A Comparison of Student Perceptions and Academic Performance across Three Instructional Modes

Vic Matta
matta@ohio.edu
Ohio University
Athens, OH

Shailendra Palvia
Shailendra.Palvia@liu.edu
Long Island University
Brooklyn, NY

Abstract

The recent pandemic compelled educational institutions all over the world to shift to online instruction. And now institutions find themselves trying to answer questions like how should we proceed when we come back to normal? Which online instructional innovations should we keep? This research attempts to answer those questions by comparing three modes of instruction: in-class, synchronous, and asynchronous for the same course during a semester taught by one instructor. The research analyzes responses from students on the following instructional characteristics: instructor involvement, interaction amongst students, interaction with instructor, course design, student satisfaction and learning experience. Survey data is analyzed using a repeated measures design with pairwise comparisons to understand the differences in students' perceptions of instructional characteristics across these modes. The study also explores differences in actual learning outcomes. Results showed that students overwhelmingly perceived all instructional characteristics to be better facilitated with in-class instruction than with either of the online modes, except for course design which showed no significant differences. It is also seen that students perceive synchronous and asynchronous instruction to have many parallels. Commentary from students suggests that online instructional practice may need a shift, not just in technology improvement, but also in pedagogical design. Students noted that with the shift to online instructional modes, they would like to see increased flexibility, willingness to personalize support, and timely responses.

Keywords: instructional modes, student satisfaction, new normal, e-learning, synchronous, asynchronous, repeated measures design

1. INTRODUCTION

The mandatory shift to online education led innovations in online instructional delivery. Video conferencing platforms increased their customers many-fold and improved their offerings in online instruction. Instructors ramped up their skills of technology use and pedagogical approaches. Remote teaching lasted longer than expected and permitted all stakeholders to get better than they had during the hasty transition. For instance, videoconferencing platforms like Zoom improved their video quality and security features. They created the ability to add status updates and streamlined their application to be easy to use (Correia, Liu, & Xu, 2020) among other improvements. Instructors began to educate themselves on techniques to improve online instruction by reading or reviewing texts on the topic (Matta, 2021). Researchers had already

been discussing techniques to overcome some of the limitations in e-Learning, such as maintaining student attention in synchronous sessions (Hrastinski, 2008), or reducing isolation in asynchronous sessions (Ballenger & Garvis, 2010). Students became more accustomed to online learning and the more introverted students actually preferred asynchronous education (Hood, Jacques, Chen, & Hebert, 2021).

The innovation around remote instruction generated a spectrum of instructional models between fully online to fully in-person, depending on location: whether in-class or anywhere, timing: whether simultaneous or at student's own time, tools: classroom technology, or portable technology, and finally with varying levels of flexibility. For the sake of clarification, a few salient instructional models are briefly defined. According to Kakeshita (2021), the term Hybrid is often used generically to imply some permutation of online instruction, whether it is synchronous or asynchronous. This understanding is sustained for the purposes of the current research and can therefore include HyFlex or Blended education. In his open source book, Beatty (2014) defines a HyFlex course as one in which students have a choice for attending the course in-person or online. In contrast, a blended course uses both, online and in-person modes, not one or the other. Additionally, students do not have a choice of instructional mode. While HyFlex courses provide students with a choice, HyFlex course style can be more difficult to implement, and often needs instructor training (Raman et al., 2021). An instructional support person may also be needed to facilitate the instructor's divided attention between the online and in-class student (Pathak & Palvia, 2021). Therefore, they may be best suited for times during a pandemic, but not necessarily for the new normal after the pandemic.

Both, in-class and blended instruction require physical classrooms and some version of in-person presence. Before the Covid-19 pandemic, instructors have often used blended instruction for teaching analytics because analytical techniques can be detailed and involved. Recorded video for more involved analytical techniques may be reviewed more than once. Often, analytics courses use such recorded instruction to assign an initial preparatory assignment before the first in-class discussion (Sokout, Usagawa, & Mukhtar, 2020). After a year of various hybrid versions of instructional delivery, the question arises: what does the new normal hold for us? Can we return to the old way of doing things with blended courses? The questions arise not only because instructors have refined online synchronous and asynchronous instruction, but also because students often tend to prefer online instruction even while they are on-campus (Kelly, 2021). One way to proceed is to understand students' perceptions and actual learning outcomes with online instruction as compared with that of in-class instruction.

This research informs us about these perceptions and actual learning outcomes by comparing them across in-class, online synchronous and online asynchronous modes of instruction. The rest of the paper develops the research question, and is followed by methodology of the research, discussion of results, limitations and conclusion.

2. RESEARCH DEVELOPMENT

There has been considerable research in the last decade on online education, comparing in-class, hybrid and online modes of instruction. Studies comparing student perceptions on learning, academic performance, satisfaction, level of interaction, across these modes have reported a preference for in-class instruction (Weldy, 2018). According to one study (Fish & Snodgrass, 2015) that surveyed undergraduate and graduate business students, perceptions of online instruction improved as students took more online courses. However, on occasion, students were asked about their perceptions of modes of online instruction without having taken the class. Findings of these studies are interesting but need to be interpreted with caution as students' perceptions were not based on their experience with all three modes (Weldy, 2018).

Some studies, on the other hand, have found contradictory results, with student preferences for online modes of instruction. For instance, a few studies have found higher levels of student satisfaction and perceptions of learning and engagement in online than in-class modes, in which students were enrolled in the same course taught by the same instructor (Bowers & Kumar, 2015; Fadol, Aldamen, & Saadullah, 2018). These divergent findings make it challenging to reach a clear understanding of student perceptions and satisfaction across different modes of learning. There is, therefore, a need to further investigate perceptions and experiences across modes.

Findings with student learning outcomes were also mixed. A meta-analysis of nine studies that examined differences in student performance for college level economics courses between the years 2000 and 2012 found student performance to be stronger for in-class courses, as compared with online synchronous and asynchronous

courses. Another study also reported an interesting finding, that prior academic achievement was a significant moderator (Sanford, 2017). Students with prior lower academic record performed significantly better for in-class modes of instruction than for online modes, but this was not the case for students with a higher academic record. It appears that lower performing students need the in-class instruction to motivate them and generate the required discipline. This finding has been confirmed by other studies as well (Evans, 2013; Flanagan, 2012). On the other hand, studies that also examined differences in academic performance across instructional modes had more mixed results. Callister and Love (2016) examined differences in a negotiations course, while DiRienzo and Lilly (2014) examined differences between instructional modes for concepts with varying complexity. In both cases, no difference was found in learning outcomes across different modes of instruction.

Student Perceptions and Learning Outcomes

Prior research has examined student experience between instructional modes using various approaches. Ahmed (2010) surveyed students to examine acceptance of hybrid learning using information technology (IT) infrastructure, instructor characteristics, and organizational and technical support. Information Technology infrastructure and organizational support were proven to be key determinants of the instructor characteristics as a critical success factor of hybrid e-learning acceptance. In another study, Miranda, Isaias, Costa, and Pifano (2017) leveraged an extensive literature review and focus groups with different stakeholders to identify technology type, course content, students' and instructors' attributes as critical success factors for online learning. Another research study (Sebastianelli, Swift, & Tamimi, 2015) built on prior research and surveyed 169 MBA students to find that course characteristics, interaction amongst students and interaction with the instructor were significant characteristics of instructional delivery quality. These characteristics were confirmed by Eom and Ashill (2016), who used constructivist learning theory in a survey of 372 business students to examine the relationship of student perceptions of instructor involvement and facilitation, course design, satisfaction and learning outcomes. These findings are consistent with other research suggesting that instructor involvement and instructor-student and student-student interactions impact student satisfaction and learning outcomes in online formats (Garrison, 2016).

Our research builds on prior research by combining their findings on instructional characteristics to compare them across three modes of instructional delivery: in-person in-class (IC), online synchronous (SN) using live video conferencing and online asynchronous (AS) using recorded video. We separate online modes into synchronous and asynchronous because of the inherent difference in attention paid and responsiveness of students between these modes, and students' general preference for asynchronous instruction (Adkins & Tu, 2021). Along with the comparison of student perceptions, we also compare actual learning outcomes across the three modes of instructional delivery. The perceptions include instructor involvement, interaction amongst students, interaction with the instructor, course design and learning experience. Actual learning outcomes involve homework assignments and exams across in-class and online modes of instruction. In doing so, we extend the research conducted so far in a few unique ways. First, we compare student perceptions aggregated from several studies that relate to instructional delivery. Secondly, this multi-modal study is done within a single course, in a semester, and with one instructor, thereby reducing confounding effects when different student groups are subjects of the study. Thirdly, it examines perceived as well as actual learning outcomes.

3. METHODOLOGY AND ANALYSIS

Data for this study was collected from students in two sections of a core class in business analytics in a college of business at a Midwestern university. The course taught basic principles of descriptive, predictive, and prescriptive analytics using Microsoft Excel. The course was taught in each of the three modes of instruction, beginning with (i) in-person and in-class (IC), followed by online synchronous (SN) in which students received instruction using live video conferencing, and ending with (iii) online asynchronous (AS) in which students used video streamed on the Panopto™ platform till the end of the semester. In this manner, each student experienced all three modes of instruction.

A total of 61 students were surveyed for their perceptions of instructional characteristics. The survey was adapted from a study by Eom and Ashill (2016) who examined the determinants of student satisfaction and their perceived learning outcomes in the context of online learning. Items such as students' perception of instructor

involvement (Ahmed, 2010) as well as learning items were added to the survey. Three attention checks were included in the survey to ensure that each respondent was paying close attention to the survey. The survey is included in Appendix A. After removing non-attentive responses, duplicates and incomplete responses, 48 data points remained for analysis.

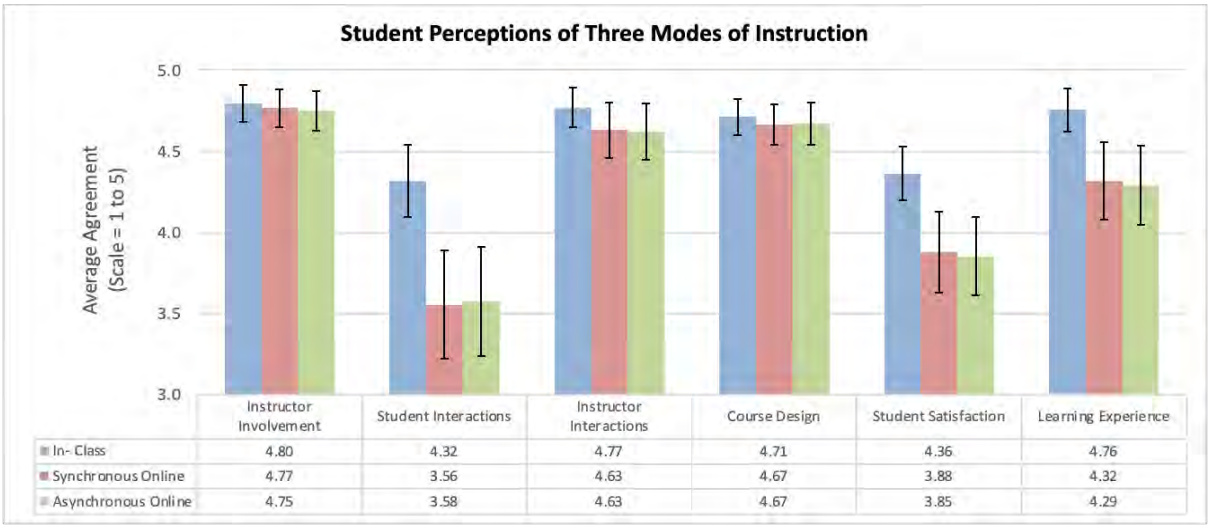
Data Analysis and Results

Since all students experienced each instructional mode, the study was appropriate for a repeated measures design. The survey examined levels of agreement across the six perceptions of instructional characteristics held by students and two learning outcomes. The six perceptions included instructor involvement, dialog amongst students, interaction amongst students and that with the instructor, course design, student satisfaction and learning experience. These perceptions were examined for each mode of instruction using a Likert scale from 1 to 5, with 1 representing strong disagreement and 5 representing strong agreement with the positive influence of each characteristic. The learning outcomes were collected at the end of each instructional mode.

The observations were sampled randomly and independently of each other. Academic performance was only compared across in-class and online modes (composite of asynchronous and synchronous modes) because the requirements of these modes were the same, i.e., this work was completed outside of class. A quick review of aggregate values for student perceptions (Figure 1) revealed that in general, they were highest for the in-class mode. Amongst the perceptions, student interaction, student satisfaction and learning experience appeared to drop more sharply for the two online modes than the other instructional factors. Quizzes and midterm exams were proctored in the same format and therefore aggregated as 'exam' at the conclusion of the in-class mode of instruction. Visual inspection of aggregate values for academic performance did not reveal strong differences between the in-class and online modes of instruction.

Figures 1 and 2 and the accompanying tables each show the comparison of averages, along with 95% confidence interval for these characteristics across the three modes of instruction. Not surprisingly, student perceptions of all six characteristics were lower for the modes of online instruction (SN & AS), than for in person (IC). Actual learning outcomes (Figure 2) were more mixed.

Internal consistency for all measures was tested using Cronbach Alpha and found to range between 8.0 and 9.5. The data violated assumptions of normality and homogeneity of variance. Therefore, we conducted the omnibus Friedman's test (Marino, 2018) with a repeated measures design for each construct using SPSS to find differences between the modes. Table 1 shows the output of the Friedman's test, which compares the mean rank for each characteristic across the three modes. This test outputs the results in the form of Chi square with p-values. Statistically significant differences between student perceptions are marked with an asterisk (*). Pairwise comparisons were conducted post-hoc using the Wilcoxon Signed Rank test to find the modes that differed (Table 2).



	Instructor Involvement	Student Interactions	Instructor Interactions	Course Design	Student Satisfaction	Learning Experience
In- Class	4.80	4.32	4.77	4.71	4.36	4.76
Synchronous Online	4.77	3.56	4.63	4.67	3.88	4.32
Asynchronous Online	4.75	3.58	4.63	4.67	3.85	4.29

Figure 1: Student Perceptions of Modes of Instruction

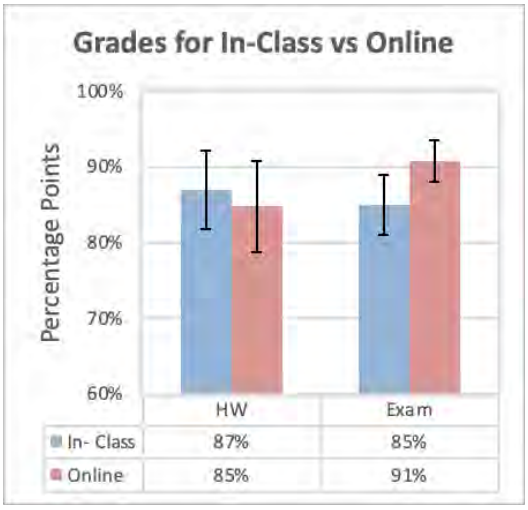


Figure 2: Grades for In class and Online Modes

Results in Table 1 and Table 2 indicate that the students perceived the in-class mode to have significantly better values than both online modes on all constructs except course design.

Actual learning outcomes were also examined pairwise across the modes of instruction using the Wilcoxon Signed rank test. As can be seen in Table 3, results were mixed. Although scores for the homework were higher for when the students were in-class, the difference between the in-class and online performance was not significant. However, students tended to do significantly better with online exams and tests than in-class.

Instructional Characteristics Means: Ranks→	IC	SN	AS	Chi-Square	df	Asymp. Sig.	Kendall's W
Instructor Involvement	2.17	1.95	1.89	7.585*	2	0.023	0.079
Interaction amongst Students	2.53	1.73	1.74	44.851*	2	0.000	0.467
Interaction with Instructor	2.22	1.92	1.86	13.216*	2	0.001	0.138
Course Design	2.11	1.92	1.97	3.959	2	0.138	0.041
Student Satisfaction	2.49	1.78	1.73	43.195*	2	0.000	0.450
Learning Outcomes	2.36	1.85	1.78	13.559*	2	0.000	0.329

** Significant at p < .05*

Table 1: Overall Test for Differences in Perceptions of Instructional Modes – Omnibus Friedman Test

	Instructional Characteristics											
Paired Comparisons	Instructor Involvement		Student Interaction		Instructor Interaction		Course Design		Student Satisfaction		Learning Outcomes	
	Z	* Asym. Sig. 2t	Z	Asym. Sig. 2t	Z	Asym. Sig. 2t	Z	Asym. Sig. 2t	Z	Asym. Sig. 2t	Z	Asym. Sig. 2t
SN-IC	-1.71[b]	0.088	-4.48[b]	0.000[a]	-2.42[b]	0.016[a]	-1.85[b]	0.06	-4.39[b]	0.000[a]	-3.74[b]	0.000[a]
AS-IC	-2.16[b]	0.031[a]	-4.46[b]	0.000[a]	-2.20[b]	0.028[a]	-2.00[b]	0.05	-4.13[b]	0.000[a]	-3.63[b]	0.000[a]
AS-SN	-1.19[b]	0.24	-.736[c]	0.461	-.11[b]	0.915	-.33[c]	0.74	-.71[b]	0.48	-.96[b]	0.336

** Asym. Sig. 2t represents Asymptotic Significance, two tailed*
a. significant at p < .05
b. Based on positive ranks
c. Based on negative ranks

Table 2: Pairwise Comparisons of Perceptions of Instructional Modes - Wilcoxon's Signed Rank Test

Paired Comparisons	Homework		Exams and Tests	
	Z	Asym.Sig. 2t *	Z	Asym.Sig. 2t *
Online vs In-class	-1.71[b]	0.088	-4.48[b]	0.000 [a]

** Asym. Sig. 2t represents Asymptotic Significance, two tailed*
a. significant at p < .05
b. Based on positive ranks
c. Based on negative ranks
Table 3: Analysis of Actual Learning Outcomes using Wilcoxon's Signed Rank Test

4. DISCUSSION

Student Perceptions of Instructional Characteristics

The descriptive information provided in figures 1 and 2 suggests students' preference for in-class instruction, across all characteristics: instructor involvement, interaction amongst students, interaction with instructor, course design, student satisfaction and learning outcomes. Analysis of data collected by the survey confirmed this for all characteristics but course design. Effect sizes (using Kendall's W) have been calculated for Friedman's test for each of these characteristics. The Kendall's W coefficient assumes a value from 0 (indicating no relationship) to 1 (indicating a perfect relationship). Kendall's W uses the Cohen's interpretation guidelines of 0.1 - < 0.3 (small effect), 0.3 - < 0.5 (moderate effect) and >= 0.5 (large effect).

1. Instructor involvement: this included providing timely feedback, encouragement, and facilitation of the course. Students perceived a difference in this characteristic when comparing in-class and asynchronous modes, but not with the synchronous mode of instruction. One reason for this could be that in both modes, the instructor is able to respond concurrently. In comparison, the asynchronous mode is perceived as being more latent, since it uses email or other non-current communication. This may have led to the perception of lowered involvement. Accordingly, the effect size of differences between the modes was found to be low (Kendall's W=0.079).

2. Interaction amongst Students: Students inherently interact with their peers when they are physically present. The ease of communication and interaction is clearly felt while comparing perceptions of interactions in-class with that in both synchronous and asynchronous modes of instruction. Peer-to-peer interaction has been recognized as having significant benefits, and its aspects have been well discussed (Pittman & Pike, 2016). In both online modes, this interaction is inherently reduced from that of in-class instruction, resulting in larger differences in student perceptions, with one of the largest effect sizes (W=0.467, medium-large).

3. Interaction with Instructor: Like the perceptions for dialog amongst students, students perceived that dialog with the instructor was significantly reduced during synchronous and asynchronous modes (W=0.138). While this may be true during asynchronous modes, it is interesting that students found the synchronous instruction to also have lower interaction than the in-class mode. One reason for this could be that students sense the absence of rich simultaneous in-person communication that takes place in-class.

4. Course Design: The lack of differences across the three modes of instruction delivery are not surprising, because course design was consistent across the three modes for all modules in the Business Analytics course (W=0.031). For each module, through the entire duration of the course across the three modes, students were first asked to follow step-by-step procedures shown in videos, to learn how to solve a set of problems. These videos demonstrated techniques and provided some theoretical background. For the second deliverable, students solved a sample problem live, with the instructor for the in-class mode as well as for the synchronous mode. For asynchronous instruction, this instruction also became a video that they needed to follow. The third and fourth deliverables for each module (i.e., homework and exams), had no change whatsoever, because students had to work on their

own and there was no instruction associated with those deliverables.

5. Student Satisfaction: This characteristic captured whether students liked working in this mode, such as doing presentations, taking quizzes, and learning from the instructor or other students. It exhibited some of the strongest differences between the in-class and both online instructional modes (W=0.450). In both the online modes, students had to depend on intrinsic motivation to pay attention to their work. We believe that there are a few reasons for this. While working asynchronously, the instructor is typically not available concurrently to support the student when they have a question. In the synchronous mode, only one student can be heard at a time. If a student seeks support for an issue, they may need to hold the entire class' attention to resolve a question – which can be a deterrent for introverted students.

6. Learning Outcomes: This characteristic captured students' perceptions about the quality of each mode, and whether it facilitated learning well. Students perceived strong differences between in-class and the two online modes of instruction (W=0.329). It is possible that some of this could be attributed to the fact that in the beginning of the course, students became accustomed to in-class instruction. In class, the instructor's presence motivated and compelled students to work on time. Switching to synchronous, and subsequently asynchronous modes, gradually put an increasing burden of timely work on the student, which required more intrinsic motivation.

Actual Learning Outcomes

Although it was clear that students preferred the in-class mode of instruction over the online modes, the learning outcomes did not clearly reflect improved performance with in-class instruction. Homework improved slightly for in-class but not significantly. However, performance on exams was significantly better for the online modes. One explanation for this is that in-class students are more aware of requirements of homework assignments due to richer in-class interactions. In contrast, online students must depend more heavily on intrinsic motivation. Homework carries less weight and therefore less importance in comparison with the exam. Therefore, homework may be less capable of drawing on intrinsic motivation and effort. As is often the case with analytics, answers can be completely correct or completely incorrect – i.e., there isn't always a middle ground. Students often under-estimated the time it would take them to complete homework correctly and before the deadline, incurring errors and penalties for late submissions. In comparison, exams carried a much more portentous appeal for preparation in advance, potentially causing more concern and driving the need to prepare better. It appears that for the online modes of instruction, students prioritized performance on exams to make up for lower performance regularity with course work (homework).

Student Commentary

The survey instrument collected open-ended comments from the students along the following lines:

1. Instructor Interaction: students appreciated quick responses to emails, flexibility, and personalized responses. They also acknowledged enthusiasm, positivity, and willingness to help with difficulties even when it took longer. This suggests that instructors should make a concerted effort to keep up interaction while switching to online modes.
2. Interaction with Other Students: Students reported that they often interacted with their peers to get support. Creating student groups was beneficial for students because it became a platform for them to interact with each other about issues, especially as interactivity was inherently reduced with online modes of instruction.
3. What Students Could Improve: Students acknowledged that they should attend more review sessions, be more proactive about reaching out to their own teams and use a central message/discussion board.

In general, the results show that students perceived in-class instruction to be most present and connected, followed by the synchronous mode of instruction. Even through course work such as reading or viewing videos for instruction is required, the student is not under direct supervision of the instructor during online modes. As a result, students only interact amongst themselves or with the instructor when necessary. Instructors may need to take this into account while working with online modes of instruction.

5. CONCLUSION, LIMITATIONS AND FUTURE RESEARCH

Analysis of data revealed that students preferred in-class instruction but tended to fare better on exams online. This research also suggests that instructors need to increase points of contact with students, create multiple check points, provide increased scaffolding, and perhaps create sliding scale for completing homework on time and with precision to reduce point loss for delays and inaccuracies. Students overwhelmingly acknowledged the appreciation and interest for interactivity. Instructors may facilitate interactivity by creating student groups to serve as a support system, and provision of other forms of scaffolding as appropriate.

One limitation is that there could have been some collaboration on online exams. Although this course leveraged special software to create individualized exam files for students and timed them carefully to minimize learning-on-the-fly, it may be difficult to completely rule out illicit collaboration. Students have often fared better in online assessments (Navarro & Shoemaker, 2000), but it is more common to see students faring better in-class (Sohn & Romal, 2015). Another possibility is that work at home may be less distracting, more comfortable, easing test anxiety and perhaps improves focus. A second limitation is that this research involved a business analytics class, which could limit its generalizability to classes that are similar. A third limitation is that this research had a small sample size,– a research constraint by way of having a single instructor and single course to ensure consistency of research. Since this study explores affects in the same course, it is possible that students became more comfortable with subsequent modes. Perhaps drawing samples from different sections for different modes could mitigate this, as well as the potential impact of any variation of complexity in course topics.

Further research may be needed to resolve the paradox of lower perceptions but better performance for online modes. Findings from this study could be corroborated with research using section-based separation of instruction modes, instead of using all modes in the same course.

The last two years have seen some flux in instructional design, wherein students and instructors alike moved to online instruction in combinations and variations such as HyFlex and blended instruction. In this state of flux, opinions and perceptions change as stakeholders of all types, from administrators to students, learn from their mistakes and improve on techniques. Therefore, additional research may also be needed to explore motivations, perceptions, and efficacies of various modes of instruction to stay abreast of this fast-changing nature of instructional delivery.

6. REFERENCES

Adkins, J. K., & Tu, C. (2021). Online teaching effectiveness: A case study of online 4-week classes in a graduate information systems program. *Information Systems Education Journal, 19*(3), 3.

Ahmed, H. M. S. (2010). Hybrid E-Learning acceptance model: Learner perceptions. *Decision Sciences Journal of Innovative Education, 8*(2), 313-346.

Ballenger, R. M., & Garvis, D. M. (2010). Student Usage of Instructional Technologies: Differences in Online Learning Styles. *Information Systems Education Journal, 8*(51), n51.

Beatty, B. (2014). Hybrid courses with flexible participation: The HyFlex course design. In *Practical applications and experiences in K-20 blended learning environments* (pp. 153-177): IGI Global.

Bowers, J., & Kumar, P. (2015). Students' perceptions of teaching and social presence: A comparative analysis of face-to-face and online learning environments. *International Journal of Web-Based Learning and Teaching Technologies (IJWLTT), 10*(1), 27-44.

Callister, R. R., & Love, M. S. (2016). A comparison of learning outcomes in skills-based courses: Online versus face-to-face formats. *Decision Sciences Journal of Innovative Education, 14*(2), 243-256.

Correia, A.-P., Liu, C., & Xu, F. (2020). Evaluating videoconferencing systems for the quality of the educational experience. *Distance Education, 41*(4), 429-452.

DiRienzo, C., & Lilly, G. (2014). Online versus face-to-face: Does delivery method matter for undergraduate business school learning? *Business Education & Accreditation, 6*(1), 1-11.

Eom, S. B., & Ashill, N. (2016). The determinants of students' perceived learning outcomes and satisfaction in university online education: An update. *Decision Sciences Journal of Innovative Education, 14*(2), 185-215.

Evans, N. S. (2013). *A cross-sectional descriptive study of graduate students' perceptions of*

learning effectiveness in face-to-face and online courses: Wilmington University (Delaware).

Fadol, Y., Aldamen, H., & Saadullah, S. (2018). A comparative analysis of flipped, online and traditional teaching: A case of female Middle Eastern management students. *The International Journal of Management Education, 16*(2), 266-280.

Fish, L. A., & Snodgrass, C. R. (2015). Business student perceptions of online versus face-to-face education: Student characteristics. *Business Education Innovation Journal, 7*(2), 83-96.

Flanagan, J. (2012). Online versus face-to-face instruction: Analysis of gender and course format in undergraduate business statistics courses. *Academy of Business Research, 2*, 93-101.

Garrison, D. R. (2016). *E-learning in the 21st century: A community of inquiry framework for research and practice*: Taylor & Francis.

Hood, J., Jacques, L., Chen, Y., & Hebert, D. (2021). *Students' Perceptions on the Various Delivery Methods of Instruction.* Paper presented at the Society for Information Technology & Teacher Education International Conference.

Hrastinski, S. (2008). Asynchronous and synchronous e-learning. *Educause quarterly, 31*(4), 51-55.

Kakeshita, T. (2021). *Improved HyFlex Course Design Utilizing Live Online and On-demand Courses.* Paper presented at the CSEDU (2).

Kelly, R. (2021). 73 Percent of Students Prefer Some Courses Be Fully Online Post-Pandemic. *Campus Technology*.

Marino, M. J. (2018). Chapter 3 - Statistical Analysis in Preclinical Biomedical Research. In M. Williams, M. J. Curtis, & K. Mullane (Eds.), *Research in the Biomedical Sciences* (pp. 107-144): Academic Press.

Matta, V. (2021). Teaching in the online classroom: surviving and thriving in the new normal: by Doug Lemov and the Teach Like a Champion™ team, Published by Jossey Bass, A Wiley Brand, 192 pp., ISBN-13: 978-1119762935. *Journal of Information Technology Case and Application Research, 23*(1), 76-80.

Miranda, P., Isaias, P., Costa, C. J., & Pifano, S. (2017). Validation of an e-learning 3.0 critical success factors framework: A qualitative research. *Validation of an e-learning 3.0 critical success factors framework: a qualitative research*(1), 339-363.

Navarro, P., & Shoemaker, J. (2000). Performance and perceptions of distance learners in cyberspace. *American journal of distance education, 14*(2), 15-35.

Pathak, B. K., & Palvia, S. C. (2021). Taxonomy of higher education delivery modes: a conceptual framework. *Journal of Information Technology Case and Application Research, 23*(1), 36-45.

Pittman, J. M., & Pike, R. (2016). An observational study of peer learning for high school students at a cybersecurity camp. *Information Systems Education Journal, 14*(3), 4.

Raman, R., Sullivan, N., Zolbanin, H., Nittala, L., Hvalshagen, M., & Allen, R. (2021). Practical tips for HyFlex undergraduate teaching during a pandemic. *Communications of the Association for Information Systems, 48*(1), 28.

Sanford, D. (2017). Course format and learning: The moderating role of overall academic performance. *The International Journal of Management Education, 15*(3), 490-500.

Sebastianelli, R., Swift, C., & Tamimi, N. (2015). Factors affecting perceived learning, satisfaction, and quality in the online MBA: A structural equation modeling approach. *Journal of Education for Business, 90*(6), 296-305.

Sohn, K., & Romal, J. B. (2015). Meta-Analysis of Student Performance in Micro and Macro Economics: Online Vs. Face-To-Face Instruction. *Journal of Applied Business & Economics, 17*(2).

Sokout, H., Usagawa, T., & Mukhtar, S. (2020). Learning Analytics: Analyzing Various Aspects of Learners' Performance in Blended Courses. The Case of Kabul Polytechnic University, Afghanistan. *International Journal of Emerging Technologies in Learning (iJET), 15*(12), 168-190.

Weldy, T. G. (2018). Traditional, blended, or online: Business student preferences and experience with different course formats. *E-Journal of Business Education and Scholarship of Teaching, 12*(2), 55-62.

APPENDIX A

Survey items adapted from Eom & Ashill (2016), with Cronbach Alpha values for each mode.

#	Items	In-class	Asynchronous	Synchronous
Instructor Involvement		0.896	0.891	0.880
	The instructor was actively involved in facilitating learning.			
	The instructor provided timely helpful feedback on homework assignments.			
	The instructor provided timely helpful feedback on quizzes.			
	The instructor provided timely helpful feedback on student presentations.			
	The instructor provided timely helpful feedback on discussion forums.			
	The instructor stimulated students to exert intellectual effort.			
	The instructor cared about my individual learning.			
	The instructor was responsive to student concerns.			
Dialog amongst Students		0.838	0.923	0.914
	I had positive and constructive interactions with other students frequently.			
	The level of positive and constructive interactions among students was high.			
	I learned a lot from my fellow students.			
	The positive and constructive interactions among students helped me improve the quality of my learning outcomes.			
	What aspects of the student-to-student interaction impressed you the most to enjoy learning?			
	What could have helped you to improve student-to-student interactions in this mode?			
Dialogue with Instructor		0.829	0.833	0.853
	I had positive and constructive interactions with the instructor frequently.			
	The level of positive and constructive interactions between the instructor and students was high.			
	The positive and constructive interactions between the instructor and students helped me improve the quality of my learning outcomes.			
Course Design		0.783	0.811	0.787
	The course objectives and procedures were clearly communicated through the syllabus and explained in detail.			
	The course materials were interesting and stimulated my desire to learn.			
	The course materials supplied me with an effective range of challenges.			
	Student grading components such as homework assignments, presentations, quizzes, and exams were related to learning objectives of the class.			
Learning Experience		0.780	0.844	0.849
	The academic quality of this mode is excellent.			
	I have learned a lot from this mode.			
	The quality of the learning experience in this mode is great.			
Student Satisfaction		0.780	0.844	0.849
	I enjoyed doing presentations in this mode.			
	I enjoyed taking quizzes and tests in this mode.			
	I enjoyed learning in this mode from the instructor.			

	I enjoyed learning from peers in this mode.
Demographics	
	How old are you?
	What is your gender?
	What is your current year in school?
	What is your area of study?
	Before Spring Semester 2020, did you take an online course?
	If your answer was "Yes" to the previous question, was it fully online or blended?
Open Ended Comments	
	What aspects of the instructor impressed you the most?
	What could have the instructor done differently to make the learning environment even better?
	What aspects of your interaction with the instructor impressed you the most?
	What aspects of your interaction with other students impressed you the most to enjoy learning in the synchronous mode?
	What could have helped you to improve your interaction with the instructor?
	What could have helped you to improve your interaction with other students?