Do zoom meetings really help? A comparative analysis of synchronous and asynchronous online learning during Covid-19 pandemic

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\textbf{Abstract}

\textbf{Background:} Online learning and teaching were globally popularized due to the impact of Covid-19. The pandemic has made both synchronous and asynchronous online learning inevitable in regions privileged with the technological affordance.

\textbf{Aims:} This study was designed to examine and compare the effectiveness of both learning modes through the Community of Inquiry framework.

\textbf{Materials & Methods:} Comparative analyses on a sample of \(N=170\) undergraduate students who took both synchronous and asynchronous online courses in Spring 2021.

\textbf{Results:} The paired-sample T-tests results indicated a significant difference in social presence, cognitive presence and self-evaluated performance.

\textbf{Discussion & Conclusion:} Teaching presence significantly influenced social presence and cognitive presence in both learning modes. However, under synchronous learning mode, social presence significantly impacted self-evaluation, grades and school identification. While social presence only influenced school identification under asynchronous learning mode. Theoretical and practical implications were also included.

\textbf{KEYWORDS}
asynchronous online learning, community of Inquiry, coronavirus, online education, synchronous online learning, virtual learning

Due to the Covid-19 pandemic that swept across the globe starting in late 2019, students and educators all over the world were forced to shift their learning and teaching experience (Onyema et al., 2020). Some were forced to temporarily stop or shift to homeschooling. Some institutions creatively adopted outdoor social-distanced teaching to avoid getting students in crowds. For countries and regions that were privileged with technological affordance, online teaching and learning were popularized due to the circumstances. However, different online learning modes were adopted to combat the difficulties placed on by the pandemic. Platforms like Zoom, WebEx, and Microsoft Teams that enable synchronous online learning were used nationally. These tools allow educators and students to meet in virtual classrooms at the same time, simulating real-time conversations and discussions. Platforms like Canvas and Blackboard are online course management tools that not only were useful before the pandemic but also were incredibly helpful in hosting online asynchronous courses. These courses typically do not require synchronous class meetings. Students were able to access course materials and submit assignments through Canvas and Blackboard. Educators can distribute course materials, post announcements, and instructions, and grade student works directly on these platforms.

Before the pandemic, online learning and teaching have received some scholarly attention. While previous research has explored the effectiveness of online learning, most research was centered around asynchronous online courses (e.g., Akyol & Garrison, 2011). The pandemic had forced institutions and organizations to adopt synchronous meetings as part of their online communication. However, few research have been dedicated to the study of the process and effectiveness of such online communication. Through the lens of the Community of Inquiry framework (Garrison et al., 2000) the current study...
aims to fill this research gap by comparing synchronous and asynchronous online learning during the pandemic to deconstruct the learning experience of both class modes. By recruiting students that were enrolled in BOTH modes of classes, this research offers an important empirical examination of the effectiveness of synchronous and asynchronous online learning. By incorporating self-reported performance, grades, and identification with the attended institution as three learning outcomes in the research model, the study aims to extend the Community of Inquiry framework by enlarging the scope of learning experience and effect research in the long-term contexts.

1  |  LITERATURE REVIEW

1.1  |  Community of Inquiry Framework

Community of Inquiry (CoI) research framework was first developed to study online learning experiences from a collaborative and constructive perspective (Garrison et al., 2000). The learning experience was conceptualized to be impacted by three presences: teaching presence, social presence, and cognitive presence. Teaching presence described the students’ perceived course organization and instructions provided to students by either instructors or by fellow peers. Social presence describes the extent to which the students are able to present themselves as “real people” in the online course environment. Cognitive presence describes the extent to which students are able to construct meanings out of the course communication (Garrison & Arbaugh, 2007). Ever since the measure of CoI has been developed (Arbaugh et al., 2008), scholars globally have tested and confirmed the rigour of the research framework (e.g., Shea & Bidjerano, 2010). Researchers found that the three learning presences mentioned above was influencing students’ satisfaction with online courses (Rubin et al., 2013), course grades among graduate students (Rockinson-Szapkiw et al., 2016) and undergraduate students (Mercado & Zhang, 2021a), and self-regulation and motivation (Kills & Yildirim, 2018). Within the research framework, the relationship among the learning presences has been explored. Garrison et al. (2010) have found that teaching presence is significantly influencing social presence and cognitive presence, and social presence is significantly impacting cognitive presence.

Most research was focused on asynchronous online learning (e.g., Joo et al., 2011) as it offers a great amount of flexibility for students’ time schedule, which extended the scope of higher education to include students who would otherwise be unable to attend traditional daytime institutions. However, the pandemic has increased the use of both asynchronous and synchronous online learning in an inevitable way for numerous institutions and businesses. In fact, over the years of people living under the influence of the pandemic, people have been forced to get familiar with having synchronous meetings for both academic and business reasons. The potential impact and foreseeable future usage of synchronous communication tools have made it a critical task to explore and understand the differences in the learning process between the asynchronous and synchronous online courses.

1.2  |  Asynchronous and synchronous online learning

The mode of online learning varies based on the format and intensity of communication between educators and students. Typically, it can be separated into two categories: synchronous and asynchronous learning. Both of these learning modes require multiple learning presences featured in the Community of Inquiry Framework to be highlighted in order to best benefit the students. This is especially prevalent when noting that the face-to-face learning modality allows for teaching and social presence to be seamlessly present within all portions of the course. For online learning modalities, instructors must work to open lines of communication both between themselves and students as well as between students and their fellow peers in order to optimize the CoI framework (Ruetet et al., 2019). Research has shown that the CoI framework significantly predicts the final course outcomes of students participating in online learning (Rockinson-Szapkiw et al., 2016). As such it is crucial that presences within the CoI framework are being actively utilized to maximize student learning.

Synchronous online learning occurs when students are taking part in a class lesson in real-time as it is being taught. This allows students to actively participate in real-time discussions and work on their social presence of CoI during class time. Students and educators can communicate with one another as the course is occurring, allowing for classes to be discussion-based with student-led conversations. While all aspects of CoI are important, in virtual classroom settings teaching presence is the most prevalent indication of a positive course outcome (Szeto, 2015). The ability of teachers to facilitate discussions in real time may be an important factor in both student self-satisfaction as well as final course grades. While teaching presence impacts a student’s ability to engage within a class, engagement is also dependent on the technology that each individual student has available to them. Research has shown that the type of technology students has at their disposal may have a greater impact on the end of course outcomes than the CoI framework (Rubin et al., 2013).

Asynchronous online learning is any form of online learning where the communication of both learning and instruction are not occurring at the same time. This can include but is not limited to: watching pre-recorded lessons, viewing slide presentations, or having discussion work done at varied times. Online learning is consistently viewed as the more flexible method of classroom learning allowing students to work at their own pace. Research done by Allen and Seaman (2011) showed that roughly 80% of students believed online learning to be “superior” or “somewhat” superior at allowing students to use their time more flexibly and work at their own pace. This flexibility may impact students’ end of course outcomes and retention rate throughout the semester as research shows that students who completed courses via asynchronous online learning have a higher rate of passing their courses than students who completed synchronous online courses (Giesbers et al., 2014). Student self-reported satisfaction at the conclusion of online courses however was found to be
roughly the same for students in both asynchronous and synchronous online courses (Giesbers et al., 2014).

### 1.3 Learning experience and Students’ identification

Apart from grades and students’ self-evaluation of what they have learned from the classes in college and universities, another outcome of their learning experience is students’ identification with their academic institutions. Student identification refers to the bonding or attachment experienced by a student due to a sense of belonging and valuing of the attended academic institution and the related outcomes of attending (Voelkl, 1997).

Students’ identification not only can be of great value to the students as it brings sense of belongingness and/or pride but also to the academic institutions in increasing recruitment of new students and donations from alumni (Stephenson & Yerger, 2014). Students with higher identification with their academic institutions are more likely to engage in school-related activities and thus have a higher chance of gaining meaningful experience and achieving more academic goals, which leads to a higher chance of graduation (Mitchell et al., 2018). Stephenson and Yerger (2014) found out that alumni identification with university/college can influence their decision to donate, the amount of donation dollar amount, and the number of times they donate.

Students’ identification with their attended academic institutions can be influenced by a series of factors. To a student, his or her identification with the academic institution can be derived from a good relationship with their teachers or professors (Roorda et al., 2011), positive interactions and group support (Bizumic et al., 2012) from peers from the same courses (Hanushek et al., 2003), fun or meaningful activities on campus, and/or a safe and comfortable environment provided by the academic institution (Cornell & Mayer, 2010). Through a meta-analysis of 99 studies, Roorda and colleagues found that affective teacher-student relationships significantly influenced students’ engagement and school-related achievements (Roorda et al., 2011). Bizumic et al. (2012) studied the influence of both personal and group factors on students’ identification in a longitudinal setting and found that perceived group support significantly predicted students’ school identification over time. Wehlage (1989) emphasized how student identification with academic institutions could be influenced by a psychological sense of membership. This membership can be the result of receiving supportive feedback from teachers and agreeing to the values of the school. Trust is also an important element in students’ identification. Through a survey of 5441 students, Mitchell et al. (2018) found out that student trust in teachers is a positive predictor of their identification with their academic institutions.

Previous research indicates that students’ experience inside and outside of the classroom is closely related to their identification with their attended academic institutions. Drawing from the Community of Inquiry framework, this study aims to find out how students’ teaching presence, social presence, and cognitive presence within an online synchronous or asynchronous classroom influence their identification with attended academic institutions.

### 1.4 Research question and hypotheses

Based on previous research in synchronous and asynchronous online learning, the Community of Inquiry framework, and students’ identification, the following research questions and hypotheses were posed and the research model was constructed (See Figure 1).

**RQ 1**: Do students have a significantly different learning experiences and outcomes in synchronous and asynchronous online classes during the pandemic?

**Hypothesis 1.** Students experienced significantly higher (a) social presence, (b) teaching presence and (c) cognitive presence in synchronous online classes compared with asynchronous online classes.

**Hypothesis 2.** Students have significantly higher (a) self-evaluated performance and (b) grades in synchronous online classes compared with asynchronous online classes.

**Hypothesis 3.** Compared with asynchronous online classes, students’ teaching presence in synchronous online classes has a significantly higher influence on their (a) social presence and (b) cognitive presence.

**Hypothesis 4.** Compared with asynchronous online classes, students’ social presence in synchronous online classes has a significantly higher influence on their cognitive presence.

**RQ 2**: How do students’ learning experiences contribute to their self-evaluated performance in the class, grades, and identification with their undergraduate institution in synchronous and asynchronous learning modes?

**Hypothesis 5.** Compared with asynchronous online classes, students’ social presence in synchronous online classes has a higher significant influence on (a) self-evaluated performance, (b) grades, and (c) identification with their learning institutions.

**Hypothesis 6.** Compared with asynchronous online classes, students’ teaching presence in synchronous online classes has a higher significant influence on (a) self-evaluated performance, (b) grades, and (c) identification with their learning institutions.
Hypothesis 7. Compared with asynchronous online classes, students’ cognitive presence in synchronous online classes has a higher significant influence on (a) self-evaluated performance, (b) grades, and (c) identification with their learning institutions.

2 | METHOD

2.1 | Sampling and demographics

Participants were recruited via online anonymous questionnaires on Amazon Mechanical Turk, a crowdsourcing service that helps to connect researchers and participants. This platform was chosen because it allows the researcher to reach a greater number of participants than offline convenience sampling methods. In addition, the platform allows the study to be taken by U.S. participants only to ensure a focused scale of the study. Filter questions were placed to screen out participants that were undergraduate students in the United States and were enrolled in classes in the Spring 2021 semester. Attention check questions were constructed to ensure the quality of data. Participants that passed both filter questions and attention check questions were compensated with 1 USD for their time and effort. A total of N = 788 participants took the study. Since the study aims to compare synchronous and asynchronous learning modes, only participants who were enrolled in BOTH synchronous and asynchronous courses were selected for this study. The final sample size of the study is N = 170.

Within the sample that consists of 170 undergraduate students who enrolled in both synchronous and asynchronous courses in the United States, 92.9% (N = 158) took the online courses virtually at home, and 7.1% (N = 12) took online courses on campus. For gender, 60.6% (N = 103) of the participants are male, and 39.4% (N = 67) are female. In terms of race and ethnicity, 40.6% (N = 69) identified as Hispanic, Spanish, or Latino, 27.1% (N = 46) of them identify as white, 23.5% (N = 40) identify as black or African Americans, 2.9% (N = 5) identify as Asian and 1.2% (N = 2) identify as American Indians or Alaska Natives. Regarding age, 50.1% (N = 86) are between the ages of 19 and 30, 27.1% (N = 46) are between the ages of 31 and 40, and 22.4% (N = 38) are above the age of 41.

2.2 | Measures

2.2.1 | Learning modes

To find out which learning mode the participants had in their Spring 2021 classes, a question was asked: “For Spring 2021, which kinds of classes were you enrolled in? Select all that apply.” Participants were asked to select from the following options: “Online synchronous class (Regular online meetings with the professor of the course through Zoom, WebEx, etc.),” “Online asynchronous class (No weekly meetings with the professor of the course)” and “Face-to-face in-person class”. Based on the research question, only participants who had BOTH online synchronous and asynchronous learning experiences were recruited for this study (N = 170).

2.2.2 | Teaching presence

Adapted from the scale developed by Arbaugh et al. (2008), teaching presence was measured on a 7-point Likert scale from “strongly agree” to “strongly disagree” on a 5-item scale (1 = “strongly disagree” and 7 = “strongly agree”; M = 5.535, SD = 1.025, α = 0.745 for Synchronous Learning Mode; M = 5.444, SD = 1.017, α = 0.842 for Asynchronous Learning Mode). The items include: “The instructor clearly communicated important course topics” and “The instructor provided clear instructions on how to participate in course learning activities”.

2.2.3 | Social presence

Adapted from the scale developed by Arbaugh et al. (2008), social presence was measured on a 7-point Likert scale from “strongly agree” to “strongly disagree” on a 5-item scale (1 = “strongly disagree” and 7 = “strongly agree”); M = 5.448, SD = 0.929, α = 0.801 for Synchronous Learning Mode; M = 5.259, SD = 1.090, α = 0.873 for Asynchronous Learning Mode). The items include: “Getting to know other course participants gave me a sense of belonging in the course”, “I felt comfortable participating in the course discussions”, and “I felt comfortable communicating with people in the class via group chat and discussion posts.”
2.2.4 | Cognitive presence

Adapted from the scale developed by Arbaugh et al. (2008), cognitive presence was measured on a 7-point Likert scale from “strongly agree” to “strongly disagree” on a 9-item scale (1 = “strongly disagree” and 7 = “strongly agree”), \( M = 5.575, SD = 0.892, \alpha = 0.901 \) for Synchronous Learning Mode; \( M = 5.459, SD = 1.004, \alpha = 0.923 \) for Asynchronous Learning Mode). The items include: “Learning activities helped me construct explanations/solutions for Synchronous Learning Mode; finding relevant information helped me resolve content-related questions for Asynchronous Learning Mode). (Mercado & Zhang, 2021b).

2.2.5 | Self-evaluation

This scale is developed to measure students' self-reported performance after taking the class and students' self-reported learning outcomes of the class. Adapted from the scale developed by Fieger (2012), students' self-evaluated performance in class was measured on a 7-point Likert scale from “strongly agree” to “strongly disagree” on a 9-item scale (1 = “strongly disagree” and 7 = “strongly agree”), \( M = 5.588, SD = 0.890, \alpha = 0.894 \) for Synchronous Learning Mode; \( M = 5.444, SD = 0.954, \alpha = 0.887 \) for Asynchronous Learning Mode). The items include: “As a result of this class, I feel more confident about this area of study”, “This class has helped me think about new opportunities in life” and “This class has helped me think about new opportunities in life.”

2.2.6 | Grades

Since participants were recruited during July 2021. They have received or are about to receive their Spring 2021 grades. Thus, a question was asked to participants to provide their grades anonymously: “What grade did you receive for this online asynchronous/synchronous class? If you have taken multiple online asynchronous/synchronous classes in Spring 2021, what’s the average grade of all of the classes? If the grades are not displayed in letter format for the course(s), please give us an estimate of a letter grade which best corresponds to your final course outcome. (Collection of this data is used for research purposes only. We will not collect any information about your personal identities). (Mercado & Zhang, 2021b)

2.2.7 | Identification

Adapted from the widely used scale developed by Mael and Ashforth (1992), students' identification with the academic institutions was measured on a 7-point Likert scale from “strongly agree” to “strongly disagree” on a 6-item scale (1 = “strongly disagree” and 7 = “strongly agree”), \( M = 5.261, SD = 1.149, \alpha = 0.888 \). The items include: “When someone criticizes my university/college, it feels like a personal insult”, “When I talk about my university/college, I usually say ‘we’ rather than ‘they’”, and “I am very interested in what others think about my university/college.”

2.3 | Data analysis strategies

To compare the learning experience and outcomes of synchronous and asynchronous learning modes, a series of Paired-Sample T-tests were performed. To test the validity of measures, Confirmatory Factor Analyses were performed separately for synchronous learning research model and asynchronous learning research model. To investigate the relationship among variables, Structural Equation Modelling tests were performed separately for the two learning modes.

3 | RESULTS

3.1 | Comparative analyses

Paired-Sample t-tests were performed to compare students' learning experiences and outcomes under synchronous and asynchronous learning modes. Results indicate that compared with asynchronous online classes, under synchronous online learning mode, students have a significantly higher social presence, \( t (169) = 2.800, p < 0.01 \); cognitive presence, \( t (169) = 2.592, p < 0.05 \); and self-evaluated performance \( t (169) = 2.905, p < 0.01 \), supporting Hypotheses 1a and 2a. No significant difference was found in teaching presence and grades, rejecting Hypotheses 1b and 2b.

3.2 | Construct validity

To test the validity of the measures, Confirmatory Factor Analyses (CFAs) were performed on SPSS Amos respectively for the synchronous online learning model and asynchronous online learning model. After dropping items that had lower factor loadings than 0.60 from the measurements, the final CFA model for synchronous online learning had good model fit: \( \chi^2 (442) = 742.540, \chi^2/df = 1.680, CFI = 0.912, TLI = 0.902, RMSEA = 0.063; \) Estimator = MLM; \( n = 170 \). The final CFA model for asynchronous online learning also had a good model fit: \( \chi^2 (560) = 920.680, \chi^2/df = 1.644, CFI = 0.914, TLI = 0.903, RMSEA = 0.062; \) Estimator = MLM; \( n = 170 \). (See Figure 2). Under synchronous learning mode, teaching presence was found positively impacting students' social presence.

3.3 | Structural equation modeling results

Structural Equation Modeling test for synchronous learning mode displayed good model fit: \( \chi^2 (472) = 768.097, \chi^2/df = 1.627, CFI = 0.914, TLI = 0.903, RMSEA = 0.061; \) Estimator = MLM; \( n = 170 \). Under asynchronous learning mode, teaching presence was found positively impacting students' social presence.
β = 0.892, p < 0.001) and cognitive presence (β = 0.877, p < 0.001).

Students’ social presence in synchronous learning classes was found significantly predicting their self-evaluation of performance in class (β = –0.268, p < 0.05), grades (β = 0.567, p < 0.01), and identification with the academic institution (β = 0.931, p < 0.001).

For asynchronous learning mode, the Structural Equation Modeling test also displayed good model fit: χ² (593) = 963.656, χ²/df = 1.625, CFI = 0.911, TLI = 0.901, RMSEA = 0.061; Estimator = MLM; n = 170; * p < 0.05, ** p < 0.01, *** p < 0.001. Insignificant paths are indicated with dotted lines.

4 | DISCUSSION

This study explored the difference between synchronous and asynchronous online learning through the Community of Inquiry framework. Students in synchronous online learning mode experienced significantly higher social presence, teaching presence, and self-evaluated performance than in asynchronous settings. Social presence in synchronous online courses significantly predicted students’ self-evaluation, grades, and school identification. While in asynchronous online mode, students’ learning presence (teaching presence, cognitive presence, and social presence) was less effective in predicting their learning outcomes.

4.1 | Learning modes and class engagement

Significant differences were found in social presence, teaching presence, and self-evaluated performance between synchronous and asynchronous online courses. In synchronous online courses, educators and students were able to engage in real-time conversations through platforms like Zoom, WebEx, or Microsoft Teams. These conversations mimic a real-life offline teaching environment and provide students opportunities to ask questions and offer feedback. Educators can also benefit from synchronous conversations to provide clearer explanations of course content and assignments. In addition, the synchronous nature of the course also enables real-time in-class discussions and activities, which offers students the chance to engage in conversations with their peers. In line with previous research, higher teaching presence and social presence are indications of positive outcomes (Szeto, 2015). Thus, students experienced higher teaching presence and social presence in synchronous courses, which further increased their self-evaluated performance of the course. Contrary to the previous finding which students had similar self-reported satisfaction for both synchronous and asynchronous online courses (Giesbers et al., 2014), the current study found a significant difference in self-
evaluation. This might due to the fact that this study recruited students who took courses of both formats and used paired sample comparative tests rather than tests that compared means of two samples.

However, students in synchronous courses did not have significantly different cognitive presence and grades. Learning is an active cognitive activity. It highly depends on the self-motivation of the learners themselves. Thus, for self-regulated and self-motivated learning, they might experience higher cognitive presence regardless of the teaching format. In terms of the grade, previous research has found that asynchronous online courses tend to have a higher passing grade than synchronous courses (Giesbers et al., 2014), which might due to the differences in the assessments between the two types of course.

In both asynchronous and synchronous online learning models, teaching presence positively influenced social presence and cognitive presence. This finding further confirmed the importance of having clear and engaged teaching facilitation in the online learning environment. However, within the synchronous online learning mode, social presence positively contributed to students’ grade and negatively contributed to students’ self-evaluation, while social presence displayed no influence on grades nor self-evaluation in asynchronous online courses. Unlike in synchronous online courses, in asynchronous online courses, students and educators are not required to have real-time conversations. The performance and grades of the students are dependent more on the efforts and endeavor of individual students. In terms of the negative relationship between social presence and self-evaluations, it might be due to students’ unfavorable experience with poorly executed in-class activities enabled by features within synchronous meeting platforms, for example, “breakout rooms”.

### 4.2 Identification with attended academic institutions

In both synchronous and asynchronous online classes, students’ social presence was found as the only significant predictor of students’ identification with their attended academic institutions among other investigated independent variables. Unlike self-evaluated performance and grades, student identification as a learning outcome not only impacts the students themselves, but also their attended institutions. As revealed by previous studies (Stephenson & Yerger, 2014), how students identify with the beliefs and values of their attended academic institutions could have a significant impact on their future decisions of donation, including how frequently they would donate and how much they would contribute each time. Identification to school values goes far beyond agreeing or disagreeing with the mission statements displayed on the school websites. As indicated by the results, identification derives mainly from the social interactions in classrooms, including interactions with peers and professors. In line with previous findings, a good and trusting relationship between teachers and students is fundamental to students’ identification (Mitchell et al., 2018; Roorda et al., 2011). Interactions among peers in a classroom is also critical (Bizumic et al., 2012; Hanushek et al., 2003). Even in an online learning environment, relationship building is essential. In synchronous learning mode, relationship building can be embedded in class meetings, small group discussions, and other technology-enabled mechanisms like polling and online debates. In asynchronous learning mode when synchronized meetings are not available to class members, faculty members should be aware of intentionally building a socially engaged classroom by incorporating discussion posts and giving incentives to peer interactions.

### 5 LIMITATIONS AND FUTURE RESEARCH

Despite the theoretical contribution to the Community of Inquiry research framework and practical implications in distance learning, this study inevitably has limitations. First, the sample was recruited through an online crowdsourcing service, which generated a convenience sample. Future research using a representative sample is recommended. Second, the study is conducted in a U.S. context. However, distance online learning can have various forms and effects based on the different levels of technological support and different cultural rituals and routines. Studies conducted in other countries and contexts are recommended. Third, students’ technology affordance and digital competencies can influence their attitude towards distance online learning. Future researchers are advised to study the issue among different student populations. Fourth, this study focuses on online synchronous and asynchronous learning modes during the Covid-19 pandemic. Online learning is an important area of research when the world is not in a global pandemic. Researchers are advised to compare online learning during the pandemic and in a pandemic-free era in the future to further digest how global health emergencies can affect the experience and effectiveness of online learning.

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### DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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