A Synthesis of Discoveries Spanning Ten Semesters of HyFlex

Dr. Lakshmy Mohandas, Purdue University

Lakshmy Mohandas works as an Associate Instructional Developer Researcher at the Center for Instructional Excellence at Purdue University. She completed her Ph.D. in 2022 in Technology from Purdue. Her research interests lie in the interaction between technology and education to help provide equitable teaching and learning experiences. HyFlex learning model, AI in education, equitable learning using different modes of participation, student motivation, and achievement goals are some of her current contributing areas.

Prof. Nathan Mentzer, Purdue University

Nathan Mentzer is a professor in the Purdue Polytechnic with a joint appointment in the College of Education at Purdue University. Hired as a part of the strategic P12 STEM initiative, he prepares Technology and Engineering teachers for state certification.

Ms. Adrie Koehler

Doctoral Student, Learning Design & Technology

Elnara Mammadova, Purdue University

Elnara's research is centered on advancing inclusivity for students with disabilities in STEM education by developing curriculum and lesson plans in higher education. Her objective is to establish a data-driven proactive approach to improve the digital accessibility of educational materials and course syllabi. Leveraging her substantial experience supporting students with disabilities, she has assisted faculty members in redesigning instructional content and syllabi to ensure digital accessibility. Furthermore, Elnara has conducted training sessions for instructors and textbook authors to enhance the representation of students with disabilities both in classroom settings and within textbooks. She is a Graduate Research Assistant in the Technology Leadership and Innovation program at Purdue University.

Mr. Shawn Farrington, Purdue University

Shawn is currently a Senior Lecturer at the Polytechnic Institute at Purdue University. He coordinates the core design thinking course as part of the Freshman Experience, teaches his sections, trains and mentors graduate student instructors and undergraduate TAs and participates in his research. His research centers on design thinking and encompasses student learning and motivation and the HyFlex instructional model. He graduated with his Bachelor's and Master's degrees from Purdue University in Engineering/Technology Teacher education. He was a high school engineering and technology teacher in Illinois before coming back to Purdue in his current role. He is also pursuing a Ph.D. in Learning Design and Technology.

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Abstract

This is a complete research paper. The research paper synthesizes findings from two research grants studying HyFlex instruction in a first-year design course. “HyFlex” is a method providing students with autonomy to participate in person or online and, in many cases, fluidly blends the two based on the instructor or students' individual needs. While HyFlex is not new, it has become more feasible since COVID, as technologies have improved and cultural acceptance of remote work has evolved. Our two funded projects have resulted in a variety of specific research studies that are published in papers. This research paper follows a compilation method to review and synthesize multiple findings, sharing each as data sources and draw conclusions across the larger set of results with implications for the future of HyFlex education. Findings will include the impacts on students' basic psychological needs, grades, and attendance habits, as well as instructional approaches.

Introduction

Although highly flexible (HyFlex) classrooms have been used as a pedagogical approach investigated by educational researchers for over 20 years (Eyal & Gil, 2022), this approach has gained increased attention in recent years. The COVID pandemic disrupted many facets of life including accepted norms of how educators engage with students. Prior to the pandemic, face-to-face classroom environments were the primary option for many students and their educators. At Purdue University, the spring of 2020 concluded with an online only emergency response to COVID safety protocols. In July of 2020, Purdue resumed face-to-face courses beginning with a heavily supported and monitored summer session. As a method of anticipating not all students would be able to make it to class daily, our introductory design course, which services nearly 1400 students annually, was offered as HyFlex. Regardless of the pandemic, there are days where not all students are able to participate from inside the classroom due to various reasons (e.g., university sponsor travel, mild illness, issues with transportation). While the need for an alternative to face-to-face only participation was extensive during the pandemic, the need is historic and likely to be enduring (Adams, 2022).

Though our course instructors agree that this active learning problem and project-based design course is best experienced in person, we hypothesize that the HyFlex approaches we piloted during the pandemic may have future utility for supporting student learning when students (or instructors) are not able to participate in person. We see this as an inclusion strategy and a means to reduce a barrier to student participation (Boylan et al., 2022). The purpose of this paper is to first amass the compartmentalized research supported by two separate research grants conducted as our HyFlex methods and community culture evolved since 2020 and to next synthesize the findings. All research was conducted in the same undergraduate introductory design thinking course taught using a HyFlex instructional format post COVID, where students have a choice of attending remotely or face-to-face during a synchronous class meeting. The course is required as part of a core curriculum and operates in sections of 40 students each semester. The majority of the participants are in their first year.

The body of this article follows a repeating pattern of contextualizing each study, identifying the specific targeted sample, research questions, methods and key findings. Then, we offer a discussion synthesizing key design, implementation, and facilitation considerations and implications when using a HyFlex learning approach. Additionally, we offer strategies for various stakeholders involved in HyFlex learning.

The design of our HyFlex implementation was guided by a few principles. First, we sought a low overhead model for both simplicity and sustainability. We recognized that Purdue students have access to devices with cameras and microphones in the form of laptops, tablets, and/or phones with high-speed internet connectivity offered on or near campus as our program is residential. As a Microsoft Office 365 for Education school, all students and faculty have access to Microsoft products including MS Teams with login that syncs seamlessly with their school credentials. With these hardware and software tools, launching a video call during class with supplemental chats before, during, and after class was accessible system wide. The classroom where our class meets in person has no additional technology - no additional cameras, no integrated microphones, no need for camera operators or technical support as students have their own devices. We also value student autonomy. Students can use MS Teams and the physical classroom 24/7 as the door is never locked (literally and figuratively) and students each have their own channels in MS Teams where they can meet, store information, chat, all at their convenience without worry of the information disappearing when a class session ends for the day. While helpful for planning purposes, students do not have to provide advanced notice or justification when they need to be remote as the approach can readily foster their engagement.

As a routine, instructors and students plan to be face-to-face in the classroom. Prior to each class meeting, the instructor will put a meeting on the calendar in the class' general channel using MS Teams. At the start of class, with most students physically in the classroom, the instructor will open the MS Teams meeting, sharing the screen with the class (virtually and physically). Students in the room may join to see the screen on their own device, participate in the chat, and leverage tools such as live transcription. Students who are remote join as well with the same benefits. Our active class oscillates between whole group instruction in the general channel and small group work during which teams, blending remote and face-to-face students, initiate a meeting in their assigned team channel facilitating smooth transitions between small and large group interactions.

This approach has garnered support internally and externally: Our project received a Best Practices in Higher Education grant from the Provost office and a National Science Foundation's Improving Undergraduate STEM Education grant (2110799). Our early work was featured on local television news and a national press release (Nickel, 2020) and has been recognized with local departmental awards and an international award through the QS-Wharton Reimagine Education North America Gold Award (*Wharton-QS Reimagine Education Awards 2022,* 2022). Support from these grants have fostered the opportunity to investigate instructor and student experiences from a variety of perspectives across time, which informed iterations of our model. Eleven selected publications spanning the development of our HyFlex approach are shared and synthesized here with links for more detail.

Theoretical framework

There are two theoretical frameworks guiding the HyFlex course design and associated research in these eleven studies. The first one is Community of Inquiry (CoI), which consists of three key elements to guide instructional design for online learning: cognitive presence, social presence, and teaching presence (Garrison et al., 2000). Cognitive presence refers to the degree to which students are "able to construct meaning through sustained communication" (Garrison et al., 2000, p. 89) and has four elements aimed to guide individuals as the navigate learning experiences: triggering event, exploration, integration, and resolution (Akyol & Garrison, 2010). Social presence describes the ability of community members to present themselves to other members as authentic individuals and is considered through three categories: open communication, group cohesion, and affective expression (Garrison, 2011). Teaching presence is "the design of the educational experience" and its "facilitation" to improve "social and cognitive presence for the purpose of realizing educational outcomes" (Garrison et al., 2000, p. 90).

The second theoretical framework used in some of the studies was Self-Determination Theory (SDT), developed by Ryan and Deci (2000) as a methodological approach to motivation. Basic psychological needs, which consist of competency, autonomy, and relatedness, were proposed as one of the six variations of SDT (Ryan & Deci, 2000). In educational settings, autonomy refers to giving students a choice in deciding their learning; competency is the feeling of being capable and confident in fulfilling the educational expectations, and relatedness refers to the need to connect with peers and instructors in the class (Levesque-Bristol et al., 2010; Wong, 2022). Shuetz (2008) asserted that satisfying these needs is a driver of successfully engaged and motivated students.

Study 1: Mohandas, L. (2022). ***The Impact of Interactive Synchronous HyFlex Model on Students' Perception of Social, Teaching and Cognitive Presence in a Design Thinking Course*****. [Doctoral dissertation, Purdue University Graduate School]. https://doi.org/10.25394/PGS.20359989.v1**

The Mohandas study addressed the significant changes in higher education due to technological advancements and the COVID-19 pandemic, leading to a rise in online and blended learning. Notably, the HyFlex (Hybrid Flexible) model has emerged as a new standard, offering benefits such as student choice, equivalency, reusability, and accessibility. Despite its popularity, existing literature on HyFlex highlights technological and pedagogical challenges, particularly in dynamic, group-based courses. This study introduced and examined the Interactive Synchronous HyFlex model, aiming to provide an engaging and equitable classroom experience for students in active group-based classrooms, regardless of their attendance mode.

A convergent parallel mixed methods case study was conducted to understand students' experiences through the lens of the Community of Inquiry (CoI) framework. The central research question was: *How and in what ways do first-year design thinking students experience the Interactive Synchronous HyFlex model through the lens of CoI*? Sub-questions investigated the model's effectiveness for social, cognitive, and teaching presence; variation based on participation mode; and how students' experiences shape their perceptions.

The study's quantitative phase employed the Community of Inquiry (CoI) survey, focusing on teaching, social, and cognitive presence. Descriptive statistics and MANOVA tests were used to assess the model's effectiveness. Results showed a general agreement among students about teaching, social, and cognitive presence elements in the HyFlex environment, irrespective of their daily participation mode choices. The qualitative phase considered students' experiences in the HyFlex design thinking class through focus group interviews, classroom observations, and discussion forums, simultaneously offering data triangulation. The findings revealed active student interaction and emotional expression, regardless of their daily participation mode choices. The study also observed how cognitive, teaching, and social presence were integrated into class activities through various strategies used by the instructors and students themselves. Using contiguous data integration, key findings showed confirmation coherence across data sources.

Teaching presence was perceived very positively by students, as instructors actively facilitated learning by engaging both remote and face-to-face students using visual aids, collaborative software, and inclusive questioning. Regarding social presence, students openly communicated and expressed emotions regardless of mode, and groups demonstrated cohesion during in-class and out-of-class collaborations. Considering cognitive presence, the design thinking projects required exploration, integration, and resolution of ideas, reflecting cognitive presence. However, triggering events designed to motivate participation varied from student-to-student based on intrinsic interest. Overall, the Interactive Synchronous HyFlex model successfully provided flexible, equitable and engaging learning with a solid sense of community during a challenging pandemic semester.

Recommendations included evidenced-based guidance for effectively designing and implementing a student-centered collaborative HyFlex approach. Specifically, instructors should clearly communicate

expectations, use headsets to engage all students and implement collaborative activities for mixed-modality groups. Students should leverage the flexibility responsibly and keep cameras on for social presence. Assessing appropriate software and scalability considerations for class size and layout are advised at an institutional level when adopting this model. While teaching presence often overshadows other presences (Akyol & Garrison, 2008), here they were balanced. Communication barriers common in other HyFlex formats (Kohnke & Moorhouse, 2022) were also effectively minimized through instructor strategies and recording of sessions. In conclusion, despite pandemic disruptions, the Interactive Synchronous HyFlex model showed potential for facilitating connected and equitable learning experiences critical for unpredictable circumstances in higher education.

Study 2: Mohandas, L., Mentzer, N., Koehler, A., & Farrington, S. (2023). ***To Be Face-to-Face Today or to Be Remote Today: That is the Question*****. 2023 AERA Annual Meetings. https://doi.org/10.3102/2017564**

Building on the first study by reviewing data a year later, this study by Mohandas et al., examined students' perceptions of a HyFlex model post-COVID surge. Although learning experiences and environments were returning to pre-pandemic norms, issues like “Zoom fatigue” were prevalent. Similar to the first study, the Community of Inquiry (CoI) framework was used in this study. The CoI framework, aligned with literature on HyFlex and student-centered learning environments, considers three constructs: teaching presence, social presence, and cognitive presence (Akyol et al., 2009).

In Fall 2021, with a return to normal attendance policies, students were asked to complete the CoI survey to gather their perceptions regarding the community quality in the course. Six hundred seventy-four students were enrolled, with a response rate of 62.6% (422 students). Quantitative data analysis, including descriptive statistics and correlation analysis, was used to address the research questions.

Students generally experienced positive classroom communities in the Interactive Synchronous HyFlex class, with high scores in teaching, cognitive, and social presences. Correlation analysis showed that students' perception of these presences was similar regardless of their mode of participation (face-to-face or remote). The study indicated that in a HyFlex learning environment, students' sense of classroom community is not affected by their daily choice of class participation mode. This supports the use of HyFlex models in the peri-pandemic era to address challenges like student engagement and “Zoom fatigue”, underscoring the importance of student autonomy and flexibility. Overall, the paper presents significant insights into the effectiveness of the Interactive Synchronous HyFlex Model in maintaining student engagement and community perceptions in a blended learning environment during and after the COVID-19 pandemic.

Study 3: Mentzer, N., & Mohandas, L. (2022). Student experiences in an interactive synchronous HyFlex design thinking course during COVID-19. ***Interactive Learning Environments,*** **1-16. https://doi.org/10.1080/10494820.2022.2124423**

The purpose of this Mentzer and Mohandas study was to understand how students experienced a blended synchronous learning approach that was gaining popularity due to COVID-19 during the fall of 2020. The research question that guided the study was: How and in what ways did students experience the Interactive Synchronous HyFlex model at the start of the global pandemic in our active learning design course?

Situated in the same course as the other studies reviewed in this paper, the study used a qualitative phenomenological method. Focus group interviews were conducted with students at the beginning, middle, and end of the semester. In total, 84 students participated across 19 focus groups. Data were analyzed using inductive coding to identify key themes.

Results showed students appreciated the affordances of the Interactive Synchronous HyFlex mode as an effective learning approach: providing flexibility in participation, fostering a sense of community, enabling ease of communication, and offering preparation for future jobs involving online work. Additional benefits included accommodating different learning preferences, enabling continued participation when exposed to COVID, allowing comfortable interaction with instructors, and providing a collaborative environment.

Opportunities for improving the Interactive Synchronous HyFlex model were also identified. Students experienced an initial software learning curve when learning to use Microsoft Teams. Additionally, remote students did not always effectively navigate their environment. In some instances, remote students failed to speak up and gain the attention of their peers, placing more burden on their face-to-face peers. In other cases, remote students felt ignored by face-to-face group members. Additional challenges included technological distractions, echo/feedback problems, and the motivation to engage in remote participation by both physically present and remote students.

These results underscore the necessity for providing more software training, setting clear expectations for online participation and accountability, using strategies like requiring cameras, and monitoring engagement. Addressing technology issues and encouraging face-to-face students to fully engage with remote peers is also important. The study provides insights into student experiences with HyFlex learning that can inform implementation of blended synchronous approaches as the likely "new normal" in higher education post-pandemic.

Study 4: Mentzer, N., Krishna, B., Kotangale, A., & Mohandas, L. (2023). HyFlex environment: Addressing students' basic psychological needs. ***Learning Environments Research, 26*****(1), 271–289.** **https://doi.org/10.1007/s10984-022-09431-z**

In two previously described studies, students articulated experiences that indicated students' basic psychological needs were being satisfied while participating in the Interactive Synchronous HyFlex model. However, as the nature of qualitative work is to understand and explain a phenomenon, we were curious about the extent to which this sense of psychological needs satisfaction was experienced by students in the course more broadly and how this might compare to students' experiences in the course prior to experiencing the HyFlex approach. In response, this Mentzer et al. study launched a quantitative investigation examining the extent to which basic psychological needs were met prior to the pandemic in a traditional face-to-face only version of the course compared to a version of the course using our HyFlex model.

This quasi-experimental study had two distinct components, each with their own research question and sample. First, we hypothesized that the HyFlex environment met students' basic psychological needs as well as or perhaps better than the traditional face-to-face only environment. As a test for this hypothesis, we accessed basic psychological needs satisfaction data from Fall 2019 and compared these to data collected during the Fall 2020 for a sample of 1344 students. Data were collected as part of a university effort to maintain quality teaching and learning environments administered by the Center for Instructional Excellence using a validated and reliable survey called the Basic Psychological Needs Satisfaction and Frustration Scale (BPNSFS).

Independent samples t-tests indicated alignment with qualitative discoveries in the previous studies, further establishing that the HyFlex environment had comparable levels of autonomy satisfaction (the freedom to make decisions based on their interest in the course) and competence satisfaction (the capability to effectively fulfill what is required through classroom expectations) as well as relatedness to peers and instructors (connectedness among students when they collaboratively work together and have engaging interactions with their instructors). Interestingly, frustration associated with autonomy and competence was significantly lower in the HyFlex environment than the face-to-face only environment.

The second component of this study narrowed the sample to focus on students in the HyFlex cohort during Fall 2020 who had both attendance and BPNSFS data (n=136) and was driven by the hypothesis that the basic psychological needs were met equally well for remote and face-to-face learners. Motivation for this question emerged from early qualitative data that suggested students appreciated the HyFlex environment although they may not have taken advantage of the opportunity to be remote. In addition, while students generally appreciated the autonomy and the safety net to participate remotely if needed afforded by a HyFlex environment, they also recognized the additional complexities of blending face-to-face and remote members of their class and small group. Thus, we wondered if students who were remote at times felt the same sense of their basic psychological needs being met as those who engaged in the HyFlex environment but did not try remote participation.

A Mann-Whitney U Test indicated that for five of the six measures of basic psychological needs, students in the HyFlex course who participated consistently through a face-to-face modality had slightly more positive results than students who participated once or more times remotely. The sense of relatedness to peers was significantly higher for students who chose to be face-to-face daily.

Results of this study provided an unexpected conflict: HyFlex meets students' basic psychological needs slightly or significantly better than face-to-face only environments, but, those students who take advantage of the HyFlex environment through participating remotely one or more days have slightly or significantly less satisfaction of their basic psychological needs.

Study 5: Mentzer, N., Isabell, T., & Mohandas, L. (2023). The impact of interactive synchronous HyFlex model on student academic performance in a large active learning introductory college design course. ***Journal of Computing in Higher Education*****. https://doi.org/10.1007/s12528-023-09369-y**

Our earlier studies concentrated on examining the impact of Interactive Synchronous HyFlex on students' basic psychological needs, but we knew little about how this instruction impacts students' academic performance. The experience of learning and collaborating with peers and instructors in HyFlex settings, initially designed for residential undergraduate students, was unusual and unexpected for students. Students needed to extensively use technology for communication, peer collaboration, and group projects. Due to the conflicting results of previous studies about the impact of HyFlex models on students' academic performance (He et al., 2015; Lakhal et al., 2014; Lightner and Lightner-Laws, 2016; Miller et al., 2013; Rhoads, 2020), in this study we decided to analyze the impact of our Interactive Synchronous HyFlex model on academic performance. First, we compared the course grades between a traditional face-to-face only modality course offering (Fall 2019) and an Interactive Synchronous HyFlex course offering (Fall 2020). Second, we focused on HyFlex instruction and analyzed whether the final course grades of students who exclusively chose to participate in-person differed from those who attended the class one or more times remotely.

This quantitative study included data from 1,344 students across two semesters: Fall 2019 (traditional face-to-face only mode) and Fall 2020 (HyFlex modality). We had readily available attendance data on 483 students who participated in the HyFlex modality. As student grades are a widely accepted metric for evaluating student success (York et al., 2015), we gauged academic performance using student grades on three projects and final course grades. Before the analysis, we conducted a pre-analysis similarity check of students' Scholastic Assessment Test (SAT) scores and demographic data to determine the degree to which they were similar at the beginning of their academic terms.

To compare students' grades for the three projects and final course grades between traditional and HyFlex settings, we utilized a *t*-test and Mann-Whitney *U* test due to deviation from the normal distribution in the dependent variable. *T*-test results indicated that students received higher grades in HyFlex than the traditional face-to-face only learning environment for Project 1. The mean scores for the other projects and final course grades were similar between HyFlex and traditional face to face only modalities. However, the Mann-Whitney

U test results showed significantly higher mean rank scores for HyFlex in all projects and final course grades compared to the traditional face-to-face only approach. To understand these conflicting results, we conducted a chi-square test, revealing that compared to traditional instruction, HyFlex students had a significantly different grade distribution, showing they received more As and Fs. Hence, the mean ranks were significantly different, while the mean scores were similar.

The second study narrowed the sample to only students in the HyFlex modality, comparing the academic performance of students who attended the class exclusively in person and those students who chose to be remote one or more times. Our focus was on potential differences across three projects and final course grades. *T*-test results did not show significant differences between students who attended class in person exclusively and those who participated one or more times remotely. Mann-Whitney *U* test results, however, indicated that in-person students significantly outperformed their one or more times remote counterparts in the second and third projects and final semester grades. Examining grade distribution closer revealed that in-person students received more As and Fs compared to their peers who attended one or more times remotely.

In conclusion, the results of both tests indicated that students' scores on the first project were significantly higher in the HyFlex modality. HyFlex's median ranks were significantly higher in all other grade measures (Project 2, 3, and final semester grades), whereas means were similar for the rest. Between in-person and one-or-more-times-remote students, *t*-tests and the Mann-Whitney *U* test indicated similar grades for Project 1. The median ranks were higher for in-person students, whereas the means in both modalities were similar in all other measures.

Study 6: Deep Learning (unpublished work, currently in progress)

While grades are a traditional measure of academic success and commonly used to determine university progression, they may be reflective of effort and or performance (Banta et al., 1996). For this study, we looked at deep learning as measured by design performance documented in students' design journals (Jonassen, 2006).

Currently a work in progress, this study uses a quasi-experimental design, considering a random sample of 72 design journals from teams from the design thinking course. Using a design journal rubric developed by Abts (Groves, Abts & Goldberg, 2014), researchers compared team design journals from Spring and Fall of 2019 (face-to-face traditional group) to team design journals from Fall 2021 and Spring 2022 (HyFlex treatment group). Specifically, the rubric measures 13 dimensions of design thinking from problem identification to idea generation and evaluation and prototyping to testing and reflection on solution performance.

First, two researchers piloted the design rubric by independently rating 12 design journals. Next, the researchers compared their work, negotiating consensus during a few iterative sessions in order to establish a 90% inter-rater reliability measure spanning 20 design journals. Finally, in the time available for this project, one researcher was able to evaluate 72 journals randomly selected from Fall and Spring 2019, when the course was offered as face-to-face only and Fall 2021 and Spring 2022, when the course was offered as HyFlex.

Results of the comparison offered two insights. First, independent samples *t*-tests indicated that the means were not significantly different across course modalities, with scores from the HyFlex offering at 28.40, whereas face-to-face only offering was 28.65, which was marginally higher and neither practically nor statistically different. In addition, the standard deviation of the scores was larger for the HyFlex groups, which coincides with our previous studies indicating that grade distributions in HyFlex were wider such that some students and teams were more successful, while others were less successful.

Study 7: Mohandas, L., Mentzer, N., Koehler, A., Farrington, S., & Mammadova, E. (2023). ***Understanding Students' Self-regulation in a HyFlex Design Thinking Course*****. 2023 ASEE Annual Conference & Exposition.**
https://peer.asee.org/understanding-students-self-regulation-in-a-hyflex-design-thinking-course.pdf

HyFlex learning models have grown in popularity since the onset of the COVID-19 pandemic (Calafiore & Giudici, 2021; Padilla Rodriguez, 2022), and research has shown promising academic outcomes for higher-education contexts using HyFlex (Penrod, 2022). Additionally, research suggests that student self-regulation impacts academic outcomes in traditional face-to-face learning environments (Kashif & Shahid, 2021) . However, less is known regarding student self-regulation in HyFlex instructional modalities in higher education.

This study explored the relationship between students' self-regulation and their daily participation choices (absent, remote, or face-to-face). Strong self-regulation skills can benefit students as they navigate HyFlex participation modalities, especially when the course context is problem-centered and requires significant small-group interaction. For instance, Mentzer and Mohandas (2022) shared that the engagement level of some remote attendees is lower in their HyFlex learning format. As such, we hypothesized that students need higher levels of self-regulation when attending remotely in order to be successful. We used the following research question for the study: "What is the relationship between students' self-regulation and their choice of daily participation in a HyFlex class?"

This quantitative study took place in the Spring 2022 semester with 17 course sections. We employed the Motivated Strategies for Learning Questionnaire (MSLQ) to determine the relationship between student self-regulation and their participation choice in the HyFlex instructional format. The MSLQ is a widely cited survey instrument that contains two sections: motivation and learning strategies; and is comprised of over 15 scales. As a modularly designed instrument, each scale can be used independently (Pintrich & Others, 1991). As such, 5 scales were selected as they were the most appropriate for the study context: control of learning beliefs ($\alpha = .68$), critical thinking ($\alpha = .80$), metacognitive self-regulation ($\alpha = .79$), effort regulation ($\alpha = .69$), and peer learning ($\alpha = .76$). The 5 scales were combined into one questionnaire and shared with 579 students as part of a larger survey administered at the conclusion of the semester. This resulted in a total of 331 respondents. Additionally, attendance data were collected from all of the course instructors for the entire semester. The course had 29 meetings, and instructors kept records whether students joined face-to-face (F2F), remotely, or were absent.

To calculate a correlation between attendance choice and self-regulation, a ratio of modality was calculated as a percentage of F2F participation by dividing the number of F2F meetings attended by the total number of meetings in which the student participated, either F2F or remotely. Absences were not considered in the computation, as the emphasis was placed on students' daily decisions regarding their preferred mode of participation (remote or face-to-face). This is especially relevant since the course was originally conducted in a face-to-face format, and HyFlex was introduced to ensure continued participation during the pandemic. In a case where a student attended 24 meetings face-to-face, participated remotely in 3 meetings, and was absent for 2 meetings, the student's face-to-face percentage would be calculated as 24/(24+3), resulting in 88.9%. Subsequently, Pearson correlations were computed using the percentage of face-to-face attendance and each of the five relevant components/subcomponents of self-regulation.

On average, students strongly believed in their ability to control learning (mean score: 5.47). The Pearson correlation ($r = -0.15$, $p = 0.005$) revealed that higher face-to-face participation was associated with lower self-regulated control of learning belief. Students perceived a mean critical thinking score of 5.09, indicating a belief in applying previous knowledge in their HyFlex class. The non-significant Pearson correlation ($r = -0.103$, $p = 0.061$) showed that the mode of participation (face-to-face or remote) was not significantly correlated with students' critical thinking. Metacognitive self-regulation scored 4.70 in meta-cognitive

self-regulation, indicating a moderate belief in applying awareness, knowledge, and control of cognition in their HyFlex class. The non-significant Pearson correlation ($r = -0.083$, $p = 0.134$) showed that students who chose face-to-face or remote participation had a comparable experience in applying cognitive skills. Effort regulation scored 4.86 with a range of 1 to 7, signifying a moderate belief in their ability to control effort and attention in their HyFlex class. The non-significant Pearson correlation ($r = 0.019$, $p = 0.773$) indicated that students who opted for face-to-face or remote participation had a comparable experience in effort regulation. Students, on average, scored 4.58 in peer learning, indicating a moderate belief in working and learning with peers in their HyFlex class. The non-significant Pearson correlation ($r = -0.020$, $p = 0.716$) revealed that face-to-face or remote participants had similar experiences in peer learning.

Study 8: Krishna, B. (2023). *Effect of Modalities on Group Performance in Hyflex Environment (30685608)* [Master's thesis, Purdue University]. ProQuest Dissertations Publishing.

As we began to realize that the impact of participating in a HyFlex was not the same for all students, we recognized that our analysis had been focusing on individual students' experiences in the course though much of the coursework was in team-based experiences. This thesis study offered a unique contribution as the analysis was conducted at the group level rather than the individual level, accounting for students' immediate interactions with their peers.

To better understand the academic success of teams as they blend remote and face-to-face members, we analyzed grades from two larger group projects: Project 2 and 3. Project 2 spanned approximately 4 weeks with team members from similar majors assigned by the instructor. The learning goal of this project was to contextualize design thinking work within students' majors. Project 3 was the final course project and spanned approximately 8 weeks. Teams were self-selected and situated in grand global challenges such as clean water, alternative energies, and urban infrastructure. Student teams identify a local opportunity to work on a problem that has global significance.

This study included 645 students during Fall 2021. During Project 2, students formed 168 groups, and in Project 3, there were 146 groups. Group assignments were graded by section instructors or graduate students dedicated to grading. All assignments had rubrics and instructions that had been refined each semester for clarity, validity and reliability. Grading was led by two course coordinators who provided explanation, practice, support, and monitoring to ensure calibration and consistency. Attendance data were kept for students by class instructors.

A correlation analysis was used to inspect potential relationships between the extent to which teams of students participated remotely. Two variables were created for analysis for each project to test for correlation. First, "Group Remoteness" was computed for each team. For example, a team of four students who met for Project 2 during six class meetings had a total of 24 potential attendance measures. The number of meetings each team member was remote were counted and a ratio was computed. In this example, a team that had one student remote four times and another student remote twice had a total of six remote attendances of 24 possible which was a ratio of 6/24 or 25% remote participation. Second, group grades for the project were calculated by averaging the grades received across students in the group. Group grades for project two were typically the same for all students in the group unless they were absent, while grades for Project 3 were modified using a measure of contribution calculated for each student with input from peers.

Results indicated a slight negative correlation between the extent to which the team engaged with each other remotely and their grades for both projects. These findings indicated that at a team level, the extent to which one or more members contributed remotely is unrelated (or only very slightly related) to their modality. These results align with findings from the individual level in our previous study and reinforce the message that when possible students should be in person, as we hypothesize communication and teamwork are easier when all students in the team are together. These results also align with the findings from our previous study that suggest

grades are similar or slightly higher in the HyFlex environment as students who might otherwise be absent and non-participating have an option to contribute to the group effort remotely and synchronously.

Study 9: Mentzer, N., Mammadova, E., Mohandas, L., Koehler, A., & Farrington, S. (*under review*). Analyzing the Impact of Basic Psychological Needs on Student Academic Performance: A Comparison of Post-pandemic Interactive Synchronous HyFlex and Pre-pandemic Traditional Face-to-Face Instruction.

Although our HyFlex model developed as a response to the pandemic, we continued teaching in this mode when the disruptive impact of the pandemic was minimal. In early 2023, the pandemic was declared a non-emergency internationally ("WHO statement on COVID-19," 2023). It was time for us as researchers to analyze the feasibility of our model for the post-pandemic era. This quantitative study examined the impact of the Interactive Synchronous HyFex mode from two perspectives. First, how the Interactive Synchronous HyFlex course design addresses students' fundamental psychological needs in the post-pandemic era, differing from the traditional face-to-face-only course delivery method utilized pre-COVID-19. Second, the impact of basic psychological needs and demographic factors on students' academic performance in the Interactive Synchronous HyFlex and traditional course delivery modes.

The study used 2558 students' data, which consisted of students' final course grades (n=2558), the basic psychological needs survey results (n=1203), SAT scores, and demographic information. Demographics affirmed that most students were in their first or second year by credit hour. Students represented nine groups of diverse ethnicities, including White, Asian American, Hispanic/Latino, 2 or more races, Black or African American, Native Hawaiian or Other Pacific Islander, and American Indian or Alaska Native. About 11% of students were international and classified by the university as “international” regardless of their ethnicity.

We used data from four semesters, Fall 2019/2022 and Spring 2020/2023, as fall and spring tend to yield different student experiences. The course was taught traditionally (face-to-face only participation) in the Fall of 2019 and Spring of 2020, which fall before the pandemic era. In Fall 2022 and Spring 2023, our treatment semesters, the course was delivered in our HyFlex instruction. Given that the primary course audience was first-year students, who typically enroll in the fall semester (while upper-level students who have not yet taken the course tend to enroll in the spring term), we anticipated and statistically accounted for differences between the fall and spring semesters. SAT scores served as a proxy pretest to ensure academic comparability among students before analysis, and demographic variables were incorporated to confirm uniformity across demographic characteristics.

To examine the impact of Interactive Synchronous HyFlex on students' basic psychological needs in the post-pandemic era compared to traditional face-to-face only teaching, we utilized independent sample t-tests. Results were slightly different for the fall and spring semesters. In the spring semesters, all four BPN scores (autonomy satisfaction, competence satisfaction, relatedness to instructor, and relatedness to peer) were significantly higher for the Interactive Synchronous HyFlex mode than the traditional one. The effect sizes of the differences indicated minimal, small, and medium effects, as Cohen's d ranged from 0.187 to 0.519 (Cohen, 1992). In the fall semesters, however, only three BPN scores (autonomy satisfaction, competence satisfaction, relatedness to instructor, and relatedness to peer) were significantly higher for our HyFlex model, except for competence satisfaction, as it was marginally higher. The effect sizes of differences indicated small and medium, as Cohen's d ranged from 0.247 to 0.553. These results differ from our Study 3 (Mentzer & Mohandas, 2022), which compared the pre-pandemic traditional mode to HyFlex during the pandemic. In that study, we did not find a significant difference in BPN satisfaction scores, and effect sizes were very small, as Cohen’s d ranged from 0.01 to 0.13.

Once we analyzed the impact of our HyFlex model on BPN scores in pre-pandemic time, we decided to dive deeper and investigate which of the BPN is a significant predictor of students' academic achievement in both

teaching modes alongside demographic variables and semester. Analysis was done using a multiple regression analysis. As a subcategory of demographic variables, gender was coded as a binary variable: 'female' and 'male'. The class rank was classified into three categories based on credit hours students had before enrolling on the course: "0-29 credit hours," "30-59 credit hours," and "60+ credit hours." As the residency variable, we had two categories: "domestic" and "foreign". The ethnicity had four categories: "underrepresented," "overrepresented," "international," and "unknown." However, as the university automatically considered students as international who indicated their residency as foreign, it led to a multicollinearity issue within the dataset. Hence, we removed the international from the ethnicity category to ensure the robustness of the results. We grouped semesters into two categories since we ran two separate regression analyses for HyFlex and traditional modes. Each group had fall and spring semesters represented with separate dummy variables to let us capture variations in final course grades across semesters.

Results showed that all variables (Basic Psychological Needs (BPN), gender, class rank, ethnicity, semester) could significantly predict students' final course grades both in traditional teaching ($F(11, 758) = 5.54$, $p=<.001$, with $R2=.061$) and in Interactive Synchronous HyFlex ($F(11, 421) = 5.01$, $p<.001$, with $R2=.093$) modes. Among BPN scores, competence satisfaction ($B=1.35$, $\beta=.18$, $p<.001$) and relatedness to peers ($B=1.104$, $\beta=.127$, $p=.002$) were significant predictors of students' final grades in traditional teaching. However, in HyFlex mode, only relatedness to instructor ($B=0.739$, $\beta=.132$, $p=.045$) was a significant predictor.

Among demographic variables, gender was a significant predictor of the final course grade both in traditional ($B=2.625$, $\beta = 0.144$, $p<.001$) and in HyFlex modes ($B=3.164$, $\beta = 0.195$, $p<.001$) as female students tend to get higher grades than their male counterpart. The other demographic variables (ethnicity, class rank, and residency) were not significant predictors in the traditional mode. However, in HyFlex, ethnicity and class rank were significant predictors. In the ethnicity category, compared to the overrepresented peers (reference group), students with "unknown" ethnicity received statistically significantly higher grades ($B=4.027$, $\beta=0.075$, $p<.001$). In class rank, the 30-59 credit hours group was associated with a statistically significant increase in a final course grade ($B=1.664$, $\beta=0.11$, $p=.027$). Regarding semesters, it was a significant predictor of final grades only in traditional teaching and learning mode as students tend to get significantly lower grades in the Spring of 2019 ($B=-1.458$, $\beta=-.09$, $p=.017$) compared to the Fall of 2019 (reference group).

In summary, findings indicate that, in post-pandemic, the Interactive Synchronous HyFlex course design significantly enhances students' basic psychological needs compared to the traditional pre-pandemic mode. The key predictors of academic performance in traditional face-to-face teaching include competence satisfaction, relatedness to peers, gender, and semester term. In contrast, in our HyFlex teaching model, the leading predictive factors are relatedness to the instructor, gender, and class rank. The result about the predictiveness of relatedness to the instructor in academic performance led us to investigate how Interactive Synchronous HyFlex fostered a connection between students and instructors to increase their academic performance.

Study 10: Instructor Presence of HyFlex Instructors (unpublished work, currently in progress)

As much of our previous work had focused on the student experience, we were curious about how instructors were specifically facilitating HyFlex learning experiences and whether differences in how HyFlex facilitation impacted students. Specifically, we are currently investigating how instructor presence is established in HyFlex classrooms and whether variance in instructor approaches is associated with how students perceive instructor presence.

In this case study-mixed methods approach, we are using the Community of Inquiry (CoI) framework to capture how three instructors established instructor presence in their courses. We use Richardson et al.'s (2015) definition of instructor presence: "the specific actions and behaviors taken by the instructor that projects him/herself as a real person… [and] is more likely to be manifested in the 'live' part of courses—as they are

being implemented—as opposed to during the course design process." Each instructor represented a single case. Our data sources included instructor interviews, instructor observations, and student responses to the CoI survey. We first created a profile for each instructor's presence by investigating their reasoning for adopting specific approaches and considering their students' perceptions of their presence. Next, we compared across cases to identify similarities and differences.

We had convenient access to a full dataset for three instructors and their students. Specifically, we used semi-structured interviews with instructors, asking questions aligned with the CoI framework to determine how they believed they were establishing presence in a HyFlex environment and their motives for facilitating HyFlex learning in the way that they did. Next, we analyzed recorded course sessions for each instructor to identify specific examples of instructor presence. Finally, students from each instructor's section were asked to complete the CoI Survey. Using a one-way ANOVA, we compared students' responses across the three sections.

The three instructors, Ben, Lia, and Tom (pseudonyms used to protect identity), used specific strategies in creating instructor presence in HyFlex:

Ben valued HyFlex, focused on promoting its relevance as a professional tool students would use in their future, used a variety of technologies to establish and extend his presence, required all students to join the class via MS Teams meetings each session, and was very available to his students practically at all times. His students indicated positive perceptions of his presence.

Lia saw Hyflex as a short-term temporary solution, used a variety of technologies to establish and maintain presence, checked with face-to-face and remote students frequently, and required all students to join the class Teams meetings each session. Her students indicated positive perceptions of her presence.

Tom downplayed HyFlex, emphasized that remote attendance be used sparingly, provided specific reasons for when HyFlex could be used, required only remote students and teams with remote students to log into Teams meetings, and offered remote students alternative ways of participating in class through using technologies. His students indicated positive perceptions of his presence.

Across the three cases, instructors regularly monitored remote student participation, checked-in with students, supported team collaboration, and used technologies to extend presence. However, requirements for joining Teams, the use of the chat tool, how technologies were implemented to support multimodalities, and instructor availability beyond class time varied. The results of the one-way ANOVA revealed no significant differences across sections, suggesting that regardless of key qualitative (from observation and interview data) differences in instructor presence, students' perceptions remained consistently positive.

Key takeaways from this research include: 1) instructors can establish and maintain presence in HyFlex classrooms in different ways, 2) instructors revealed a range in their beliefs and use of technology, attendance, and student autonomy, and 3) different instructor presence can lead to positive student experiences. Regardless of clear differences in how instructors established their presence, students appeared to follow and accept whatever norms were created. This research offers deeper understanding to the facilitation of HyFlex learning environments and how instructor presence is established.

Study 11: Onboarding to HyFlex as a New Instructor (unpublished work, currently in progress)

As our model of implementation has been refined and the impacts on students have been generally positive in terms of student experience, basic psychological needs, grades, and learning, we place the emphasis of this study on the experience of becoming a HyFlex instructor. This study, currently in the analysis phases, is

qualitative and seeks to understand the lived experiences of two new instructors in the post-pandemic learning environment as they begin to use this method in their classroom.

In the fall of 2023, the instructional team had two new instructors. These two instructors agreed to engage in a collaborative autoethnography with an experienced instructor who is a lead researcher on the HyFlex research grant. Following a method described by McDonald et al. (2022), the two new instructors journaled weekly and met for 30-45 minutes weekly to reflect on their experiences collaboratively.

Both instructors had educational experiences previously to prepare them to be instructors and some unique experiences related to HyFlex learning environments. Both instructors were beginning a masters degree in STEM education in the Technology Leadership and Innovation department. One instructor just recently completed the degree requirements for licensure in secondary Technology and Engineering Education, including a supervised student teaching experience in a secondary classroom. During her undergraduate degree, she was a teaching assistant in a course that blended remote learners as needed with the face-to-face students. This was setup ad hoc based on a small class size as needed for occasional COVID-related student isolations. The other instructor was previously a science and math teacher who had experienced the abrupt transition from face-to-face to remote teaching (while teaching science) and a gradual return to face-to-face teaching (while teaching mathematics to 5th and 6th grade students), which included offering his courses to remote and face-to-face students through a Zoom interface in the classroom.

For the duration of the first semester of HyFlex teaching, the instructors responded weekly to prompts about how they prepared for their HyFlex courses that week, how their course went and potential opportunities for improvement. The lead instructor reviewed these reflections prior to facilitating an audio recorded discussion with the two instructors at the end of each week. The lead researcher served as both a facilitator of the focus group interview and a participant engaging in discussion that resulted in feedback based on experience and our research findings. Thus, instructor questions and concerns often led to ideas that were implemented and discussed at future meetings for additional reflection. Themes were emergent based on the discussion and reflection data established by the lead researcher and negotiated to consensus with the instructors. The lead researcher drafted initial findings which were refined and validated collaboratively among the co-authors.

Three themes emerged from the discussion: communication, technical operations, and a learning curve. As an emergent theme, communication with students was critical - both what needs to be communicated, but, also, how the message is communicated to students. Initial university level communication indicates our course is offered in a face-to-face modality through the university registration system, however, our syllabus and classroom practice indicate students can participate temporarily remotely as needed. Expectations associated with a definition of “temporary” and when remote participation is reasonable are important to share with students so they can make decisions on a daily basis in their own best academic interest. Communicating expectations about blending face-to-face and remote participation was necessary. Though meetings were scheduled for remote learners to join using MS Teams software, students may have difficulty with noticing, if they do not regularly use Microsoft products such as Outlook or Teams. Therefore, communicating with students so they know how to access the whole group general channel was a topic of concern. Further, when students transitioned from whole group to small group work, students in the classroom who have a remote peer may not be aware that the peer is remote and seeking to participate, especially if the peer does not reach out to them via e-mail or the MS Teams chat. The instructors found asking students who were remote to provide advanced notification or instant chat message at the start of class helpful. Through this method, the instructor was able to foster the connection between remote and face-to-face team members.

Technical hardware and software operation was another emergent theme for both instructor and students. Microsoft Teams as a software was generally new to students and was new to both instructors. While familiarity with synchronous video meetings was familiar in general, navigating the complexities of the new software was a challenge. Particularly, jumping across the general channel for whole group chats and video meetings and the

small group channels presented opportunities for students to struggle and for instructors to provide guidance based on their own, but limited experiences. In addition to the software, technical problems in interfacing with additional hardware also created challenges. For example, the room has two large monitors which are shared via HDMI cable from instructor owned laptops. Instructors can mirror or extend their screen and then share the appropriate screen with the face-to-face and remote students. The room has overhead ceiling mounted speakers which facilitate whole group media sharing. We have found that using an external microphone yields better results than the instructor laptop microphone during whole group interaction, which challenges the instructor to send video and outgoing audio through HDMI that is separate from incoming microphone audio on USB or Bluetooth. While sharing the screen, the instructor also needs to share their system audio with the external HDMI system (in order for all students to hear video clips that might be used as instructional supplements) and remote students (so they may hear the audio with the screen share). In addition, the remote students' comments and questions during whole group discussion are also best heard when routed to the room speakers, further complicating the audio configuration.

The learning curve was often discussed from both the instructor and the student perspective and is treated here separately from communication and technical operation although inherently related. Instructors were provided with an orientation prior to the semester start, which blended content, pedagogical and HyFlex preparation and was run with a HyFlex approach. Further, instructors have a document that outlines teaching aspects in writing, including conceptual, technical, and procedural aspects of the HyFlex approach. Despite these extensive preparation efforts, the first weeks of stepping in front of 40 students with unfamiliar hardware and software presented challenges that were not fully anticipated or prepared for. As an example, playing a video in class where the audio is shared in the room and online via MS Teams was not something either instructor had success with on the first attempt (and was further complicated by software updates that rendered our instructions outdated (without notice) and varied by version of Windows or Apple OS). While procedures for students seemed equally clear, the instructors discussed that since the course is primarily set up as a face-to-face learning environment, where remote participation is temporary, most students who are remote are doing it for the first or second time. Therefore, the remote students are unfamiliar and need support every time throughout the term. Not only do the remote students need help connecting with their teams, teams of students may be unfamiliar with launching meetings in their team channel and inviting the remote student to join.

As an ongoing study, we anticipate key implications related to communication and technical aspects may ease the learning curve by driving changes in future implementations. Regarding communication, in addition to scheduling meetings using Microsoft products (Outlook and Teams), we will consider embedding a link to the general MS Teams channel (where each class starts) in the course learning management system (LMS) such that students who are remote and have not installed the Outlook and/or Teams applications on their devices will have additional access points. We will consider roles and responsibilities more deliberately - for remote learners - they should log into the LMS and to MS Teams prior to the start of class and look for the meeting and content. When students are remote, they should communicate with their small groups to remind everyone that they will be joining remotely. Face-to-face students will have a similar routine where they reach out to a missing student to establish communication and connect with them synchronously in the team channel. On the technical side for instructors, instructional leaders may create a list of technical challenges to be anticipated, and much like a driver education test, we can challenge new instructors to navigate these situations ahead of the semester. In addition to watching an experienced instructor do it, they could be challenged to demonstrate competency themselves on their hardware with their operating system and current set of updates. For students, an assignment early in the term where they launch a meeting in their team channel to blend remote and face-to-face learners may increase familiarity so that when it is needed, they are ready rather than figuring it out on the fly by themselves.

Discussion

The summaries from eleven studies highlight the efficacy of Interactive Synchronous HyFlex settings as a supporting system of students' learning and basic psychological needs, often either similar or better than traditional face-to-face settings. For instance, Study 5 reported significantly higher student grades in HyFlex classrooms for the first-course project and significantly higher median ranks for the rest of the course projects and students' final course grades, showcasing the adaptability of the Interactive Synchronous HyFlex approach and adding to a growing body of literature (Calafiore & Giudici, 2021; He et al., 2015; Lakhal et al., 2014; Magana et al., 2022; Miller et al., 2013; Rhoads, 2020). Study 9 found that the HyFlex environment meets students' basic psychological needs significantly better, not only during the COVID-19 pandemic, as Study 4 stated, but also after the pandemic era which builds on two related studies by Bozan and colleagues (2023) and Holzer and colleagues (2021). Additionally, HyFlex created an effective environment for robust facilitation of team learning compared to face-to-face instruction by allowing students to be part of the team remotely and synchronously whenever needed (Study 8). This option was highly supported by students in study 3, which is evidence of students' strong self-regulation skills over controlling learning that emphasizes students' adaptability to different learning modalities.

Expectations and Messaging

Several of our studies highlighted a few recommendations for improving teaching and learning experiences in HyFlex, including clear communication between student and instructor and sharing well-defined expectations about attendance modality with students which have been a theme in existing literature (Howell, 2022; Kohnke & Moorhouse, 2021; Rasheed, Kamsin & Abdulla, 2019) . Study 4 reported that students who joined the class remotely one or more times had slightly or significantly less satisfaction with their basic psychological needs. Study 5 reported that the mean ranks of grades for students who joined lessons in person and one-or-more times remotely were similar throughout their three course projects, but the median ranks were higher for in-person students. Nevertheless, whether students joined lessons remotely or in person, they had similar experiences in terms of effort regulation, applying cognitive skills, and peer learning (study 7); their choice of class participation did not affect their sense of classroom community (study 2), but their teamwork and communication might be easier if students were in person (study 8). These results necessitate instructors to communicate expectations and definitions of attendance distinctly, ensuring that students comprehend engagement parameters. The need for clear communication of expectations for participation modality and its accountability was also reinforced by new instructors in Study 11. These insights illustrate the importance of instructional designs that bridge the gap between in-person and remote participation, fostering an inclusive and effective learning community.

Course Design

The findings of our studies highlighted the pivotal role of coordinated design across multiple layers in HyFlex learning environments building on previous work by Miller (2013). As revealed in Studies 1 and 3, considerations of the availability of technology for the institution, instructors, and students, along with the physical classroom setup, emerged as crucial factors influencing the success of HyFlex implementation. Additionally, establishing upfront values such as keeping cameras on for social presence and fruitful team collaboration, using headsets to improve audio experience and reducing potential disruptions in a hybrid environment, and continuing monitoring of student interaction through Microsoft Teams channels serves as a foundational layer, impacting the overall effectiveness and engagement levels within HyFlex structures (Mentzer & Mohandas, 2022; Mohandas, 2022). With these insights, Studies 10 and 11 emphasize the significance of clearly communicated expectations about the course design, ensuring that each stakeholder understands how to navigate between remote and in-person spaces to keep both parties engaged. Another suggestion from our studies is a proactive offer of easily accessible meeting spaces for students to keep them engaged at individual and team levels (study 10). While acknowledging the HyFlex class’s unique hybrid

characteristics, students and instructors must manage multiple modalities simultaneously and ensure easy switching from virtual to physical spaces and vice versa.

Technology Mediated Interactions

Our studies' findings show that remote and in-person students only sometimes fully understand what effective remote participation looks like as students navigate this new experience (Abdelmalak & Parra, 2023). Our study with new instructors emphasizes that incorporating remote teammates and being a proficient remote participant requires intentional strategies, foundational skills of using software and hardware used in the class, having intentional discussions about the pros and cons of participation modality, including modeling the communication means by the instructor in full-group sessions (Study 11). Although study 9 reported that relatedness to the instructor was a statistically significant predictor of HyFlex, it was also evident through study 10 that not all instructors effectively took advantage of creating the most equitable experience for students while establishing instructor presence in the class. Mainly, the challenge arises when teamwork is not explicitly taught or scaffolded, and adding the HyFlex layer further complicates collaborative efforts. Study 8 calls for intentionally implementing teamwork strategies in HyFlex learning environments to address these complexities.

The role of instructors in HyFlex environments is multifaceted, with insights from Studies 3 and 10 shedding light on its crucial aspects. Mentzer and Mohandas (2022) brought attention to the need for in person peers to actively engage their remote students and the occasional lack of remote students' contribution to group work, emphasizing the necessity of monitoring engagement of all students, highlighting the need for instructors to assess and address students' participation levels actively. Study 10 also stressed instructors' varied approaches to establishing their presence across different modalities. While technology plays a pivotal role in leveraging presence and shaping the learning community, instructors displayed a variety of choices regarding technology use, attendance modality recommendations, and the autonomy granted to students. Two instructors preferred to use different technologies to establish and maintain their instructor preference with remote and in-person students; the third instructor offered technological alternatives mainly for remote students. Given the characteristics of HyFlex teaching, the onboarding process for instructors requires them to hone their skills, especially in managing the intricacies of technology and modality considerations. It aligns with the broader theme across studies, highlighting the need for continuous training and adaptation to navigate the challenges associated with HyFlex teaching effectively.

Implications

One of the distinctive features highlighted by these studies is flexibility and inclusivity embedded into HyFlex instructional design. Our studies highlighted how Interactive Synchronous HyFlex went beyond the limitations of a one-size-fits-all approach, offering students the autonomy to choose between in-person and remote attendance based on their individual preferences and circumstances, providing students with a digital version of course materials, recordings of each classroom sessions, and giving students options in connection with their peers and instructors. This flexibility did not emerge as a response to unforeseen disruption like the pandemic but also as a deliberate pedagogical strategy. As a result of providing flexible choices, several of our studies displayed the higher student basic psychological needs satisfaction in HyFlex compared to traditional face-to-face only teaching. The customized characteristics of HyFlex position this instruction as a potential exemplar of inclusive instructional design, recognizing that students have unique needs that may be better met through flexible and hybrid approaches.

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