Classroom and Online Learning: Teaching Research Methods. *Journal of Public Affairs Education*, 19:2, 199-215.

Rapanta, C., Botturi, L., Goodyear, P. et al. 2020. Online University Teaching During and After the Covid-19 Crisis: Refocusing Teacher Presence and Learning Activity. *Postdigit Sci Educ 2*, 923–945.

"Time Management for Remote, Online & Blended Learning." *Oregon State University.* 2020. https://success.oregonstate.edu/learning/remote-online-learning. March 10, 2021.

APPENDIX I

PIE CHARTS OF SURVEY RESPONSES

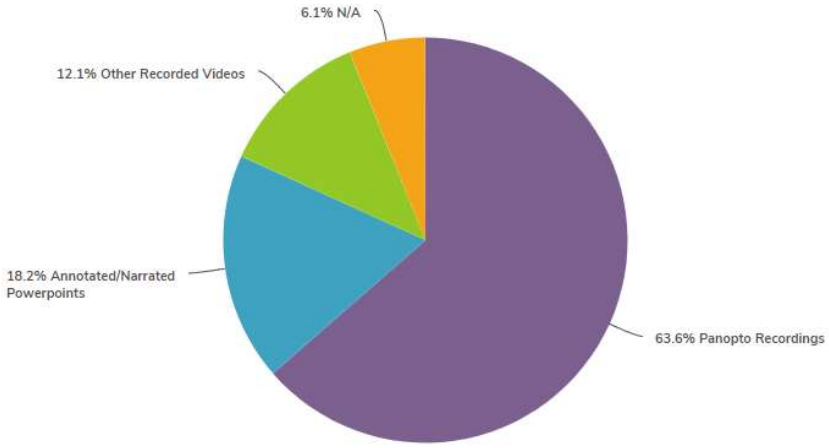


FIGURE 4 - Response to Survey Question: Which Asynchronous Platform Do You Prefer?

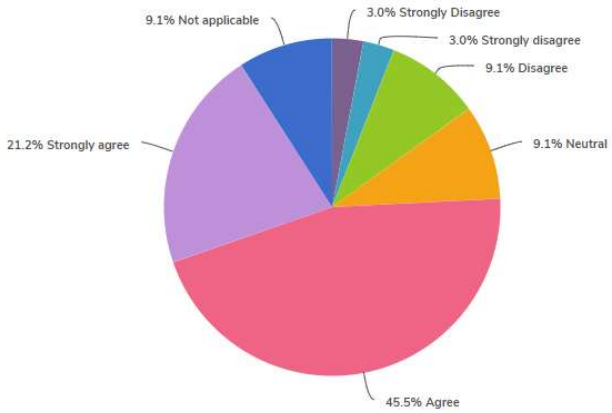


FIGURE 5 - Response to Survey Likert Scale: Blackboard Collaborate is a Good Tool for Virtual Class Meetings and Group Work.

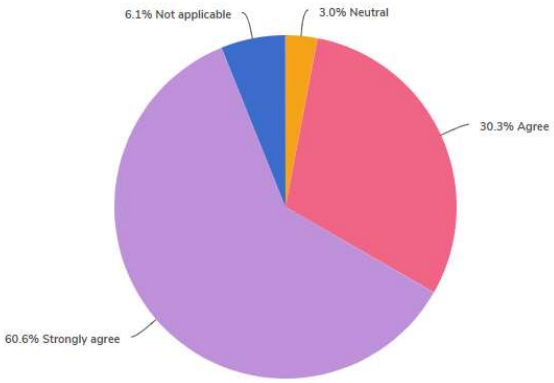


FIGURE 6 - Response to Survey Likert Scale: Microsoft Teams is a Good Tool for Virtual Class Meetings and Group Work.

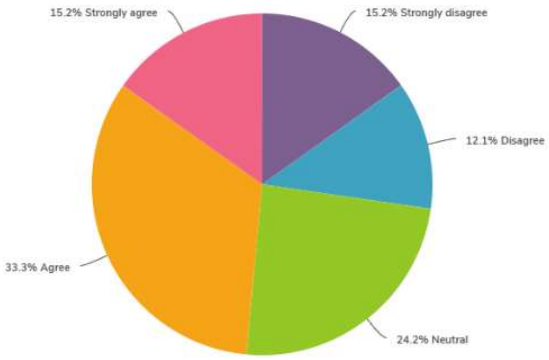


FIGURE 7 - Response to Survey Likert Scale: Live Lectures (Virtual or In-Person) are Vital to My Understanding and Engagement in College Courses.

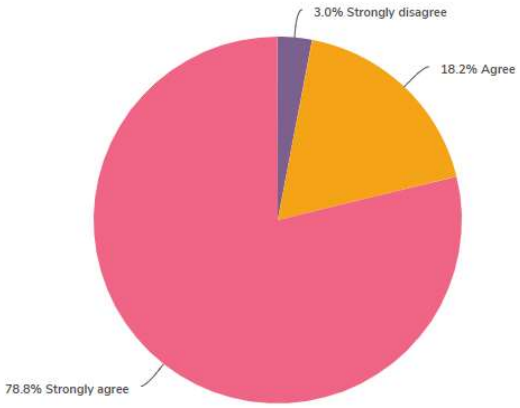


FIGURE 8 - Response to Survey Likert Scale: All Classes with a Virtual Component Should Provide Video Recordings of the Lectures.

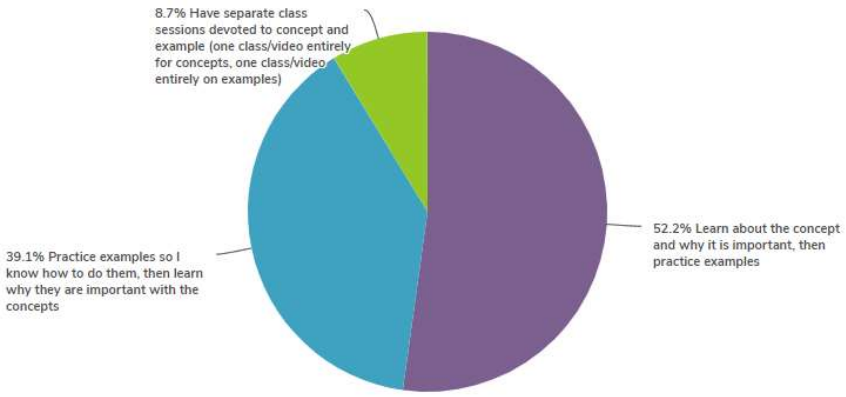


FIGURE 9 - Response to Survey Question: For Classes That Require an Even Mix of Theory/Concept and Examples, What is Your Preferred Way to Learn?

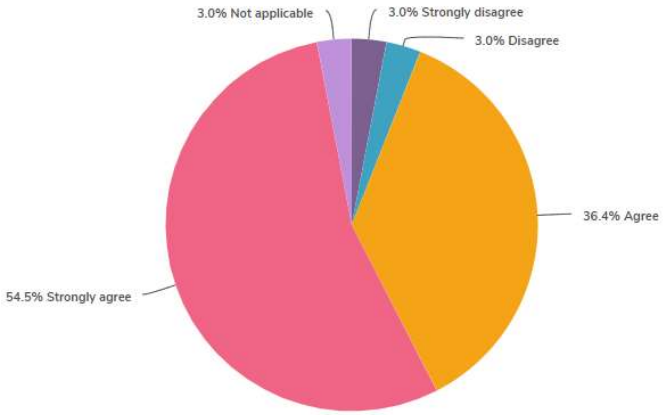


FIGURE 10 - Response to Survey Likert Scale: In-Class Assignments and Explicit Examples are Vital to My Understanding of Class Assignments.

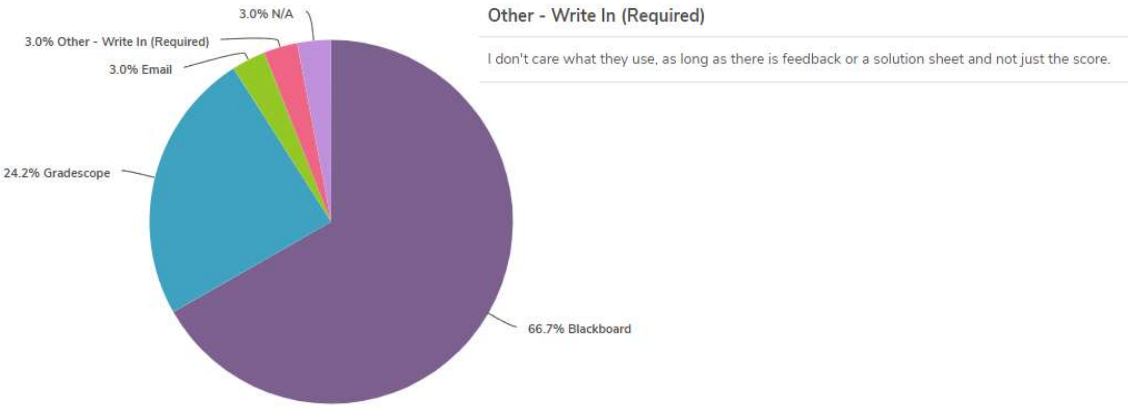


FIGURE 11 - Response to Survey Question: Which Grading Platform Do You Prefer?

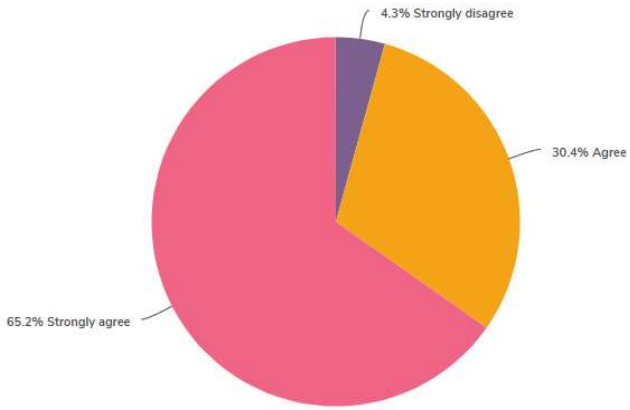


FIGURE 12 - Response to Survey Likert Scale: I Would Like to Have Some Review Session in Every Class Before an Exam.

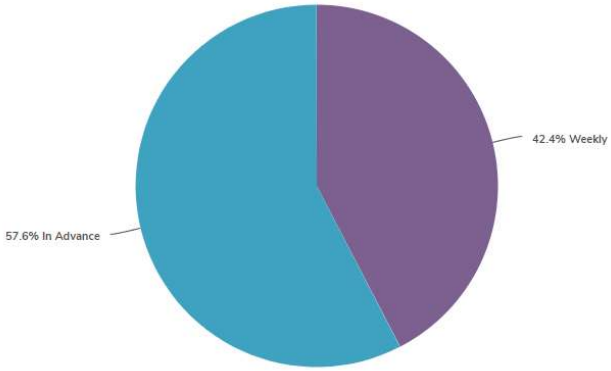


FIGURE 13 - Response to Survey Question: Do You Prefer Distance Ed Courses that Post Material Weekly or Courses that Post Material Multiple Weeks in Advance (2+)?

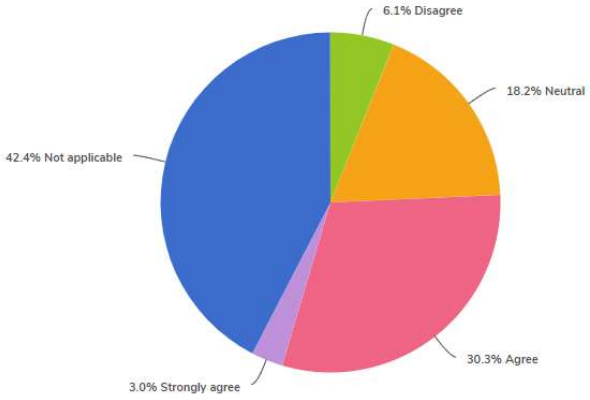


FIGURE 14 - Response to Survey Likert Scale: Platforms Like Kahoot, Quizlet, and Mentimeter are Good Tools for Engagement.

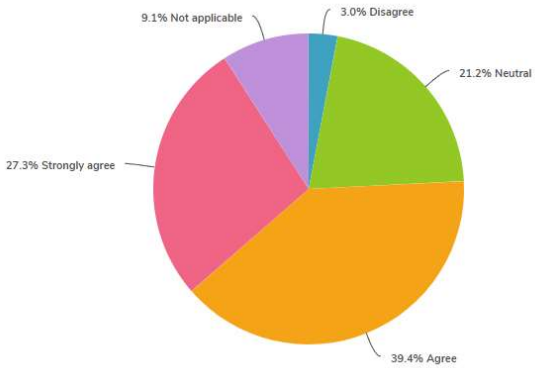


FIGURE 15 - Response to Survey Likert Scale: Engagement Opportunities (as Described in the Previous Equation) are Vital to My Understanding and Engagement in College Courses.

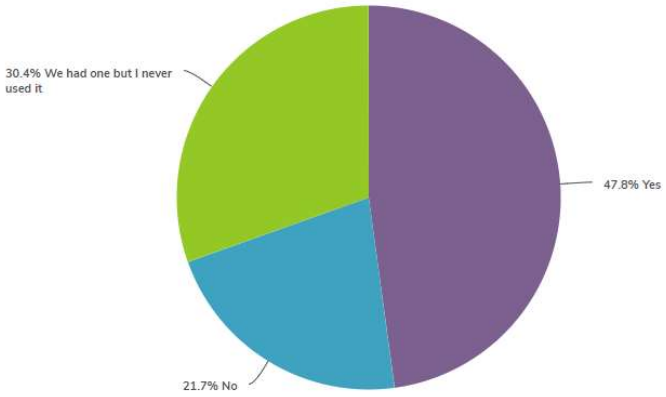


FIGURE 16 - Response to Survey Question: Have You Used Any Form of Discussion Board in Any of Your Classes that Professors or TAs Also Have Access to? This Can Be Any Team's Chat, a Discord Channel, a Blackboard Discussion Board, etc.