

REALIZING THE IMPORTANCE OF COURSE DESIGN THROUGH RAPID AND FREQUENT MODIFICATIONS IN INSTRUCTIONAL MODALITY

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ABSTRACT

At the beginning of the pandemic, universities implemented a variety of learning modalities to offer learning experiences. Many approaches attempted to help students who may have difficulties attending classes on-campus. The university implemented a mixed-mode (MM) approach to teaching and learning. The aim of this research is to operationalize, share outcomes and connect MM to the literature and practice. The research aims at providing a better understanding of how the model impacts the academic experience in the perspective of the faculty and students. A course using a MM of delivery is one that is delivered in a combination of online and on-campus instruction. In MM, students who are in an on-campus class can communicate with students in an online class via teleconferencing, allowing them to collaborate with each other and engage in the course material with each other. Ultimately, most faculty did not use the sophisticated technology purchased to support the mixed-mode approach. Through many conversations between colleagues, students and IT staff, it was clear that the majority of the faculty ranked their preference for instruction as F2F as the most preferred; online teaching second; and at a distant third, mixed-mode.

Keywords: Classroom Technology, Mixed-mode, Online Teaching, Course Design, Distance Learning

INTRODUCTION

The context for our study was a comprehensive liberal arts Sino-American University. Students spend up to two semesters at study away campuses across the world, which is critical to the University's objective of developing globally-minded individuals. The University has less than 1500 undergraduate and graduate students, half of whom are from China and the other half from 70 other nations. The university is staffed by faculty members from 27 countries teaching mathematics, data science, neuroscience, and finance. The technology teams are structured into two groups. The first group is called Research and Instructional Technology Services, who provide technology assistance for teaching, learning, and scholarly pursuits. The second technology group is the IT Services unit whose technology experts in Servers, Network, Cloud, Multimedia, Development and Service Design build and maintain the datacenter, technological infrastructure and make sure the campus is integrated with other global campuses.

In the Fall 2020, restrictions over international flights were imposed globally, which impacted the ability of students to attend classes on-campus. Therefore, a large number of the student body were not able to return physically to the campus. Academic units along with technology departments discussed the potential of digitizing the on-campus experience by implementing a digital teleconference technology into the classroom allowing two-way communication. This mode of involves using a classroom digital camera to transmit activities to online students, while the camera and audio of online students are broadcasted on a large monitor display in the classroom. Technology departments created several iterations of design and training, in addition to offering several classroom technologists on stand-by to support the faculty operating the technology in their classrooms.

For this study, we will discuss and connect the following methods for applying technology into higher education classrooms. Each technology approach will be aligned with a theoretical framework and current literature, resulting in specific instructional strategies deployed.

- How mixed methods of integrating various technology affect the quality of instruction
- Instructional Environment/Ecosystem;

- Classroom management and dynamics for using each technology;
- Instructor prior/during/after beliefs, perceptions and motivations; and
- What technology was the most and least effective.

In addition, we noted various attributes for exploring effective teaching and learning in various modalities throughout the project, which included:

- Scenarios where some or all of the students are online and in-person influences factors that plays key roles in the teaching quality;
- Context of the knowledge designed for face-to-face (F2F) may not translate efficiently for alternate modes of instruction (especially without additional training on how to design courses for different settings);
- Classroom design and changes to adopt to classroom, and number of total students participated in the design and implementation stage;
- Feedback received (from students, instructors and IT staff);
- Course enrollment in mixed mode for each semester detailing the number of students (and instructors) who were F2F or online (and if online, which timezone);
- Student engagements (indicators used to judge level of engagement);
- Misconceptions of classroom design as technology solutions without consideration of course design;
- Student expectations for each of the proposed learning environments; and
- Common misconceptions formed by stakeholders between mixed-mode and hybrid learning.

METHODS AND LITERATURE REVIEW

This study adopted a systematic review methodology to connect (I) research-based learning modes with the (II) current literature; (III) applied technology and (IV) instructors' pedagogy. There are many ways we can create and offer learning opportunities and in several different types of environments or modes. Numerous teaching modalities have been developed over the years, some include (alphabetically) Blended, Computer-based, Correspondence, Digital, Distance, Distributed, e-Learning, Flipped, Hybrid, m-Learning, Massive Open Online Course (MOOC), Mixed-Mode (contemporary), Mixed-Mode (historical), Online, Virtual and Web-based. In addition to connecting the literature, technology and pedagogy, in this project, we share operational definitions of major learning modes; ideas for implementing mixed mode instruction; challenges for mixed mode instruction; and corresponding outcomes.

SECTION I. INSTRUCTIONAL MODALITIES

The Spring term of 2020 witnessed a pivotal shift in educational methodologies across the globe. Faculties were universally urged to quickly adapt their in-person courses to an online format, setting the stage for an unprecedented era of remote learning. Discussions of how we might best interact with students during these times were paramount and continue today. The follow represent options which are typically discussed when considering alternate instructional modalities (Maloney & Kim, 2020):

- **Face-to-face (F2F):** This traditional form of education takes place when both the students and the instructor are present simultaneously at a shared physical location. [note: research that has been compiled on this approach has often shown a lecture, linear approach to be ineffective for sustained, deep learning (Wiggins, 2017)].
- **Start online and transition to F2F:** If courses are delayed due to continued health challenges around the world (which as we now know, returning to 'normal' was/is delayed).
- **Start F2F and transition to Online:** This approach is adopted in anticipation of a potential second wave of COVID-19. Most universities chose not to plan for this occasion, instead incorporating temporary plans and waiting for normal to return.
- **Fully Online:** In case the pandemic persists; or institutions do not have the resources to offer F2F programs which would provide a safe environment for students - or that students perceive the conditions did not meet their criteria for safety. Additional variables for potential online learning encompassed the accelerated timeframe; the high volume of faculty and students affected; inadequate infrastructure; a dearth of experience in online pedagogy; unexplored attitudes and perceptions towards virtual instruction (encompassing elements like faculty self-efficacy and students' aptitude for autonomous learning); and for some, significant time zone discrepancies among students.
- **Blended (BL)/Hybrid:** This teaching style is a fusion of face-to-face (F2F) and online methodologies. Garrison and Kanuka (2004) interpret BL as a considered harmonization of in-person learning and online experiences. Through an exhaustive 2015 meta-study named "Blended Learning Over Two Decades", Zhonggen evaluated 30 articles to examine the concept, merits, and issues of BL, concluding that an innovative shift in pedagogy towards a blended model could be beneficial for institutions. The analysis identified several key insights on BL, including:

- BL allows for a varied emphasis on different instructional strategies, encouraging educators to devise courses that incorporate diverse teaching methodologies (Carbonell, Dailey-Hebert & Gijsselaers, 2013);
- It underscores interaction as an engaged process that prompts learners to actively participate, rather than merely receive information passively (Dias & Diniz, 2013);
- Improved BL methodologies can progressively refine pedagogy, effectuating significant shifts in educational paradigms (Graham, 2006);
The extent of teachers' self-efficacy in internet usage and web-based learning plays a crucial role in shaping their attitudes towards web-based instructional development (Kao & Tsai, 2009);
- The incorporation of interactive learning activities within a BL environment proves effective in assisting students to attain their learning objectives (Kember, McNaught, Chong, Lam & Cheng, 2010).
- **Lab Considerations:** As much as possible F2F (e.g., lab courses, studios, discussion sections, etc.), and offer the remainder of the course online. Virtual labs could include [American Chemical Society](#), [Labster](#), Harvard's [LabXchange](#), and CSU's [MERLOT](#).
- **Additional Sections:** Hold multiple sections of the same class at the same day/time in smaller numbers in different rooms to maintain social distancing (and/or teach the same class four times in a row to ¼ of the students enrolled).
- **Large Classes:** Move all large lecture classes to an online format; hold small enrollment classes F2F with social distancing.
- **Targeted Curriculum:** By reducing the quantity of offered courses, campus density can be limited and support resources can be focused primarily on essential courses or distinctive experience classes. This strategy may involve postponing low-enrollment courses and giving preference to those that can be flexibly adapted to various modalities.
- **Divided Curriculum:** Courses are deliberately architected as either in-person or online offerings. Whenever feasible, each class is provided in two sections to cater to varying learner needs and preferences.
- **Block Module:** This model has students concentrate on a single course at a time for a condensed duration of 3-4 weeks. These intensive sessions or blocks are lined up back-to-back throughout the entire semester, offering increased flexibility.
- **Hybrid-Flexible (HyFlex) Module:** Courses are delivered via face-to-face and online modes simultaneously, steered by the same instructor either synchronously or asynchronously based on student preference. This model generally leans towards synchronous learning and to execute it effectively, it often necessitates real-time classroom assistance, a purposefully structured classroom environment, and a hefty amount of patience.
- **Adapted Tutorial Approach:** This model involves students attending a shared online lecture, followed by faculty-led tutorial sessions with smaller groups, thus facilitating social distancing. Unlike the HyFlex model, this adapted tutorial approach doesn't necessitate additional in-class assistance. However, it might require a significant investment of time from faculty members.
- **Mixed-mode:** This is a combination of various modes. Modules were developed at such a rapid speed during the pandemic. As such there was no adequate research or evidence to assist the faculty in developing an efficient course design.
 - Mixed-mode (as per our IT department) uses a specially designed classroom that enables students to engage both physically and remotely in the same course concurrently. The technology allows two-way communication and aims to increase student engagement. The faculty, in-person and remote participants can all communicate with each other simultaneously. The class technology allows the classroom to be recorded for asynchronous, or note taking, while the artificial intelligence (AI) technology allows auto-switch, track and zoom-in/out between the lecturer and students to trace and broadcast it to the remote students and keep it focused on the active participant(s).

SECTION II. CONNECT TO CURRENT LITERATURE

As a combination of different modes, mixed-mode modality adds an additional layer of complexity, since it incorporates F2F and online modes, synchronous and asynchronous aspects. As a starting point for further discussion of mixed-mode learning, we would like to borrow some insights from the literature on HyFlex regarding challenges and design implications. Beatty (2020) identified four pillars of the HyFlex modality:

- **Principle 1 - Learner Choice.** Learners choose the mode of participation for each class based on their preferences and their best suitability (Wang & Hargis, 2021).
- **Principle 2 - Equivalency.** No matter which modes learners choose, they all have learning activities “leading to equivalent learning outcomes (Gourneau & Smart, 2022).”

- **Principle 3 - Reusability.** The learning activities from different modes could be accessed and reused as resources for learning.
- **Principle 4 - Accessibility.** Students have the technological competence to access learning activities in each mode in order to facilitate students' choice of learning, as well as to enhance the reusability of learning resources.

A number of students faced barriers during the pandemic, including technological limitations and mental health challenges resulting from housing and financial conditions, anxiety about the pandemic, difficulty adapting to changes in the course, and lack of motivation and focus during online learning (Gillis & Krull, 2020). Specifically related to the challenges faced by students with the teaching modality, according to Bubacz et al. (2021), online or hybrid learning posed problems in facilitating teacher-student and peer-to-peer interactions, as well as encouraging students' active participation and involvement. In the online learning mode, students experienced self-teaching as they spent more time reviewing instructional materials and attempting to figure things out on their own. Additionally, students' learning experiences were negatively impacted by audio-visual delays and video quality (Bubacz et al., 2021).

Though moving to different learning modality is challenging, there is potential to bring in students' engagements and resolve technological issues if schools and educators draw attention to course design and classroom technology (Gillis & Krull, 2020; Bubacz et al., 2021). To implement HyFlex principles suggested by Beatty (2020), we reviewed literature in classroom technology and course design to further investigate the role they play in mixed-mode learning.

Mixed-Mode and Classroom Technology: Due to the pandemic, the widespread rapid transition to distance learning presents challenges for the di Numerous pre-pandemic studies explore the use of information and communication technologies (ICTs) due to their adaptability, accessibility, convenience, and practicality. (Shen & Ho, 2020; Hue & Jalil, 2013; Marcelo-García et al., 2015). The initial rise of classroom integrating technology is to enhance the learning experience by designing and presenting content knowledge and the execution of instructional methodologies (Marcelo-García et al., 2015). The types of technology include materials delivery platforms such as PowerPoint, communication software platforms such as Zoom, Google Meet and Microsoft Team. Other collaborative sharing and organizing platforms were also used such as Google Classroom, Google Suite, social media platforms, blog posts and podcasts. The implementation of cloud services were integrated to encourage active engagement by collecting feedback, as well as e-learning platforms that support personalized learning, and augmented reality that enables students to immerse in novel learning experiences (Shelton, 2013; Marcelo-García et al., 2015; Dudar et al., 2021; Lyakhova, 2020).

The pandemic's worldwide impact requires technology to be utilized more effectively across all industries. The challenges of incorporating technologies into course design lie in the use of appropriate and relevant technology that can support the course and be acceptable to students, the instructors' varied attitudes towards technology, the high expectation of both students and teachers to master technology, and the provision of comprehensive technology training (Popova, 2020; Rasheed et al., 2020; Hue & Jalil, 2013). In addition, Makarenya et al. noted that communication technologies such as Zoom and Microsoft Team are insufficient to facilitate long-term distance learning (Makarenya et al., 2020). The objective of classroom technology should be so revolutionary that it not only serves as a replacement for traditional in-person learning, but also facilitates the creation of new activities (Makarenya et al., 2020; Puenteduro, 2006).

Mixed-mode learning requires a more selective deployment of technology that needs to support the online students, and also the interaction between classroom participants and online students. This would demand a greater level of technical proficiency from both students and instructors. In Addition, the pandemic constraints and logistic challenges the technology blueprint was designed as general as possible to accommodate different course needs.

Course Design under Mixed-Mode: Under normal circumstances and with an abundance of resources, an effective course design supports the creation of engaging learning environments and the improvements of students' performances regardless of the teaching modality (Black et al., 2014; Swan, 2010; Moon et al., 2021; Yuan et al., 2022). As a result of instructors' reflections, Yuan et al. (2022) suggests that while shifting from F2F to online learning, it is important to maintain the academic objectives and follow the backward design concept which identifies the expected learning outcomes first, and then designs the assessments and instructions with the outcomes in mind (Wiggins & McTighe, 2005). There is, however, a need to modify assessments and instructional design so that students can interact with teachers and their peers in time and that mental stress due to the pandemic and teaching modality change can be reduced (Yuan et al., 2022).

According to Gillis and Krull (2020), a comparative study of two online course designs identified three design implications relating to the theme of; “Balanced Interaction, Enjoyment, and Accessibility”. Based on students’ responses to a survey regarding their perceptions of instructional techniques:

- To achieve a successful online teaching experience, autonomy needs to be given to students for determining their schedules and learning activities, along with flexibility on deadlines, but at the same time, an organized course structure should encourage them to complete learning events and keep on track.
- Increase the engagement between students, as the instructors facilitate peer interaction in class, so that they could help each other if they have some questions or need clarification during class.
- Students should have timely communication with faculty members. A supportive online learning environment and communication platform would help students ask questions without fear and maintain motivation.

Calafiore and Giudici’s study (2021) compared and evaluated students’ performance in hybrid and Hyflex mode introductory finance classes. Most participants were “non-traditional students,” meaning that some were from the industry and have been out of school for some time. The only difference between the two groups is the delivery mode. Both groups were provided with the same learning outcomes, activities, assessments, instructors, and content. The results of the study showed that the mode of delivery had no effect on the performance of the students. However, the researchers noted that students in the Hyflex group prepared for tests by reviewing recorded lectures. Landin and Pacenka (2021) noted that, despite the fact that some online student response platforms (such as Padlet and Kahoot) made it easier for instructors to relocate traditional formative evaluations online, summative exams have become difficult since instructors cannot guarantee academic integrity. Therefore, the authors suggested that educators could add more formative assessments. As an example, instructors could incorporate “on-camera engagement” to increase student engagement in lectures and discussions (Landin & Pacenka, 2021). In reference to Fuller et.al (2020), as well as Titarenko and Little (2021), Landin and Pacenka (2021) also emphasized the importance of personalized learning and student-centered learning environments (Beatty, 2019) especially in the online settings.

SECTION III. APPLIED TECHNOLOGY

Ideally, Mixed Mode teaching should require instructors to attend at least one training session and adjust the course design as required. In this approach, students either participate remotely (synchronously or asynchronously) or in person at the institution. It is crucial to be familiar with the various tools the institution provides to help ensure that remote and on-site students receive quality education. Faculty should also be able to teach effectively and comfortably in this setting. Our Mixed-mode classroom design has three main elements, comprised of three to six items each:

- **Multimedia**, which includes the 1) AI Cameras, 2) speakers, 3) ceiling and handheld microphones, 4) computer, 5) tablet which acts as a shared whiteboard, and 6) monitor(s) that display the remote participants and allow them to interact with the on-site group;
- **Controller**, which plays a role of 1) integrating and controlling multimedia components, 2) managing the digital videos layout and quality, and 3) resizing the different video feeds to make them more transferable for the conferencing tool; and
- **Conferencing Platform**, a popular third party conferencing tool such as Zoom video conferencing, the platform contains a solid infrastructure with datacenter distributed across the globe, and has the ability to broadcast video and audio in two-ways communication with a very low latency.

Classroom Design: The classrooms were physically re-designed to fulfill different academic needs. There are several designs for the mixed-mode classroom, which are focused on a principle that allows two-way communication between in-person and remote students. Faculty, in-person and remote students will be able to see one another via two cameras (one facing the faculty, one facing the in-person students) set up on a classroom computer running Zoom teleconferencing. Remote students’ cameras are displayed on a 70” monitor located on the wall facing the in-person students. In some scenarios, the student in the classroom may join the same teleconference session to form a working group with the remote student. The faculty has two monitors mounted on the desk, one displaying the remote students with no need to turn around, while the other displaying the content presented to the students. With the AI camera enabled, the camera will track the faculty and auto-focus into the whiteboard while the faculty is writing on it. The camera will continue to focus leveraging the space where the remote-student can observe the faculty body language, and the text written on the whiteboard. The faculty may also choose to add an extra tablet with a smart pen as a whiteboard which will be presented for remote students and projected in the classroom. The faculty may add an extra laptop to display other materials where in-person and remote students are viewing the same materials.

For cases where the faculty will use the classroom with a presentation, without whiteboard, the same presentation

will be broadcasted for in-person and remote students. While the AI camera will track the faculty movement and capture body language, the ceiling microphone will broadcast the instructor's voice in a high quality to the remote-students. Faculty are expected to make minor adjustments to the course design to incorporate technology, without making any core changes to the course materials or learning objectives.

Operating the Classroom: Faculty received demonstrations and training on the mixed-mode technology. A dedicated technical team helped to set up the room in advance. The IT group tested the technology to ensure its functionality. Each classroom is equipped with an emergency landline telephone that can be used to call support in case of an unexpected event. The technician troubleshoots the classroom remotely, or in-person within three to five minutes. Each classroom received a daily check to make sure all equipment is functioning.

The integration between ceiling microphone, speakers and the AI cameras, provides the online students can enjoy a more immersive classroom experience. Faculty and students (in-classroom and online) can maintain visual contact with each other with several new technology additions. These include digital correction of the ceiling microphone arrays, digital handheld and lapel microphones to improve classroom sound while avoiding sound echos, and extra monitors to improve user experience for both online and in-person students.

SECTION IV. INSTRUCTION

In this section, we will connect theory, literature and available technology to the application and challenges of instruction. Categories of Learning Environment, Course Design and Student Engagement will be used to organize the ideas.

Learning Environment: The years 2020 and 2021 impacted teaching and learning conditions worldwide, nevertheless China kept most of their institutions open with Covid-19 policy and restrictions applied. During 2022 the same strict policies created unmatched circumstances for students and instructors. In higher education course planning typically requires at least 12 months in advance and for a new course. A submission for review to the curriculum committee is required about six months in advance. However, during the COVID-19 emergency stage, in early 2020, education institutes in China were one of the first to transition to remote learning, the pandemic restrictions added time stress where in many occasions the instructors had as little as ten day notice of course policy changes and less than 24 hours notice of whether we will have access to the campus.

In March 2022, the Omicron variant arrived in the part of China where our university is located, which renewed the emergency status and forced a lockdown to the city where logistics was suspended. The pandemic developed rapidly, challenging the healthcare system and bringing a level of uncertainty. Public health took the highest priority of daily life, where social volunteers perform Polymerase Chain Reaction (PCR) testing on a daily basis for a city of over 25 million population. Every resident was required to take a daily PCR test, where volunteers will knock on the door to notify people. In addition, the residents members worked consistently leveraging the resources provided by their companies and local communities to secure their basic needs from food, water and medicals.

The academic community focus was divided between the academic obligation and their personal safety. On a daily basis, the instructor and students will answer the volunteers' calls for the PCR tests. Regularly, at least one student (or instructor) is called for the PCR test. Taking the PCR is efficient, however the whole process, including waiting in a queue can take 20 minutes or longer.

The university staff and students received support from the school, colleagues and the community personnel. We realized that an individuals' health (physical, mental and cognitive) is crucial for their ability to function and engage at a high quality manner. On several occasions, the instructor had no option but to rely on instructor-generated materials only as educational vendors were not allowed to ship, and private cars were not allowed to operate in the city. Attempts were made to digitize the co-curricular events of the classes such as field trips and other community engaged learning. There is ample research that demonstrates the effectiveness of virtual learning (Lee, et al., 2022).

Examples of how these conditions affected students' ability to engage and focus for a sustained amount of time differed greatly. Students from one course reported some of their challenges including being able to procure basic hygiene products. Some students needed mental health support, or access to critical medicine. Despite all these challenges, in addition to external factors such as internet stability, students in the centralized quarantine, the instructors were highly resilient to continue with the academia journey teaching their classes.

Course Design: Faculty were required to teach using mixed-mode methods, with a training focus on the

technology. With the pandemic and logistics challenges, it was difficult for the training to address pedagogy and course design. For lab skill-based learning outcomes, advanced experimentation with electronics was substituted for basic experiences that were performed remotely or simply viewed online. Classes that typically integrate physical robotics, alternative methods using simulations were offered instead. Classes that included learning outcomes such as interpersonal skills and working in groups were asked to perform similar activities online. Courses that were aiming to have students apply knowledge in design frameworks such as Inclusive Design or Co-Design Methodologies used online tools to engage students with other community members.

A significant modification in the Assessment Tools was implemented in the oral presentations for the Project-Based Learning (PBL). Classes originally planned to present physical materials were modified into highly edited videos presenting ideas about what they could have built physically. Instead of presenting functional prototypes, the students were evaluated based on their ability to express how a hypothetical solution could work for their PBL. In terms of the teaching methods adopted by faculty, the pandemic elevated the uncertainty of modality, in some cases instructors were not informed until two hours prior to the class. In addition, different areas may receive different messages from their neighborhood community.

Additional methods that instructors experimented with included flipped classrooms; using physical manipulatives remotely; video threaded conversations; and online collaborative tools for drawing, coding, brainstorming, researching and discussions. What is noteworthy is that faculty consistently indicated that they did NOT use sophisticated technology such as AI-powered cameras, or specially dedicated computers. Many reported that the most used tools were ones that involved low threshold technology such as an extra webcam, illumination, or extra screens, together with a stable internet connection and sufficient time to design their classes. Student response systems such as Kahoot and Poll Everywhere were reported to improve student engagement, the same as video-games, classes held in VR, and co-working virtual digital spaces.

DISCUSSION AND CONCLUSION

A major outcome of this research is the reaffirmation that successful online teaching does not rely on sophisticated technology. Technology plays an important role while the circle element for successful online teaching is related to how the course has been designed, then integrated with the technology factors and skills the instructors and students have. There is substantial research that indicates effective teaching in any mode has common elements (Angelo & Cross, 1993; Davis, 2009; Uttl, White, & Gonzalez, 2016). The research finds that learning-centered teaching “can be” similar for an online format as for traditional F2F settings. The methods on how we attend, connect, process and apply conceptual frameworks are different. The authors of this research recommend effective instruction typically occurs when we focus on foundational learning theories, whether the context for teaching is F2F, experiential, service, internships, informal settings (museums, aquaria, zoological parks, etc.) online. Often course design will need modifications to capitalize on a different learning ecosystem. Ideally, we might aim to integrate as many of the essential, research-based learning-centered teaching approaches into our online course design:

- Using backwards design to create active, measurable student learning outcomes;
- Implementing learning outcomes to guide student assessment, measurement and evaluation that aligns with active learning experiences;
- Intentional course planning involving far more than deciding on the content that “instructors” cover (instead of the learner “uncovering” or “discovering”);
- Being explicit about how and why you organize the content;
- The instructor's primary role is to facilitate learning, rather than disseminate knowledge;
- Engaging students actively in their learning through interactions with each other and with the instructor;
- The instructor needs to create a supportive environment for success including building rapport (which is even more essential in online learning); and
- Provide timely, helpful formative feedback on student performance.

We will discuss our findings as they relate to the configuration of this project (mode, literature, technology, instruction). In the introduction, we identified various attributes that impact effective teaching and learning. This section focuses on the attributes that were most influenced by our adoption of a Mixed-Mode style of instruction, as implemented by our institution. However, the type of teaching we provided in the beginning and continued for several years was, in fact, emergency remote teaching (ERT). ERT is a temporary switch to remote teaching methods during a crisis. It involves using fully remote teaching solutions for courses that are typically delivered face-to-face or as a blend of online and in-person learning. The goal is not to recreate a complete educational ecosystem but instead to provide temporary access to instruction that is quick to implement and reliably available during an emergency (Hodges, et al., 2020). In this section, we will focus on how the technology was adapted and implemented to address the highly dynamic circumstances at the university where often students and instructors

were not aware of the conditions for instruction until the day prior to class.

The context of the knowledge, skills and dispositions originally designed for F2F learner interactions does not translate across alternate modes of instruction (i.e., mixed-mode); and classroom design and changes to adapt to the classroom. This is especially true in the absence of well-aligned experiences on how to design courses for different settings. In our case, where mixed-mode was quickly adopted, without enough time to properly design and align with the academic course that would use effective practices of teaching. It requires a joint effort between different units including Center of Teaching and Learning Department, and IT experts with solid background in the area of pedagogy/andragogy (in any modality) (Lockard & Hargis, 2017). Evidence to support these assumptions can be found within specific courses and instructor summaries of learner interactions.

Freeman (2015) found that on average, faculty members spend over 70 hours developing an online course. Although faculty were not developing fully online courses, they were significantly modifying their course designs to be more flexible in order to adapt to the mixed-mode requirements and limitations. Standard course design includes at least three components, i.e., Learning Outcomes; Assessment (measurement and evaluation); and Teaching Methods. Data for this study found that for the learning outcomes in a course with lab components found that when working in groups, students needed to support each other online when not in F2F settings; a co-design methodology was implemented to identify ways to engage students online with potential users. Assessment tools were modified substantially as well. Oral presentations were shifted to ask students to create video recording and editing (these required serious editing); presenting a functional prototype where students needed to describe how a hypothetical solution could work; and extenuating circumstances as the new rule.

Teaching Methods were also modified. There was continual uncertainty whether the class will be online or F2F until two hours prior to each class. This meant that the instructor had to prepare multiple representations of how they would engage students in conceptual activities. Suggestions of implementing a “flipped classroom” model were made. The time factor, in addition to the logistics challenges, made it almost impossible to provide any associate training on how to create, deploy or assess the outcomes of this relatively new teaching method.

Course enrollment in mixed-mode for each semester varied significantly. The number of students (and instructors) who interacted F2F or online (and if online, which time zones since there were many international students unable to travel to campus physically). To adopt the mixed-mode teaching, the university spent the summer of 2020 to upgrade and enhance the classroom technologies, installing nearly 300 new devices in 60 classrooms in the main Academic Building. After the pandemic began, students were distributed across 61 nations while waiting for the fall of 2021, when the university began offering 383 out of a total of 556 courses in a “mixed-mode” semester.

As our literature review suggests, the student engagement varied widely, mostly dependent upon their situation (i.e., F2F, online, quarantined, in transit; waiting to travel; home conditions, etc.). Some of the indicators used to judge level of engagement included:

- Video games as a way for students to connect (Classes held in VR, co-working digital spaces, etc.);
- Student response systems (Kahoot and Poll Everywhere); and
- Discussion of student health (mental, physical, emotional health, etc.).

The pandemic's aforementioned circumstances introduced a gap between the technology and the course designer, which resulted in misconceptions throughout the terms about classroom dynamics as a technology solution missing consideration of research-based course design. Data was collected from public-facing university websites:

- “Faculty members shared that it was very important for them to be able to write on a whiteboard, so tracking cameras were added to the mixed-mode classroom.”
- “IT installed new ceiling microphone arrays and digital handheld and lapel microphones to improve classroom sound, and extra monitors and TVs to improve user experience.”

Ultimately, many faculty expressed a similar notion that they **did not use the sophisticated technology to support the mixed-mode approach, or to deliver a successful online teaching experience**. Through many conversations between colleagues, students and IT staff, it was clear that the majority of the faculty ranked their preference for instruction as F2F as the most preferred; online teaching second; and at a distant third, mixed-mode.

Challenges to Mixed Mode Instruction

Beatty (2019) identified four challenges including: 1) manage a multi-modal learning environment, 2) manage resources and workload, 3) enhance the student interaction, and 4) assess learning progression. We will incorporate these into additional ideas below:

1. **Pedagogy, Teaching Methods, Course Design.** If there are no better options, mixed-mode instruction should be more intentional about how can we create an inclusive and accessible environment for ALL students, most of the time. This will require a complete course redesign with the following considerations:
 - The course design takes in consideration the participants' common environment, educational atmosphere and human body language.
 - How we teach will need substantial redesign as we will need to create opportunities for differentiated instruction based on how students are connecting. Active learning in a face-to-face setting can also be applied to online synchronous students through live webcasts. Students receive a clear structure on how to interact individually and then share their work with the group through Google Doc, Jamboard, or other student response systems. They can also collaborate with others in breakout rooms. Whereas creating similar active learning opportunities for students learning online asynchronous will need another approach that offers similar interaction and connections to the concepts as well as community building with other students online and F2F.
 - Timely, critical assessment needs to align with outcomes and methods, measurement and evaluation. Assessment in an online mode is one approach, however, if there are students studying in three different modes, attention to consistent, reliable, valid measurement instruments will need extra attention, most likely assistance from an instructional specialist.
 - We need to maintain the original learning outcomes from those approved by curriculum committees, which for some may be a challenge.
2. **Student Informed Choice.** Some students may be unable to select (or may have no choice due to location, family, cost, etc.) the most effective alternate form of instruction (i.e., students who believe they can learn online, asynchronously, although have low ability to self-regulate their learning). How can we support and inform students (perhaps offering diagnostics on how to learn, self-regulated learning, self-efficacy, technology skills, etc.) as well as advising on study skills, time management, etc.?
3. **Identifying Student Selection.** How do we decide which students (and instructors) are able to select and/or engage with which mode? If this is open, there may be significant challenges with scheduling; if closed, how do we make the decision for allocating students into each mode, plus what happens if students are not able to function in that mode?
4. **Equity, Equity, Equity.** Technology access, instructional resources, interaction, assistance from instructors, formative assessments, response time for answering questions, logistics of hearing/seeing material, participation/attendance (if graded, how will this be equal), instructor presence and approach (how will they not forget the students online while attending to F2F students).
5. **Time.** Mixed-mode will require more of stakeholders' time including an increased workload for instructors (before, during and after term) as well as IT, Academic Affairs, Registrar and Facilities, The reason mixed-mode demands more time;
 - Administering both F2F and online students simultaneously is a formidable task.
 - Maintaining out-of-class interactions with students expecting in-person support, and with students requiring online assistance, might entail a reshuffling of engagement hours.
 - Beatty (2019) work emphasizes that the creation of the course plan and its accompanying materials is a time-intensive process. In fully online courses, there exists a potential disparity in the treatment of online and F2F students, with the former potentially receiving less interaction, relationship-building opportunities, and a sense of community. Therefore, strategic planning should prioritize the establishment of a vibrant learning community that caters to all students, regardless of their mode of learning.

Universities perceive a need for mixed-mode instruction as emergency or temporary measures, recommendations from a grant (TPHE, 2020) suggest to focus on student learning by letting go of:

1. Everyone having to do the same thing at the same time;
2. Classical instructors “covering” the content;
3. The traditional “policing” syllabus;
4. Assignments that invite cheating; and
5. Normal order contact hours.

Instead, the authors suggest:

1. Successful online teaching is beyond technology;
2. Start from academic design and user experience and backwards to technology integration
3. Collaborating with students on their learning;
4. Fostering community and connections that facilitate learning;
5. Embracing care for students as whole people;

6. Responding with flexibility; and
7. De-emphasize grading and emphasizing interaction, feedback, and learning (TPHE, 2020).

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