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The impact of course format on student perceptions of the classroom learning environment and teamwork

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Abstract

Traditionally, education has been largely delivered in an in-person format; however, an increasing number of courses are being delivered entirely online or with a blend of online and in-person components. These formats differ along various dimensions, such as the quantity and quality of interpersonal interactions and connections, which will likely lead to different student experiences. Using a sample of 200 undergraduate student responses from an online survey, we compared five different course formats (in-person, synchronous online, asynchronous online, blended with alternating weeks and blended exam only) on students' perceptions of various elements of their learning environment, including teaching presence, cognitive presence, social presence, sense of community and teamwork. A between groups ANOVA demonstrated significant differences for seven of the eight variables examined. In each case, the in-person format was rated the most positively and the blended exam only format tended to receive the poorest ratings. Overall, our results suggest that live interaction among students, and between students and instructors, whether it is from an in-person format or a blended alternating format, appears to be linked to more positive perceptions of the social learning environment.

Keywords

blended learning, community of inquiry, in-person learning, learning environment, online learning, teamwork, undergraduate students

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Traditionally, education has been largely delivered in an in-person format; however, an increasing number of courses are being delivered entirely online (synchronously or asynchronously) or with a blend of online and in-person components (Harmon and Jones, 1999; Thai et al., 2020), especially in response to COVID-19 in early 2020 when there was a sudden and forced shift to mandatory online learning. Whether a student takes a course in an in-person, online or blended format will have an impact on their learning experiences as these formats vary along several dimensions, such as flexibility, use of technology and quantity and quality of interpersonal interactions and connections (Horspool and Lange, 2012). While previous studies have compared different course formats on student perceptions of the learning enviornment (LE), the findings have been mixed (Blau et al., 2017; Chen and Chiou, 2014; Horspool and Lange, 2012; Khodabandelou et al., 2017; Lafortune and Lakhal, 2020) and we found no studies that compared more than three course formats at a time. The purpose of this study was to compare five different course formats on undergraduate students' perceptions of the LE.

The five course formats we compared were in-person, synchronous online, asynchronous online, blended with alternating weeks and blended exam only. In-person formats are defined as the traditional format in which students attend a weekly class in which they are present at the university with their instructor and peers. Synchronous online formats have some, if not all, of the course content delivered live during a virtual session in which the instructor and students will meet during a scheduled class time via an online platform. Asynchronous online formats deliver all course content asynchronously, through required readings, lecture slides and/or videos, and there is very little, if any, interaction among peers and between students and the instructor. In an alternating blended format, students will alternate each week between the course content being delivered in-person or online (in either a synchronous or asynchronous format). Finally, in a blended exam only format, students may first attend an in-person orientation to the course, but all content is delivered online, most commonly asynchronously and students will only attend in-person sessions to write exams.

Community building and the community of inquiry framework

A sense of community is built within a classroom when students develop a feeling of membership and belonging with their instructor and peers (Yuan and Kim, 2014). Building a strong sense of community has many academic benefits, including increased levels of participation and deep learning, while also having social benefits, such as an increased ability to manage stress and a greater sense of overall well-being (Berry, 2019). In addition, researchers have found that strong feelings of community support knowledge exchange, learning, attachment to group goals and better cooperation and satisfaction with group efforts (Romiskzowski and Mason, 2004; Rovai, 2002a; Rovai and Ponton, 2019; Yilmaz, 2016).

The Community of Inquiry (Col) framework is one of the most popular models used in online LEs (Warner, 2016). The model was first developed by Garrison et al. (1999) and it proposed that for deep learning to occur in an online LE, there must be three presences in the classroom: teaching presence, social presence and cognitive presence (Cleary, 2021). Social presence refers to the ability of learners to portray themselves—socially and emotionally—as real and true people in the LE (Berry, 2019). Social presence is developed through the process of identifying with the community through active and intentional communication that fosters a sense of trust and by developing social relationships (Kreijns et al., 2014). Research has shown that social presence is a key predictor in learning and the level of social presence in a classroom has a direct impact on both the quality of interactions and positive learning outcomes (Bickle et al., 2019). Teaching presence refers to the ability of the instructor to facilitate connections in the classroom using activities or interactions

that support both learning and the development of a sense of community (Cleary, 2021; Rovai, 2007). Cognitive presence is the ability of students to establish meaning through collaboration and reflection (Garrison et al., 1999). It also reflects an instructor's ability to facilitate learning that creates opportunities for student reflection, critical thinking and dialogue. If cognitive presence in the classroom environment is strong, it will result in students feeling like they worked together towards a shared goal (Berry, 2019). Overall, these three presences combine to foster a sense of community within the classroom (Berry, 2019).

The CoI framework has been effectively applied to online (Rubin et al., 2013), blended (Akyol et al., 2009; Berry, 2019) and face-to-face environments (Lafortune and Lakhal, 2020; Warner, 2016). Rubin et al. (2013) applied the framework to online instruction to better understand how the software used in an online course can impact online learning. Results indicated that the technology used was important in facilitating the three presences of a community of inquiry. The authors also found that the ease of finding course materials in a learning management system significantly impacted levels of teaching presence and student satisfaction. Berry (2019) applied the CoI framework to a blended synchronous course format and investigated the strategies that faculty used to build a community within an online course. Four strategies for community building were identified: reaching out to students often and early, limiting the amount of lecture time and increasing discussion, using multiple technical features of the virtual classroom to encourage discussion and allocating class time to share personal and professional updates. Akyol et al. (2009) applied the framework to both an online and a blended course format with the intention of studying the differences in how a community of inquiry develops within these environments. They found that while both course formats successfully developed each presence, there were developmental differences in the presences between the two formats. For social presence, affective expression was found more prominently in online courses compared to blended courses and group cohesion was found more prominently in blended courses. For cognitive presence, results found that the integration phase was the most frequently reported phase for both formats; however, this phase was found more frequently in the blended format compared to online format, while the exploration phase was found more frequently in the latter. Akyol et al. (2009) also found that students in a blended course had significantly higher perceptions of teaching presence compared to students in an online course.

Other researchers have successfully applied the CoI framework to face-to-face environments (Lafortune and Lakhal, 2020; Warner, 2016). Warner (2016) applied the COI framework to a course structured around matrixed teams, which involved students being assigned specific roles within a team while also collaborating with individuals across groups who shared their role. Warner found that both participation in the class and the quality of written work increased after implementing a community inquiry-based approach to the course. Lafortune and Lakhal (2020) conducted a study in which a course was taught with one group attending via the internet while another group of students participated in-person. They found significant differences between the two formats for only one of the presences, teaching presence, with the students in the face-to-face setting perceiving a higher level of teaching presence compared to the online group.

Teamwork in educational settings

Teamwork is a common activity in educational settings and involves small groups of students (commonly 2–4 students) working together on a common goal or task. These team-based activities can range from small group discussions during a single class to substantial projects that may last several weeks to an entire semester. Through teamwork, students are able to enhance their learning and develop important interpersonal skills through their interactions with their

peers (Adams and Hamm, 1994). There are numerous benefits of teamwork, including improved academic performance (Gabbert et al., 1986; Roseth et al., 2008), increased exposure to varied experiences and perspectives (West, 1996), the development of trust (Feitosa et al., 2020) and improved mental health and social competence (Strom and Strom, 2011). Despite these benefits, not all students like working in teams. In a study exploring university students' attitudes towards teamwork, Hillyard et al. (2010) found that all participants had engaged in teamwork at some point in their schooling with nearly 50% of their sample reporting that almost all their courses had a teamwork component. Only about half of their sample felt that working in teams enhanced their learning and that their peers were prepared for working on the project. Discouragingly, only 15% reported that all members of the team contributed equally to the team project and one-third reported that their teamwork experience had been mostly positive. Showing lowered motivation and effort during a team project (known as social loafing) is common when students work in teams (Karau and Williams, 1993) and levels of social loafing may be impacted by the way a course is delivered and the opportunities that students have to interact with one another.

Teamwork in both online and in-person formats share similar characteristics, including making equal commitments, sharing ideas and responsibilities, sharing the desire in getting to know their team members (Saghafian and O'Neill, 2018) and instance of social loafing and free-riding (Konak et al., 2019) However, there are also important differences between online and in-person formats. One, individuals taking part in online teamwork and classes show a much weaker sense of connectedness among team members (Rovai et al., 2005; Saghafian and O'Neill, 2018). Two, weaker communication and lower levels of individual accountability have been described as negative factors experienced by individuals involved in online teamwork learning (Tseng and Yeh, 2013). Three, knowledge sharing has also been shown to be challenging in online formats due to the scattering of knowledge among geographically distributed team members in the absence of traditional face-to-face interactions (Alsharo et al., 2017). Finally, trust among virtual team members has been noted as a challenge due to the absence of proximity between team members (Alsharo et al., 2017). Despite these challenges of online group work, one advantage that has been noted is an efficiency in task-oriented discussion during team meetings with students being able to accomplish their goals in a shorter time frame (Saghafian and O'Neill, 2018). Students believed that solely focussing their discussions on their assigned groupwork would allow them to have more time to focus on their studies.

Purpose of the present study

In this study, we aimed to further apply the CoI framework to varying class formats (in-person, blended-alternating, blended-exam only, asynchronous online and synchronous online) and explore potential differences among these class formats in the three Col presences, sense of community, and perceptions of teamwork among an undergraduate student sample. The key research questions addressed in this study were:

1. Are there differences in the sense of community (connections and learning) among the five class formats?
2. Are there community of inquiry presence (teaching, social, cognitive) differences among the five class formats?
3. Are there differences in attitudes towards teamwork among the five class formats?
4. Are there differences in perceived social loafing among the five class formats?

Methods

Participants

Undergraduate students were recruited for this study via MTurk, Reddit, survey exchanges and our university's subject pool within the psychology department. A total of 128 respondents were initially recruited through MTurk by posting the study on the MTurk site and paying participants $1 for their participation. After data cleaning and removing invalid responses (i.e. failed attention checks and incomplete surveys) we were left with a total of 52 usable respondents from this source. A total of 172 respondents were recruited through the other three avenues by posting a description of the study and a link to the online survey on each site and after data cleaning we retained 117 respondents. Students recruited through our university's subject pool received bonus credit for their participation and no compensation was provided to participants recruited through Reddit and the survey exchanges. At the conclusion of the survey, participants were asked if they would be willing to complete the survey a second time for a different class format (if they were taking multiple classes in multiple formats). A total of 65 participants consented to completing the survey a second time and after data cleaning (i.e. incomplete surveys, completing survey again for same course format) we had 31 usable responses. Overall, this gave us a final sample size of 200. Of these 200 responses, 64 represented an in-person course format, 49 an asynchronous online format, 31 a synchronous online format, 31 an alternating blended format and 24 a blended exam only format. One respondent did not indicate a course format and had to be removed. See Table 1 for descriptive statistics for the participants in each of these class formats.

Table 1. Participant demographics for the five course formats.

	In-person ($n=64$)	Asynchronous online ($n=49$)	Synchronous online ($n=31$)	Alternating blended ($n=31$)	Blended exam only ($n=24$)
Age—*M* (SD)	27.67 (9.10)	24.75 (6.60)	23.96 (8.14)	27.77 (9.09)	24.33 (5.31)
Gender					
Female—*n* (%)	36 (56)	29 (59)	15 (48)	15 (48)	16 (67)
Male—*n* (%)	18 (28)	7 (14)	8 (26)	10 (32)	5 (21)
Other—*n* (%)	1 (2)	1 (2)	2 (6)	1 (3)	0 (0)
Missing—*n* (%)	9 (14)	12 (25)	6 (19)	5 (16)	3 (13)
Ethnicity					
White—*n* (%)	28 (44)	13 (27)	14 (45)	12 (39)	5 (21)
South Asian—*n* (%)	11 (17)	13 (27)	5 (16)	6 (19)	7 (29)
Southeast Asian—*n* (%)	4 (6)	5 (10)	1 (3)	4 (13)	3 (13)
Other—*n* (%)	12 (19)	5 (10)	5 (16)	4 (13)	6 (25)
Missing—*n* (%)	9 (14)	13 (27)	6 (19)	5 (16)	3 (13)
International student					
Yes—*n* (%)	16 (25)	6 (12)	12 (39)	12 (39)	6 (25)
No—*n* (%)	39 (61)	31 (63)	13 (42)	14 (45)	15 (63)
Missing—*n* (%)	9 (14)	12 (25)	6 (19)	5 (16)	3 (13)
Programme					
Psychology—*n* (%)	26 (41)	26 (53)	7 (23)	7 (23)	12 (50)
Other—*n* (%)	18 (28)	10 (20)	15 (48)	13 (42)	5 (21)
Missing—*n* (%)	20 (31)	13 (27)	9 (29)	11 (35)	7 (29)

(Continued)

Table 1. (Continued)

	In-person ($n=64$)	Asynchronous online ($n=49$)	Synchronous online ($n=31$)	Alternating blended ($n=31$)	Blended exam only ($n=24$)
Year of study					
First—*n* (%)	2 (3)	5 (10)	5 (16)	2 (7)	0 (0)
Second– *n* (%)	14 (22)	10 (20)	5 (16)	4 (13)	6 (25)
Third—*n* (%)	19 (30)	9 (18)	8 (26)	7 (23)	8 (33)
Fourth—*n* (%)	15 (25)	6 (12)	4 (13)	11 (36)	4 (17)
Fifth or higher—*n* (%)	4 (6)	7 (14)	3 (10)	2 (7)	3 (13)
Missing—*n* (%)	9 (14)	12 (25)	5 (19)	5 (16)	3 (13)
Courses					
1–3—*n* (%)	34 (53)	21 (43)	12 (39)	19 (61)	11 (46)
4 or more—*n* (%)	21 (33)	16 (33)	13 (42)	7 (23)	10 (42)
Missing—*n* (%)	9 (14)	12 (25)	6 (19)	5 (16)	3 (13)
Employment					
Not employed—*n* (%)	11 (17)	12 (25)	3 (10)	3 (10)	3 (13)
Part-time (1–29 hours) —*n* (%)	27 (42)	16 (33)	14 (45)	11 (35)	10 (32)
Full-time (30+ hours) —*n* (%)	17 (27)	8 (16)	8 (26)	12 (39)	8 (33)
Missing—*n* (%)	9 (14)	13 (27)	6 (19)	5 (16)	3 (13)
Country					
Canada—*n* (%)	33 (51)	32 (65)	11 (35)	12 (39)	14 (58)
USA—*n* (%)	16 (25)	3 (6)	8 (26)	13 (42)	6 (25)
Other—*n* (%)	5 (8)	0 (0)	6 (19)	1 (3)	1 (4)
Missing—*n* (%)	10 (16)	12 (24)	6 (19)	5 (16)	3 (13)

Psychology was the only programme with at least 5% representation in each of the course formats.

Measures

Classroom community. The 20-item Classroom Community Scale (Rovai, 2002a) assessed participants' sense of community in their classroom. This scale is composed of two subscales—connectedness and learning—with 10 items in each subscale. A higher score on the connectedness subscale refers to a greater feeling of social belonging within the classroom. A higher score on the learning subscale indicates a greater sense of social connection in the joint pursuit of learning and meeting educational goals/expectations. Participants responded to each item using a five-point scale ranging from 'Strongly Agree' to 'Strongly Disagree'. Coefficient alpha for the connectedness subscale was 0.85 and for the learning subscale was 0.70.

Community of inquiry. The 35-item Community of Inquiry Survey (Arbaugh et al., 2008) was used to assess the three dimensions of cognitive presence, social presence and teaching presence. The cognitive presence subscale consists of 12 items with a higher score indicating that students perceive the course content in their course format engaging. The social presence subscale consists of nine items with a higher score indicating a greater sense of feeling like a real person within the environment. The teaching presence subscale consists of 13 items with a higher score indicating

a greater level of planning and involvement by the course instructor. Participants responded to each item using a five-point scale ranging from 'Strongly Agree' to 'Strongly Disagree'. Coefficient alpha for each subscale was as follows: cognitive presence = 0.91, social presence = 0.88, teaching presence = 0.93.

Attitudes towards teamwork. The 14-item Teamwork Expectations and Attitudes Measure (Justus et al., 2021) assessed student perceptions of how effectively they worked together with their peers on a group-based task or project. A higher score on this scale indicates a more positive perception of their team and its functioning. Participants responded to these items on a 5-point scale ranging from 'Strongly Disagree' to 'Strongly Agree'. Coefficient alpha for this scale was 0.96.

Social loafing. The 6-item Social Loafing scale (Dommeyer, 2007) assessed whether an individual in a group was idling during a group project. A higher score on this scale indicates a greater perception of social loafing among team members. Participants responded to these items using a 7-point scale ranging from 'Strongly Disagree' to 'Strongly Agree'. Coefficient alpha for this scale was 0.94.

Course satisfaction. A single 7-point rating scale item was used to measure students' overall satisfaction with their course: 'Overall, how satisfied are you with this course?'. Responses to this item ranged from 'Not at all satisfied' to 'Totally satisfied'.

Procedure

After receiving ethical approval from our university's research ethics board, data was collected anonymously and online using Qualtrics. Data was collected between October 17 and December 10, 2021, which covers the middle to end of the semester. Prior to accessing the survey, students provided electronic consent. Next, students indicated the course format and course they were completing the survey for. They then completed the five dependent variable measures in the following order: Classroom Community Scale, Community of Inquiry Instrument, the single satisfaction item, the Teamwork Expectations and Agreement Measure and the Social Loafing Scale. Finally, participants completed a set of demographic questions. At the end of the survey, students were asked if they would be willing to complete the survey again for a second course format. If no, the survey ended. If yes, they were asked to indicate the second course format and class and then complete the five dependent measures a second time. MTurk participants were then awarded compensation for their participation and students from the subject pool were awarded bonus credit. Students recruited via Reddit and survey exchanges did not receive any compensation.

Analysis

Between groups ANOVAs were used to examine differences among the five class formats for each research question. Prior to these analyses, normality was assessed by examining Q-Q plots and homogeneity of variance was assessed using Levene's test. If the homogeneity of variance assumption was met, a Tukey post hoc tests was used if the ANOVA was statistically significant. If this assumption was violated, a Welch correction was used for the overall ANOVA and a Games-Howell

post hoc test was used if the ANOVA was statistically significant. Effect size was calculated using eta-squared, with 0.01 indicating a small effect, 0.06 a medium effect and 0.14 a large effect (Cohen, 1988).

Results

While moderate departures from normality were found for the teaching presence, cognitive presence and TEAM scales, Blanca et al. (2017) have demonstrated that ANOVA is robust to such violations. The assumption of homogeneity was met for all of the scales, with the exceptions of the social presence and TEAM scales. A Welch correction and Games-Howell post hoc test was used to account for these violations.

Next, we conducted a series of between-groups ANOVAs to compare the five different course formats on the eight aspects of the LE. See Table 2 for the means, standard deviations and ANOVA results for these analyses. As seen in this table, seven of these variables showed statistically significant differences with medium to large effect sizes. For the connectedness scale, a post-hoc Tukey analysis revealed that in-person courses facilitated significantly more social connection between students in the classroom compared to courses using a blended-exam ($t(194) = 3.19$, $p = 0.014$), online-asynchronous ($t(194) = 7.09$, $p < 0.001$) and online synchronous format ($t(194) = 4.39$, $p < 0.001$). In addition, the blended-alternating course format significantly facilitated more social connection compared to the online asynchronous course format ($t(194) = 4.11$, $p = 0.001$). There were no statistical differences between the other course formats ($p = 0.138$–0.949). For the learning scale, the post-hoc analysis revealed that the in-person format was rated higher than the blended-exam format at fostering the interactions and feelings that make students feel that their educational needs are being met by the course ($t(194) = 3.98$, $p = 0.001$). There were no statistical differences between the other course formats ($p = 0.069$–0.995). For the teaching presence scale, follow-up analyses indicated that in-person course formats had significantly higher levels of teaching presence compared to courses that used a blended exam format ($t(194) = 3.86$, $p = 0.001$). There were no statistical differences between the other course formats ($p = 0.069$–1.000). For the cognitive presence scale, follow-up analyses revealed that the in-person course format also had significantly higher levels of cognitive presence than courses using a blended-exam ($t(194) = 4.47$, $p < 0.001$), online-synchronous ($t(194) = 2.85$, $p = 0.038$) and online-asynchronous format ($t(194) = 3.38$, $p = 0.008$). There were no statistical differences between the other course formats ($p = 0.120$–1.000). For the social presence scale, a post-hoc Games-Howell analysis indicated that courses that used an in-person format had higher levels of social presence compared to courses using a blended-exam ($t(35) = 2.91$, $p = 0.047$), online-synchronous ($t(57) = 2.83$, $p = 0.048$) and online-asynchronous course format ($t(79) = 4.76$, $p < 0.001$). There were no statistical differences between the other course formats ($p = 0.095$–0.978). For the single-item on overall course satisfaction, a post-hoc analysis found that course satisfaction was lower in the blended exam format compared to both the in-person course format ($t(193) = 3.90$, $p = 0.001$) and online-asynchronous formats ($t(193) = 2.99$, $p = 0.026$). There were no statistical differences between the other course formats ($p = 0.095$–0.978). For the TEAM scale, a follow-up Games-Howell post-hoc test indicated that students held more positive attitudes towards teamwork in an in-person course format compared to the online asynchronous course format ($t(74) = 3.00$, $p = 0.030$). There were no statistical differences between the other course formats ($p = 0.109$–1.000). Finally, for the social loafing scale, there were no statistically significant differences among the five course formats.

Table 2. Means, standard deviations and ANOVA results for eight dependent variables by course format.

Scale	In-person		Synchronous online		Asynchronous online		Alternating blended		Blended exam only		*F*	*p*	η^2
	M	SD	*M*	SD	*M*	SD	*M*	SD	*M*	SD			
Connectedness	3.77[a,b,c]	0.53	3.19[b]	0.67	2.95[c,d]	0.61	3.53[d]	0.65	3.31[a]	0.68	13.97	<0.001	0.22
Learning	4.13[a]	0.38	3.91	0.33	3.95	0.40	3.99	0.49	3.77[a]	0.25	4.64	0.001	0.09
Teaching presence	4.20[a]	0.52	3.80	0.86	3.89	0.73	3.83	0.78	3.55[a]	0.75	4.60	0.001	0.09
Social presence	3.80[a,b,c]	0.61	3.42[b]	0.64	3.09[c]	0.91	3.55	0.72	3.31[a]	0.75	7.13	<0.001	0.13
Cognitive presence	4.02[a,b,c]	0.50	3.63[b]	0.61	3.62[c]	0.74	3.70	0.67	3.36[a]	0.63	6.25	<0.001	0.11
Course satisfaction*	5.68[a]	1.27	5.29	1.55	5.41[b]	1.40	5.29	1.60	4.33[a,b]	1.61	3.85	0.005	0.07
TEAM	3.91[a]	0.59	3.58	0.72	3.46[a]	0.88	3.88	0.66	3.50	1.03	3.37	0.011	0.07
Social loafing*	4.09	1.66	3.98	1.23	3.56	1.41	4.03	1.60	4.25	1.68	1.12	0.349	0.02

a-dMeans with the same superscript in the same row differ significantly.
*Rated on a 7-point scale. All other variables rated on a 5-point scale.

Discussion

The formats in which courses are being delivered for undergraduate students is increasingly expanding and changing, due in large part to advances in technology, but, also more recently, in response to COVID-19 and the mandated online learning that was put in place for a time. Thus, in addition to the traditional in-person format, students can take courses that have various online elements—ranging from fully online to blended formats (Harmon and Jones, 1999; Thai et al., 2020). In this study, we compared five course formats—in-person, synchronous online, asynchronous online, alternating blended and blended with in-person exams—on students' perceptions of the LE and teamwork.

In first looking at patterns among the means for the LE variables, the in-person class format was rated highest on all variables, except for social loafing. The alternating blended format was rated second highest on nearly all variables. This is noteworthy as it is only these two class formats that have the teaching of content, and interaction among peers and instructors, occurring in person, in some, or all, of the classes, suggesting that this live interaction may be an important element of a positive LE. The blended exam only format tended to be the lowest rated format, with the asynchronous online format also receiving lower ratings. These two formats likely had the least interactively among students.

In general, all variables across all formats were rated above the midpoint of the scales. The only exception to this was the asynchronous online format for the connectedness variable, indicating the students in this class format did not perceive a strong sense of community with their peers.

Perceptions of the learning environment

In looking at the results of our LE variables, we found that in-person courses facilitated a greater sense of social belonging compared to courses that used a blended-exam, online-asynchronous or online synchronous format and that courses that used a blended-alternating approach facilitated more social connection than courses using an online asynchronous format. These results make sense considering that in-person and blended alternating courses have the most live interaction amongst individuals, and, as noted by Rovai (2002b), one key reason that classroom communities can be weak is because of a lack of interaction. Previous literature also suggests that a blended alternating approach is effective at supporting a strong community in the classroom (Chen and Chiou, 2014). Interestingly, Chen and Chiou (2014) found that those in a blended environment reported a stronger sense of community compared to students in a face-to-face environment. They explained this may be because the blended students were spending more time in online discussions, which allowed the students to express their ideas, discuss progress and connect with each other in an alternative way. While we did not find a difference between blended-alternating and in-person formats, it is encouraging to see that the blended-alternating approach can support a sense of community and promote feelings of belonging for students. Thus, not only do students retain the advantage of social connection during the in-person sessions, they also have the advantage of added flexibility during the online sessions every second week. For the learning subscale, we found that the in-person format, compared to the blended exam format, was better at fostering the interactions that make students feel connected during their joint pursuit of learning and satisfying their educational needs (Rovai, 2002a). This means that students taking an in-person course are being provided the opportunity to interact with each other in a meaningful way that satisfies their educational needs, while the blended-exam format is failing to provide these interactions, likely given that the only time students interact with one another in class is during an exam session when students are likely to be stressed.

In looking at the results for cognitive, social and teaching presence, we found class format differences for all three. Both cognitive and social presence was rated higher for in-person formats compared to blended-exam, online-synchronous and online-asynchronous course formats. For cognitive presence, this suggests that in-person courses appear to be better at allowing students to establish meaning through collaboration and allow teachers to better create opportunities for reflection, critical thinking and dialogue (Garrison et al., 1999). This is likely due to the in-person courses make it easier to collaborate with other students and allowing students to more freely engage in reflection and critical thinking as they cannot just hide behind a screen. Being in the classroom likely forces students to participate in this process more actively. For social presence, our findings were in line with Zhan and Mei (2013) who found that face-to-face courses have higher levels of social presence compared to online courses. Zhan and Mei (2013) suggested these findings are due to students being able to directly interact in a face-to-face environment and also use body language which could increase the level of perceived social presence. Kim et al. (2011) have found that interactivity is a significant predictor of social presence. In contrast to our findings, Lafortune and Lakhal (2020) did not find any significant differences in the level of social presence between students attending the synchronous class session in-person versus online. Therefore, there is also evidence that online environments may also be able to facilitate similar levels of social presence to that of an in-person course.

Teaching presence was found to be higher for students in the in-person courses compared to the blended-exam format. This means that in-person courses appear to be better at allowing teachers to effectively facilitate connections in the classroom, through activities or interaction, that supports students in learning and developing a sense of community (Cleary, 2021; Rovai, 2007). While previous literature has found differences in teaching presence between online and in-person formats (Akyol et al., 2009; Lafortune and Lakhal, 2020), we did not find this in our study. One explanation for the lack of difference could be that teachers have become better at facilitating connections and implementing activities that support learning in an online environment and developing a sense of community (Cleary, 2021; Rovai, 2007). It is possible that the differences found previously between online and in-person (e.g. Akyol et al., 2009; Lafortune and Lakhal, 2020) could have been a result of lack of experience or knowledge on how to facilitate the connections or activities that lead to high levels of teaching presence. It is also possible that with the pandemic and prolonged shift to online learning students have become more used to being online and teachers have become more effective at teaching online.

For overall course satisfaction, students in blended-exam courses reported lower satisfaction than both students in in-person courses and asynchronous courses. We think this is due to the fact that the blended-exam format had significantly lower levels of all three of the community of inquiry presences compared to in-person formats. The blended-exam format likely lacked the interactions needed to foster a sense of community within the classroom. This is consistent with a study by Ocker and Yaverbaum (2001) who also showed students expressed greater satisfaction in an in-person setting compared to an asynchronous setting. While an asynchronous format provides greater flexibility for students, having to come to campus for exams in the blended exam format likely served as an additional source of stress for students given that their fully asynchronous counterparts were able to complete exams online (and likely in an open book format).

Perceptions of teamwork and social loafing

In examining student perceptions of teamwork across the five different course formats, students taking in-person courses reported more positive attitudes towards working effectively as a team compared to the asynchronous online courses. This could likely be due to the increased proximity

of team members as these two course formats differ the greatest in terms of live interactions, and level of interaction has been shown to influence the team members accountability for accomplishing goals (Alsharo, 2014). In a study conducted by Konak et al. (2019), students believed that teamwork in online settings did not replicate the experience in in-person settings. It was also believed by these students that having teamwork online was unnecessarily complicated compared to having it in person. Indeed, these negative attitudes may stem from further issues such as communication and trust (Tseng and Yeh, 2013).

Social loafing showed no significant differences among the class formats; all formats reported the presence of some social loafing. These results are consistent with those of Konak et al. (2019) who developed a conceptual model that investigated the relationships among students' engagement, attitudes towards teamwork, teamwork self-efficacy and interest. These authors also found that online and in-person course formats faced similar percentages of social loafing and free riders. Furthermore, they noted that the main difference in themes between the two formats was their perceptions of teamwork; students believed that online teamwork was not comparable to in-person teamwork, which ultimately altered their learning experience. Furthermore, students also believed that working collaboratively in an online environment was not reflective of real-life scenarios (Konak et al., 2019).

To reduce social loafing, various strategies have been mentioned. One, George (1992) stated that individuals contributing to a collaborative task should consider increasing task significance, task meaningfulness and contribution. Second, increasing the exchange of information such as skills or expertise between group members as well as learning from prior mistakes and initiating constructive team discussions has been noted as effective in reducing social loafing (Gabelica et al., 2022). Finally, investing time to develop a team strategy that facilitates familiarity among team members as well as decreasing the number of team members in a group have also been mentioned by various authors (Buchs et al., 2016; Gabelica et al., 2022).

Limitations and future directions

There are some limitations of this study that need to be mentioned. One, for the two versions of the blended class formats, it is unknown whether the online sessions were synchronous or asynchronous, or a combination of the two. Additionally, for the synchronous and asynchronous class formats, there is still likely variability in how these classes were delivered. Two, students in this study responded to the survey questions based on a variety of different courses, instructors and at different points in the semester and these factors likely have an impact on their learning experiences and perceptions of the classroom environment. Future research could look to explore this topic under more standardised conditions or to further investigate the impact of these extraneous factors in course content, delivery method and teaching. For example, a study by Fiock et al. (2021) demonstrated the impact of the instructor on teaching presence among sections of the same course taught by different instructors. Third, these results are largely based on the findings from a single institution of undergraduate students. While MTurk was used to recruit participants to increase the generalisability of the findings, challenges in the quality of the MTurk data (e.g. bots, failed attention checks) resulted in most of this data needing to be discarded. Future research may also want to replicate these findings within a graduate student population. These two populations differ in their educational experiences in terms of breadth of content covered, workload, expectations, which could impact their perceptions of the LE. Fourth, these results are based on the self-reported student perceptions of the LE and may not fully reflect their actual behaviours in the classroom. Fifth, for the 31 participants (16% of the sample) who completed the survey twice, including them in the analysis does represent a violation of the independence assumption. However, analyses conducted

without these 31 participants produced similar results. Finally, as the focus of our study was mostly on social outcomes, future research may want to examine the impact of course format on learning outcomes.

Conclusion

As we transition away from social distancing and isolation, it is important to remember that we, as humans, are social animals and social interaction is important for our health and mental well-being (Snyder-Mackler et al., 2020). In support of this, Nitschke et al. (2021) found that increased social connectedness during the COVID-19 pandemic was associated with reduced feelings of stress and anxiety, and that having larger social networks was linked with greater social support. One way to help students develop their social networks is through interactions with their peers and instructors. Through the comparison of five different instructional formats on a variety of LE variables, we have demonstrated that students who were in classes that typically have higher levels of interaction (i.e. in-person formats) report more engagement, higher satisfaction and a greater sense of community and presence in their classes. This suggests that there may be an important sense of connection that students develop with their peers and instructors during in-person interactions that may not be fully replicable in online classroom environments. Tharayil et al. (2018) outline a number of strategies for promoting interactions and mitigating resistance to active learning within the classroom.

Based on the results of this study, the level of interactions appears to influence students' motivation and perceptions of the social elements of the LE. Building a stronger sense of connection has both academic benefits, including increased levels of participation and deep learning, as well as social benefits, such as increased rapport, a greater ability to manage stress and a greater sense of overall well-being (Berry, 2019). Greater motivation and engagement are also linked to a greater likelihood of completing a course or degree programme (Xerri et al., 2018). Relatedly, the two least interactive class formats—blended exam only and asynchronous online—were rated the most poorly on many of the LE variables we examined. This suggest that instructors should potentially consider avoiding these latter two course formats in favour of formats that have more engagement and interaction. Overall, we would recommend that instructors give preference to in-person formats over fully online formats given that this format appears to promote the greatest sense of belonging and interaction for students. While fully in-person format had the most positive ratings of the LE overall, the blended alternating approach was also well-received by students and could be another strong option for instructors. The advantage of the blended approach is that it incorporates both live interaction during the in-person sessions, which helps to promote social presence (Lafortune and Lakhal, 2020), but also maintains some flexibility for students during the online sessions, which is often reported as a key advantage of online courses (Thai et al., 2020).

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Supplemental material

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