



“It’s Nice to Mix Up the Rhythm”: Undergraduates’ Experiences in a Large Blended Learning Course in Information Science in the Context of COVID-19

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Abstract. The abrupt transition to online instruction in the COVID-19 pandemic presented an opportunity for instructors in information science to engage with new teaching and learning modalities. After their online semester (i.e., Spring 2020), some decided to utilize the insights they gained and offer blended-learning courses in the post-pandemic semester. In this mixed-methods study, we surveyed a sample of 388 students in a large undergraduate information science course that transitioned from online to blended learning: 212 students in the online offering and 176 students in the blended offering of the course. We compared students’ experiences in online and blended learning modalities and examined their perspectives on the blended learning component. Our quantitative and qualitative analyses yielded mixed results. Findings showed students preferred blended learning over online learning. They perceived it to be more engaging and active and reported that it allowed more peer interaction. Students had mostly positive perspectives of the blended learning components. However, some offered feedback on improving attendance requirements for the online component of the blended learning. Others reported online fatigue following online instruction during the pandemic. We discuss the findings and offer suggestions for effectively incorporating blended instruction in large information science courses.

Keywords: Blended learning · Online learning · Information science education · COVID-19 · Undergraduates

1 Introduction

1.1 Purpose

Disruptive innovation theory [1] frames a crisis, such as the COVID-19 pandemic, as a valuable opportunity to break common schemas and move towards more creative and innovative agendas. In a bottom-up process, a disruptive situation induces a new and creative category that gradually replaces the traditional one. In this process, a disruption might encourage a change in the long run. In this study, we frame the sudden transition to emergency online learning in higher education as a crisis event that could lead to

sustainable instructional change in higher education [2, 3]. We rely on the disruptive innovation theory to frame and explain students' perceptions of transitioning from online learning to blended learning following the COVID-19 pandemic.

In this paper, we address the gaps in literature and examine the learning experiences of a sample of undergraduates in an information science course offered online during the pandemic (spring 2021 semester) and then transformed into a blended learning modality when the university returned to in-person instruction (fall 2022 semester). By drawing on disruptive innovation theory, we aim to shed light on the opportunities for pedagogical innovation that emerged from instructors' unique teaching experiences during the pandemic. We argue that learning from student experiences can expand our understanding of emerging pedagogical approaches in the post-pandemic era. Based on our findings, we suggest guidelines and principles for implementing well-designed blended instruction in information science courses in higher education.

1.2 Background

The pandemic caused a disruption in academic routines during the spring semester of 2020, forcing most higher education institutions to transition to online learning [4]. Despite the abrupt disruption, studies show that students mostly perceived the transition as a positive step towards improving their digital competencies [5, 6]. For example, a mixed-method study of faculty and students in three universities discovered students enjoyed the flexibility of online learning and felt the new learning experience contributed to their skills and knowledge [7]. Many higher education institutions continued the online instruction in subsequent semesters, allowing students and instructors to become familiar with learning and teaching online and appreciate its advantages. Following these teaching and learning experiences, course instruction in higher education has started to slowly change to include blended learning courses [8].

Blended learning is commonly defined as a flexible instructional method that combines several modalities of instruction (e.g., in-person and online) [9, 10]. Studies show that when designed well, blended learning can improve student learning experience, engagement, and achievements [11–14]. Integrating blended learning into large-scale courses might improve course interactivity and increase peer interaction via smaller group activities in an interactive online platform (e.g., in Zoom breakout rooms) [15]. The blended learning instructional method is also inclusive, as it offers more flexibility for learners (e.g., learning modality, course attendance), and enables personalized learning [15, 16]. To construct a sustainable, well-designed, blended learning course, instructors should consider the course structure (i.e., the balance of in-person and online instruction), the selection of activities within the course, and their own role in building relationships with the students [17]. Given these requirements, designing a blended course in higher education has remained a challenge for instructors [18].

Despite the challenges of constructing sustainable blended-learning courses, Porter and colleagues [19] predict that in the future, 80–90% of courses will feature blended instruction. In fact, their prediction is already becoming a reality; Ma and Lee [8] argue that in the post-pandemic era, blended learning might become the *new normal* in higher education. A meta-analysis conducted before the pandemic challenges this notion, as it found students do not necessarily prefer blended learning. However, findings of a recent study examining student experiences in a sports and exercise program during the pandemic support Ma and Lee; in this case, students preferred blended learning over online learning [12].

Although instructional changes in higher education might be inevitable in the post-pandemic era [8, 19], little is known about the actual processes involved. For example, there is limited evidence so far on instructional changes in information science courses. Exploring how students’ perspectives and instructors’ experiences have changed might yield insights that are important for curriculum and course development.

1.3 Research Questions

In a mixed-methods study, we compared undergraduates’ experiences of an information science course in two semesters that offered different learning modalities: an online learning modality (spring 2021 semester) and a blended learning modality (fall 2021 semester). We focused on the blended learning modality to understand how students perceived the course-related changes implemented by the instructor following the pandemic. We asked the following research questions:

RQ1. How did students’ experiences change moving from online instruction to blended instruction?

RQ2. What were students’ perspectives of the blended instruction?

2 Methods

2.1 Research Context

The study was conducted in the Department of Information Science at a large research university in North America. The course is a large-enrollment (200–250 students) mid-level course for undergraduates on web applications and data visualizations; it focuses on topics such as human-computer interaction, programming, and data science.

The course was offered pre-pandemic in a regular in-person modality. During the outbreak of COVID-19 in spring 2020, the course was transformed to an online learning modality and was reoffered in an online learning modality in spring 2021. Once COVID-19 restrictions were lifted, the course was offered in a blended learning modality in fall 2021. In this study, we focused on two offerings of the course: spring 2021 (online learning modality) and fall 2021 (blended learning modality). We chose the spring 2021 semester as an example of an online instruction modality, because the first online offering (spring 2020) was not planned, and the modality switched in the middle of the semester.

All the different modalities of the course (i.e., in-person, online, and blended) were taught by the same instructor following the same curriculum. The lectures in the online and blended instruction modalities were structured the same: three 50-min lectures every week; after each lecture, the instructor uploaded recorded lectures and notes to the course website. The course's content, projects, and assessment were the same for both modalities. The only difference between the two semesters was the instruction modality. The online semester offered three synchronous Zoom sessions per week. The blended semester included three weekly sessions, mainly in-person. During the blended learning semester, every three weeks the third weekly session on Friday was replaced by a 50-min synchronous Zoom meeting.

The transition to blended instruction was promoted by the instructor who wanted to implement several online components that he found useful for improving student engagement and learning during the pandemic. In particular, the instructor wanted to tackle some of the instructional challenges posed by the large scale of the course. The first challenge was encouraging peer interaction and group activities in a large course. This is important for information science students who will need collaborative skills in the workplace [26]. The second challenge was incorporating design critique activities. The instructor considered this important in a course focusing on developing design skills [27], such as data visualization. Design critique activities encourage students to evaluate their own and their peers' work, and in the process, they improve their data visualization skills. However, this type of activity is difficult to implement effectively in a large classroom setting.

To achieve these goals in the blended learning modality, the instructor incorporated two types of activities in the Zoom sessions throughout the semester: (1) group design activities; (2) group design critique activities. The design activity sessions focused on developing design skills by conducting mini projects in groups. The design critique sessions focused on developing critical thinking skills by evaluating peers' work. While the learning goals and nature of the activities for each type of session were different, all Zoom sessions had a similar structure, as described in Table 1.

Table 1. Structure of online sessions in the blended learning modality

Structure	Description	Practices
1. Introduction	- Instructor presented the session’s topic, learning goals, and activities	- Instructor used Zoom chat to ask for students’ questions and comments
2. Small-group activity in breakout rooms	- Students worked in groups of 5–6 - Design activity: students designed a mini group-project - Design critique: students evaluated peers’ work	- Instructor gave prompts for the group activity - Instructor and TAs visited breakout rooms to facilitate group activity - Instructor sent notifications to facilitate the time management within the groups
3. Large-group discussion	- Large group discussion on the activity	- Design activities: students shared the mini-projects with the larger group - Design critique: students shared their experiences with the larger group - Instructor used Zoom chat to ask for students’ questions and comments

2.2 Participants

Participants were 388 information science undergraduate students (59.3% female, 40.7% male) who completed a survey in one of the course offerings, either spring 2021 (online learning) or fall 2021 (blended learning). We collected 222 responses for spring 2021 and 188 responses for fall 2021. We removed 4 and 6 duplicate responses for spring 2021 and fall 2021, respectively, where students responded multiple times to the same survey, and 6 and 6 incomplete surveys, respectively, where students submitted an empty or an incomplete survey. This yielded 388 responses: 212 responses in spring 2021 (online learning) and 176 responses in fall 2021 (blended learning).

Table 2 summarizes the sociodemographic characteristics of the participants in each semester based on data provided by the university registrar.

Table 2. Participant demographics

		Online instruction Spring 2021 N = 212	Blended instruction Fall 2021 N = 176
Sex	Female	61.8%	56.3%
	Male	38.2%	43.8%
Race/ethnicity	Asian	40.6%	46.6%
	White	18.9%	13.6%
	Hispanic or Latino	0%	1.1%
	Black or African American	5.2%	2.8%
	Two or more races	9.4%	9.1%
	American Indian	0%	0.6%
	International/ Not specified	25.9%	26.1%

2.3 Measures

We collected data using self-reported surveys developed to measure student experiences in a course. Gathering quantitative and qualitative data through surveys is a common approach for studying phenomena related to disruptive innovation theory [e.g., 28, 29]. Our survey included nine statements that students rated on Likert scales, which examined the following aspects: overall learning experience in the course, course organization, difficulty level, perceived gained knowledge, perceived engagement, perceived activeness in the course, perceived collaboration with peers, the number of peers they collaborated with, and students' emotions during the course [20] (see Table 3).

For the semester of blended instruction in fall 2021, we added an additional statement and an open-ended question. The statement asked students to rate on a Likert scale the perceived benefits of two blended learning activities they had experienced on Zoom (i.e., group design critique, group design activity). The open-ended question asked them to describe their experiences in the online sessions as part of their blended learning experience. Table 3 summarizes all of the survey items and the response scales.

2.4 Procedure and Analysis

The study was conducted at the end of the spring 2021 semester (i.e., online instruction) and at the end of the fall 2021 semester (i.e., blended instruction) after receiving approval from the institutional review board. Surveys were distributed by the course instructor via a hyperlink to a Qualtrics survey, a web-based surveying platform. The survey was presented to students as part of a project to examine their learning experiences in the course. Students who completed the survey received extra credit and provided informed consent to use their responses.

For the quantitative data, we performed descriptive analysis and *t*-tests for independent samples, using IBM-SPSS statistical software. Qualitative data were analyzed by

Table 3. Survey items and response scale

Variables	Statements	Reference	Rating scale
Experience	How would you describe your experience in this course?	Alon et al. 2021	0 (poor) to 4 (excellent)
Organized	How well organized was this course?		0 (poor) to 4 (excellent)
Skills	Compared to how much you knew about the course topic at the start, how much new knowledge and skills have you learned by taking this course?		0 (not at all) to 4 (a great deal)
Engaged	How often did you synthesize ideas, think critically about the content, and apply the material to unfamiliar topics and problems?		0 (never) to 4 (always)
Difficulty	How easy or difficult is the course relative to other courses you have taken at Cornell?		−3 (difficult) to 3 (easy)
Active learning	How active or passive was the learning experience in this course?		−3 (passive) to 3 (active)
Active peers	How often during class time did you discuss course materials with fellow students?		0 (never) to 4 (always)
Number of peers	How many fellow students in this class do you feel comfortable asking for help with the course?		Integer input field
Concentration Frustration Confusion Anxiety	How often did you experience each of these emotions during the course?	Calvo and D’Mello 2010	0 (never) to 5 (always)
	How much do you feel that this new activity helped you learn in the course?	Alon et al., 2021	1 (not at all) to 4 (a lot)
	Tell us about your experience with the new activity (design activity; design critique)		Open-ended question – Coded

using bottom-up content analysis [21]. According to this method, content is analyzed into categories that are gradually developed into sub-categories. In this study, we identified three categories that reflected students' experiences in blended learning. These were gradually developed into eight sub-categories.

3 Findings

3.1 Student Experiences in Online Versus Blended Learning

We conducted *t*-tests for independent samples to compare student experiences in online learning and blended learning (Table 4).

Table 4. Mean scores, standard deviations (SD), and *t*-test statistics with *p*-values for independent samples of student experience in online and blended learning (N = 388).

Survey measure	Online learning M (SD); <i>N</i> = 212	Blended learning M (SD); <i>N</i> = 176	<i>t</i> -test	<i>p</i> -value
Experience	3.47 (0.63)	3.53 (0.57)	<i>t</i> = 1.00	<i>p</i> = .319
Organized	3.46 (0.61)	3.52 (0.59)	<i>t</i> = 1.00	<i>p</i> = .327
Skills	3.21 (0.92)	3.23 (0.85)	<i>t</i> = 0.13	<i>p</i> = .828
Engaged	2.71 (0.71)	2.88 (0.71)	<i>t</i> = 2.32	<i>p</i> = .021
Difficulty	0.41 (1.21)	0.49 (1.18)	<i>t</i> = 0.65	<i>p</i> = .518
Active learning	1.27 (1.42)	1.61 (1.18)	<i>t</i> = 2.52	<i>p</i> = .012
Active peers	1.72 (1.00)	1.95 (0.95)	<i>t</i> = 2.26	<i>p</i> = .024
No. of peers	2.73 (1.83)	3.48 (2.27)	<i>t</i> = 3.62	<i>p</i> < .001
Concentration	3.23 (0.90)	3.11 (0.96)	<i>t</i> = -1.35	<i>p</i> = .178
Frustration	1.65 (1.01)	1.43 (1.06)	<i>t</i> = -2.12	<i>p</i> = .034
Confusion	1.56 (0.83)	1.54 (0.88)	<i>t</i> = -0.25	<i>p</i> = .805
Anxiety	1.15 (1.02)	1.07 (1.01)	<i>t</i> = -0.68	<i>p</i> = .486

Results showed students' learning experiences were somewhat different in the two semesters (i.e., online learning and blended learning). They reported a similar satisfaction with the course, and their affective experience was similar in terms of concentration, confusion, and anxiety levels. However, in blended learning, students reported being more engaged and active in the course. They collaborated more with their peers, and the number of peers they felt comfortable approaching for help increased. They also reported less frustration during the blended learning than the online learning semester.

3.2 Students' Perspectives on Blended Learning

To answer the second research question, we examined students' perspectives on the blended learning semester. First, we calculated mean scores, SDs, and frequencies for

student responses for the question: “How much do you feel that this new activity helped you learn in the course?” The distribution of responses is visualized in Fig. 1.

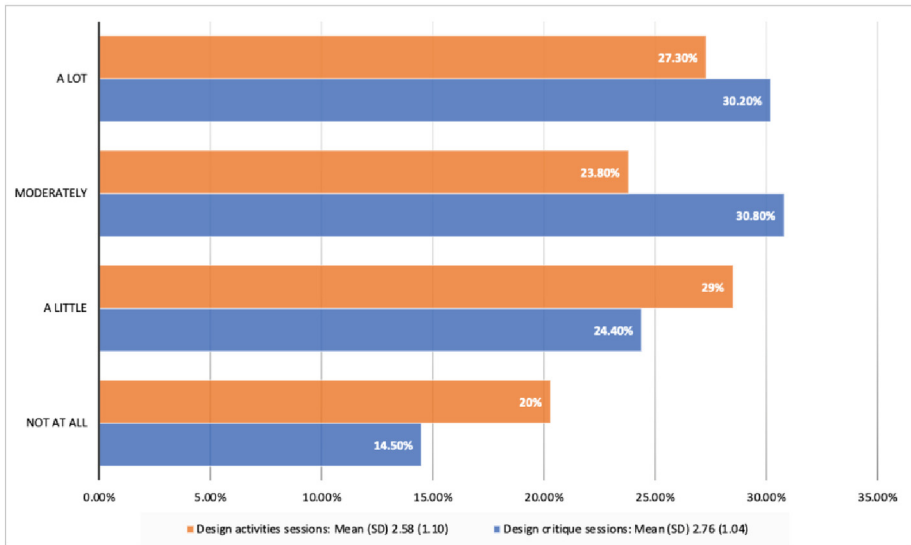


Fig. 1. Distribution of students’ responses (N = 176) to the question “How much do you feel that this new activity helped you learn in the course?” for two blended learning activities: design activities (orange) and design critiques (blue).

On average, students perceived the blended instruction activities to be moderately beneficial for their learning. They reported more satisfaction with the group design critique sessions (*Mean* = 2.76, *SD* = 1.04) than the design activity sessions (*Mean* = 2.58, *SD* = 1.10).

To better understand why students favored or did not favor the blended learning experience, we analyzed 173 responses to an open-ended question that asked students to describe their overall experience during the online Zoom sessions (three students did not answer the question). The analysis revealed more than one comment for several students (i.e., they referred to multiple topics); this resulted in 212 student comments.

A conventional content analysis of the comments revealed three categories that described student experiences in blended learning: (1) student engagement and motivation; (2) perceived benefits of the blended learning modality; (3) balance between in-person and online instruction in blended learning. For each category, we then identified sub-categories according to student responses.

In Table 5, we summarize our findings for the three categories and eight sub-categories and offer examples of student comments.

Most reactions to the blended learning experience were positive. Out of 212 student comments, 145 comments (68.4%) reflected a good student experience with the blended learning, and 67 comments (31.6%) reflected a negative student experience.

Table 5. Content analysis of student perspectives on blended learning

Categories	Sub-categories	No. of comments	Examples of student comments
Student engagement and motivation	High engagement	N = 42	<p>“Great to exercise skills in a new way”</p> <p>“Activities in breakout rooms help practice design concepts”</p> <p>“It was nice to work in groups and I got to think creatively”</p> <p>“I liked applying skills we learned and work with other students”</p>
	Low engagement	N = 22	<p>“I did not feel as engaged in Zoom”</p> <p>“Breakout rooms just were not that effective”</p> <p>“I was passive and didn’t get much out of them”</p> <p>“It’s frustrating to be in a group who doesn’t care as much as you”</p>
	Attendance policy as a motivator	N = 31	<p>“Attendance being required could serve as an incentive to go”</p> <p>“These were optional, so many peers were not motivated to attend”</p> <p>“I felt less bad missing these because Zoom feels less formal”</p>
Perceived benefits of blended learning modality	Peer interaction	N = 22	<p>“Zoom provides an opportunity to really talk to our classmates”</p> <p>“It was nice to have an environment where you can freely talk to a small group of people, especially in a large class”</p>

(continued)

Table 5. (continued)

Categories	Sub-categories	No. of comments	Examples of student comments
	Convenience	N = 33	“It removes the necessity of traveling to get to class” “Having some flexibility eases our stress” “Helps me get my schedule more flexible”
	Helpful during the pandemic	N = 3	“This helps a lot during covid time” “It was a nice option for students especially during the pandemic”
Balance of in-person and online instruction in blended learning	Good balance	N = 45	“They offered a good balance of online and in-person lectures” “It’s nice to mix up the rhythm and attend in a different modality” “The Friday Zoom meeting was a change of pace” “Keep it! I am braver on Zoom”
	Do not like Zoom sessions	N = 14	“I personally don’t like anything on Zoom” “After a year of Zoom learning, I am wholly Zoom-fatigued” “Zoom makes me easier to fall asleep”

For the student engagement and motivation category, findings showed most students perceived the blended learning experience to be engaging and helpful for their learning, as it enabled them “to exercise skills in a new way”. However, several students reported they were not engaged in the online sessions, as they were frustrated with group work and engagement in breakout rooms. In addition, some students perceived the lack of mandatory attendance as a factor that reduced their motivation to attend the online sessions and harmed their engagement.

For the perceived benefits of the blended learning modality category, students mentioned the added value of peer interaction during online sessions. Their positive responses about peer interaction suggest the benefit of adding an online component in a large-scale course in which students have fewer opportunities to interact with peers and participate

in interactive activities. Students also mentioned the convenience of having occasional remote sessions every once in a while. Finally, Zoom sessions were helpful for students who could not attend class because of limitations related to COVID-19 and other health-related concerns.

Overall, students felt that the blended instruction offered a good balance of the two instructional modalities (in-person instruction, online instruction). They expressed that the blended instruction was a “change of pace” and an opportunity to “mix up the rhythm” of the class. Nonetheless, other students complained about online fatigue after prolonged online instruction and stated that they preferred in-person instruction.

4 Discussion

Our study examined undergraduates’ experiences in an information science course that was transformed into a blended learning modality following the COVID-19 pandemic. We wanted to compare students’ experiences in the online learning modality with their experiences in the blended learning modality and examine their perspectives on the two blended learning activities. We aimed to identify the learning barriers and opportunities created by teaching changes during the pandemic, hoping to find ways to allow instruction in information science courses to evolve in the post-pandemic era.

Our first research question asked how students’ experiences changed with the move from online instruction to blended instruction. We discovered students preferred the blended learning modality over the online modality [12]. They reported a good overall learning experience in both instances (online and blended) and perceived the course to be organized and clear in the two learning modalities. Their affective experiences were also alike in terms of their level of confusion, concertation, and anxiety. However, they said the blended learning modality offered more opportunities to be engaged with the course, and their learning was more active. Their social interactions also improved, as they collaborated with more peers and felt more comfortable asking for their help. They reported less frustration during blended learning as well.

These findings correspond with previous studies that suggest blended learning is more inclusive and accessible to students when it is carefully designed [11, 12, 16]. In large classes, such as the course we examined, blended learning offers more opportunities for social interaction and peer support [15, 17]. This can be done, for example, by incorporating features of online conferencing tools that allow students to break into smaller groups for class discussions and group work. Such smaller group practices are more difficult to implement in large classroom setups [26].

Taking into consideration that planning a blended learning course is both challenging and complicated [18], these are positive findings. Students’ satisfaction with the course supported the instructor’s efforts to create a sustainable and supportive learning environment. It also showed that a well-planned blended course might serve as an active learning method in large information science courses, bringing students together and increasing their engagement and interaction [15, 23].

Our findings for the second research question painted a more complicated picture of students’ perspectives of the blended instruction. Overall, our quantitative and qualitative analysis yielded mixed findings. Students were somewhat satisfied with the online

component of the course (i.e., Zoom sessions on Friday), but they also had constructive feedback for future offerings of the blended learning course. They mentioned multiple positive aspects of blended learning, including its engaging and interactive nature, its convenience and flexibility, and the opportunity to interact with peers in a large course. These findings are consistent with previous studies which found that blended learning could enhance student engagement and collaboration [15, 17], and improve instruction flexibility [16].

Particularly, students mentioned that one benefit of joining the online meetings was that it enabled them to interact with their peers. They appreciated this interaction which does not happen too often in a large, lecture-based classroom setting. Collaborating and interacting with peers could enhance students’ sense of belonging in the classroom and help them to acquire collaborative skills [26]. Another positive aspect of blended learning that was mentioned by the students was the opportunity to exercise higher-order thinking skills during online activities. For example, being able to practice design critique skills teach students how to evaluate their own and their peers’ work. Through this process, they can improve their data visualization skills and learn best practices [27]. These aspects of online meetings (e.g., collaborating with peers, exercising practical skillsets) indicate the opportunities that blended learning holds to encourage peer interaction and group activities in large information science courses [23].

Nonetheless, students’ perspectives of the blended learning instruction also shed light on the aspects that should be improved. These included the students’ lack of engagement with the online component of the course (i.e., Zoom meetings) and the optional attendance policy that harmed student motivation. Several students also reported online fatigue following the long period of online instruction during the pandemic [22].

Disruptive innovation theory [1] suggests disruptions and changes might not be adopted by all people immediately. It might take time for some people to adjust to changes and embrace novelty. Student resistance to change in course instruction might reflect a challenging transition after a few semesters of instable instruction [7]. After transitioning from in-person to online instruction during the pandemic, students might struggle as they navigate their way back onto campus [8]. Hence, students may have trouble adopting yet another new learning modality – blended learning.

Our study suggests that despite some difficulties during the transition, students are relatively open to trying a new learning modality and welcoming the opportunities it brings for enhancing their learning experience. We therefore recommend that instructors in information science incorporate blended learning components into their courses. This is particularly important in large in-person undergraduate courses, where it is difficult to engage students, promote peer interaction, and experience various types of activities that can promote students’ skills (e.g., design critiques, group work).

That said, it is important to be aware of best practices when planning blended learning instruction with an online component. First, instructors should consider having synchronous sessions that enable more interaction and engagement than asynchronous online sessions [24]. As mentioned above, interactive online sessions have the potential to encourage more peer interaction and enable collaborative activities. Second, the balance between in-person and online sessions should be carefully planned, as students are still coping with online fatigue and their pandemic experiences [22]. Instructors

should consider focusing on in-person instruction while adding the online component as an added bonus to their classes. Balancing in-person lectures with online activities can help instructors take advantage of the best parts of each learning method [12, 15]. It is also important to communicate to students the rationale for choosing a blended learning method. Instructors should explain the reasons for incorporating online meetings and describe the expected benefits from students. Third, students' experiences during the course should be monitored (e.g., student evaluations or surveys) to see how they handle the change in instruction and how to support students who might struggle with blended instruction. This may be especially beneficial for supporting ethnic minority students, who have been found to be at a disadvantage in online instruction [25].

The current study has several limitations. First, we relied on students' self-reported surveys to examine their perceptions of online and blended learning. Future studies might examine students' behavior during blended learning by extracting and analyzing log data from learning systems and/or online platforms. This research path might reveal additional insights regarding students' learning and behavior in blended learning courses. Second, we examined students' experiences in one information science course, and did not explore the role of sociodemographic backgrounds in their perceptions of the blended learning experience. We recommend that future studies examine students' perspectives on blended instruction in a larger sample of students, in multiple courses, and focusing on the role of students' identity-based groups in their blended-learning experience. It is also important to explore if and how instructors in information science are willing to change instruction modalities following the experience gained during the pandemic. Future work can also examine how institutions can effectively support instructors in this transition to blended learning.

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