Syllabi Indicators of Learning Community Supports in Civil Engineering Classrooms

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Abstract

Learning communities in formal educational settings act as support systems for students, facilitating increased motivation, student success, and feelings of belonging. Learning communities can be compromised by instructional conditions due to institutional, national, or global disruptions, leaving students vulnerable to being disconnected from their peers and instructors. This study explored the impact of a disruption on instructor facilitation of learning communities. The research question was: "How does a disruption impact instructor facilitation of learning communities, as indicated in civil engineering course syllabi?" The syllabi analyzed in this study were gathered from second- and third-year core courses from Fall 2019 through Spring 2023 in a civil engineering department at an R1 Midwest University. This timeframe captures a significant disruption to instruction that started in mid-Spring 2020. All syllabi were deductively coded using an a priori coding scheme that included the following categories: Instructor-Student Interaction, Peer-to-Peer Interaction, and Institutional Interaction. The impact on learning communities displayed in this analysis is aligned with prior research that indicated students felt isolated during the disruption. There are indications that instructors responded to students' isolation through an increase in office hours in the subsequent semester following initial reports of student isolation. The trends in the data are used to make recommendations for civil engineering instructors on how to integrate learning communities into the classroom experience during normal and disrupted times.

Keywords: Sophomore, Junior, Syllabi, Document Analysis, Civil Engineering

Introduction

Learning communities in classroom settings act as support systems for students, facilitating increased motivation, student success, and feelings of belonging. Instructors create learning communities in the classroom by incorporating teamwork and group projects into their course designs as well as making themselves available, by way of office hours, recitations, and tutoring sessions, to support students in their academic journeys. When instructional conditions change due to institutional, national, or global crisis, students are prone to be increasingly disconnected from their peers, instructors, and institutions [1]. Changes in peer-to-peer connections and instructor availability consequently compromise learning community facilitation. The purpose of this study was to analyze trends in learning community facilitation before, during, and after a disruption, as indicated in course syllabi.

Background

Learning Community Presence in Higher Education

A learning community is defined here as a system wherein there are opportunities for open communication and collaboration between students, faculty and institutional services woven into

a course's structure [2]. The function of a learning community in the higher education classroom is to facilitate a culture of collaborative learning between students and instructors in the university setting. Learning communities encourage a joint effort to solve problems as a community, with every member being given the opportunity to contribute their expertise, gain new perspectives, and work together to discover new ways of thinking and understanding [2]. Moreover, the presence of a learning community facilitates a sense of belonging in students, where belonging is defined as the "degree to which an individual feels respected, valued, accepted, and needed by a defined group" and identified as a "key predictor of student success" [3, p. 2]. This sense of belonging is pertinent when facilitating an inclusive and equitable classroom environment and is of particular importance for students of marginalized groups in engineering education [4]. Instilling learning community presence encourages academic and personal development and social success and is linked to greater feelings of inclusivity in the learning environment [4].

Effects of Emergency Remote Teaching on Instructor-Student Communication

There has been a profound discourse about the effects of a rapid switch to online learning on students' connection to their learning communities and general isolation. This modal shift has occurred in history for many reasons, including threats of violence, natural disasters, and, most relevant to this paper, pandemics [1], [5]. Students' access to a learning community was hindered by barriers put in place due to COVID-19 restrictions. COVID-19 prompted emergency remote teaching (ERT) which is defined as "a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances" [6]. The COVID-19 pandemic affected student-instructor communication and peer-to-peer interactions, as all contact was moved from in-person to videoconferencing or email [7]. This move caused feelings of alienation in students and disconnection and lack of motivation in instructors [8], [9]. In engineering education particularly, the availability of channels of communication between instructors and students is crucial, considering that engineering students absorb many complex topics at a time and require instructors to be a source of guidance to help them understand and apply these topics [10]. Further, students receive social support from sharing ideas with peers and gaining new perspectives [1]. The COVID-19 pandemic wreaked havoc on both these phenomena, causing a profound, multi-level gap in support for students.

Inclusion and Accessibility in Syllabi

Syllabi are instructors' first line of communication with their students when it comes to the curricular aspects of a given course. Syllabi can function as a method to foster inclusion and accessibility by referencing various on campus support systems. In a study about syllabus tone, Gurung and Galardi [11] urged instructors to be conscious about how to use their position of academic and social authority to destigmatize seeking help. One method that the authors suggested was increasing awareness of learning and psychological services through their syllabi design. Increasing awareness is vital because the classroom environment is often not solely a space for learning; the classroom environment can be considered a safe space for students, even more so during the crisis of the COVID-19 pandemic. This results in students entering the classroom with a broad array of concerns, which instructors can anticipate by facilitating

learning communities in the classroom as a preventative safety net to students in academic, mental, or social crisis [12], [13].

The Syllabus as a Teaching Artifact

Higher education instructors use their syllabi as one of the first modes of communication to their students; hence, a course syllabus serves as a vessel to relay what students can expect from a given course [2]. These expectations often include elements such as course outlines, various grading policies, academic expectations, and contact information. Additionally, instructors construct their syllabi with varying levels of focus on learning communities. Since COVID-19 had a tremendous impact on interconnectedness of students and faculty [7], instructors may have altered their course designs during and after the pandemic in response.

Research Purpose and Question

The purpose of this study was to qualitatively analyze syllabi for the presence of learning communities in civil engineering courses and track the effect of a disruption on learning community facilitation. The research question was "How does a disruption impact instructor facilitation of learning communities over time, as indicated in civil engineering course syllabi?"

Methods

Setting and Participants

The research was conducted at an R1 university in the Midwestern region of the United States. The data set analyzed included syllabi from a civil engineering department in a college of engineering.

Data Collection

The data collected for this study included syllabi from the Fall semester of 2019 through the Spring semester of 2023. Data from the Spring semester of 2020 included two versions of a given syllabus: one version from the beginning of the semester and a version modified per COVID-19 instructional restrictions. The syllabi were first sorted based on the semester and year they occurred, the course type (e.g., lecture, lab), and delivery mode through which the course was taught (e.g., in-person, asynchronous). The syllabi were then narrowed down to include the 200 (sophomore) and 300 (junior) level courses in the department's core curriculum. Core courses were selected because they are required and consistently taught across Fall or Spring semesters and all consistently have enrollments of 10 or more students. Further, sophomore and junior year instruction does not receive the same attention in research as the first years, even though retention issues persist past the first year [14]. These selection criteria resulted in 112 possible syllabi of which 66 were able to be collected and analyzed for this study (Table 1). The remaining 46 syllabi were unable to be collected after multiple requests and/or instructors leaving the university. The instructor for each course was often consistent (22 unique instructors) and a majority of the courses were offered only in Fall or Spring (thus the separate analysis for Fall and Spring). The course type was primarily lecture (50%) with 20% being lab courses, and

the remaining courses being lecture/lab combined courses (30%). Average course enrollment was 49 with a range of enrollments from 17 to 86.

Table 1. Distribution of syllabi across semesters (*n* = 66)

Semester	Course Level	No. Syllabi
Spring 2019	200	0
	300	6
Fall 2019	200	0
	300	7
Spring 2020	200	1
	300	6
Spring 2020 COVID	200	1
	300	6
Fall 2020	200	0
	300	6
Spring 2021	200	1
	300	5
Fall 2021	200	1
	300	5
Spring 2022	200	0
	300	8
Fall 2022	200	0
	300	6
Spring 2023	200	0
	300	7

Data Analysis

The strategy for data analysis was adapted from a larger longitudinal study that is investigating the connection between faculty adaptability and course change. As part of this study, the Course Complexity Typology was developed to detect and classify a Wide-Array of Teaching Practices (WATPS) in engineering classrooms [15]. Applying the Course Complexity Typology longitudinally to a set of syllabi is a method to detect the presence of evidence-based practices in the engineering classroom, that is, WATPS. For the current study, a learning community lens was applied to identify codes within the Course Complexity Typology that aligned with the definition of a learning community. Three groups of codes were assembled into a Learning Community Typology: Instructor-Student Interaction, Peer-Peer Interaction, and Institutional Interaction (Table 2). Definitions for each code are provided and values for each code. The values for each code represented the presence of the code, a count of the number of instances of that code, or additional details concerning specifics related to the code and how it was present in the syllabi. Inter-rater reliability (IRR) was calculated with reference to a sample set of syllabi that had been coded by an experienced researcher. The simple percent agreement for all codes ranged from 80% to 100%.

Table 2. Learning Community Typology

Dimension	Code	Definition	Metrics/Codes
Instructor-Student Interaction	CommStudent	Total number of ways students can communicate with instructor or instructional team (e.g., email, canvas announcements, canvas email, discord) Do not include ways not to communicate.	Count
	CommInstructor	Total number of methods in which instructor will communicate with students (e.g., email, canvas announcements, canvas email, discord)	Count
	GetHelp	Ways to get help within the course beyond posting time for office hours	0 = None 1 = Traditional Office Hours (TradOH) 2 = Something beyond traditional office hours (NonTradOH) 3 = Office hours by appointment only (ApptOnly) 4 = Traditional office hours & additional office hours by appointment (TradOH, Appt) 5 = Traditional, by appointment, and something beyond traditional (ALL)
	OffHrs_Loc	Location where office hours will be held beyond typical office settings	0 = Typical Office Location (OfficeLoc) 1 = Library 2 = Online 3 = Learning Center (LearnCent) 4 = TBD/None
	OffHrs_Hours	Total number of (Instructor and TA) office hours per week	Count
Peer-to-Peer Interaction	OutClass_ GrpAssign	Short duration assignments that involve group work	0 = None 1 = Present
	InClass_ GrpActivity	Activities conducted in class that involve group work (e.g., in-class problem solving, NOT teamwork (longer duration))	0 = None 1 = Present
	TeamProject	Long duration assignments with ongoing activity among team members	0 = None 1 = Present
	InClass_ StuActivity	Non-tech based student activities (e.g., minute papers, muddiest points, class reflection, self-grading, etc)	List of activities

Dimension	Code	Definition	Metrics/Codes
Institutional Interaction	Learning_On-CampusSupports	Supports for learning (e.g., writing center, library, tutoring, etc)	0 = None 1 = Details – boilerplate (BP) 2 = Details – personalized (PL) 3 = Details - boilerplate and personalized (BP/PL) 4 = General Link to info (Link)
	Personal_On_ CampusSupport	Personal supports for students (e.g., mental health center, student services for disabilities, recreation facilities, etc.) COVID policies only count if they provide information about finding testing centers or resources.	0 = None 1 = Details – boilerplate (BP) 2 = Details – personalized (PL) 3 = Details - boilerplate and personalized (BP/PL) 4 = General Link to info (Link)

Results

In the following sections, results from the syllabi analysis using the Learning Community Typology dimensions are presented. Instructor-Student Interaction, Peer-Peer Interaction, and Institutional Interaction results are each addressed in separate sections. Within each section, the data are split into Fall and Spring semesters for ease of comparison and analysis as the same courses were not taught in both Fall and Spring. Recall, there are two syllabi for Spring 2020 – the original and the revised version based on COVID-19 restrictions.

Instructor-Student Interaction

Figures 1 and 2 show that the average number of communication methods from student to instructor and vice versa remained below 2 for both Spring and Fall semesters. Regarding the average number of office hours, the average number in Spring semesters increased from Spring 2019 until Spring 2021 before slightly decreasing in Spring 2022 and 2023 (Figure 1). As for the Fall semester, office hours increased in Fall 2020 followed by a return to pre-pandemic levels in Fall 2021 and 2022 (Figure 2). These increases in instructor office hours in Fall 2020 and Spring 2021 are notable as they are the two semesters immediately after the disruption in mid-Spring 2020.

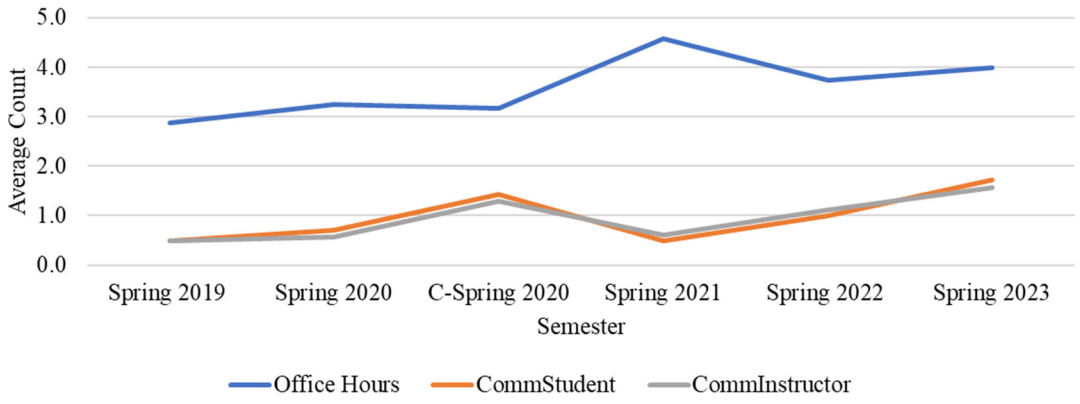

Figure 1. Average number of Office Hours and Student-Instructor and Instructor-Student Communication Methods across the Spring Semesters

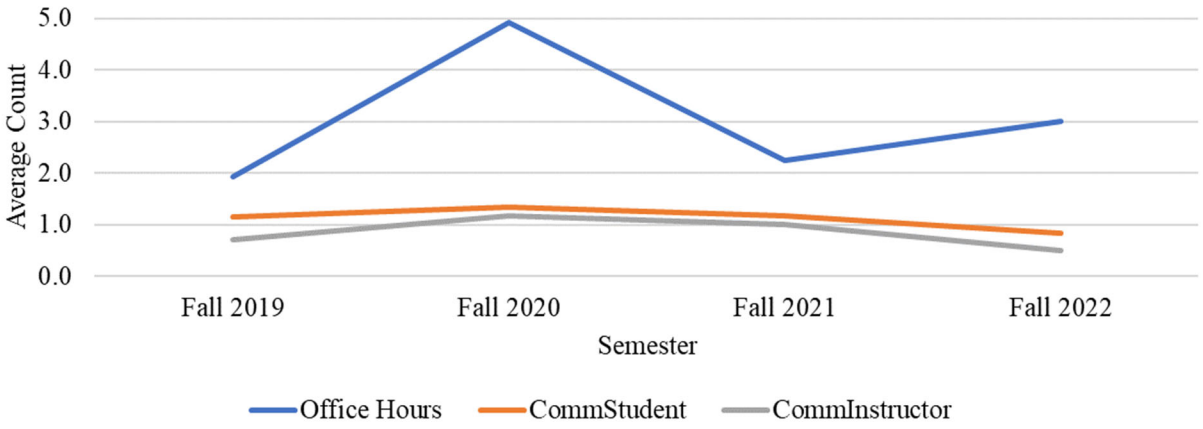

Figure 2. Average number of Office Hours and Student-Instructor and Instructor-Student Communication Methods across the Fall Semesters

Across the entire data set, all but one syllabus in Spring 2023 contained information about how students could get help via office hours (GetHelp) (Figures 3 & 4). Figure 3 indicates that in the Spring semesters, courses offered several different ways for students to seek help outside of the classroom setting, with the percentage of syllabi that included traditional office hours, additional office hours by appointment, and/or something beyond traditional office hours being consistently above 80% (indicated by 4 in blue). In the Fall semesters, there was an increase in indicators of traditional office hours, additional office hours by appointment, and/or something beyond traditional office hours (indicated by 4 in blue) (Figure 4). Office hours via appointment only was 0% in the disrupted semester (C-Spring 2020), Spring 2021 (Figure 3), and Fall 2020 (Figure 4).

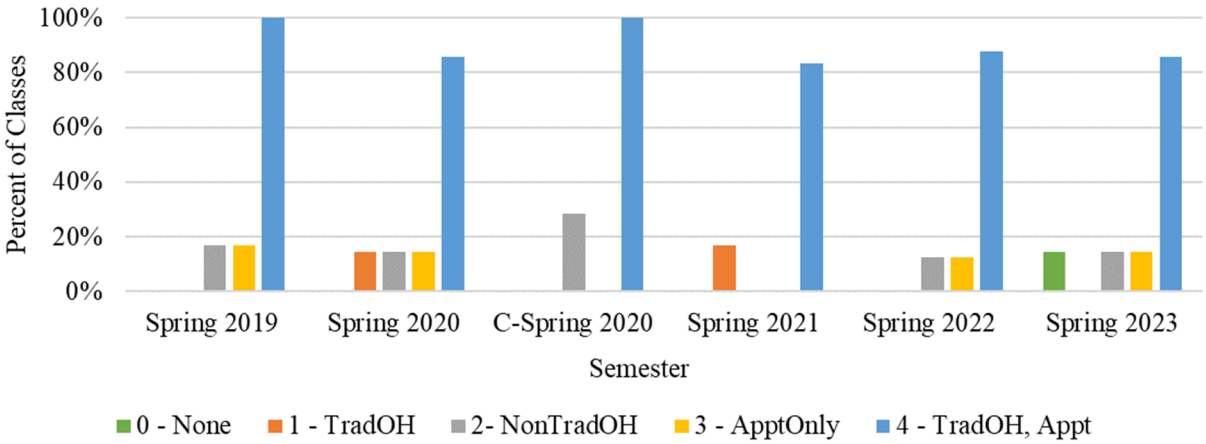

Figure 3. Percentage of Classes offering various types of office hours (GetHelp) across the Spring Semesters

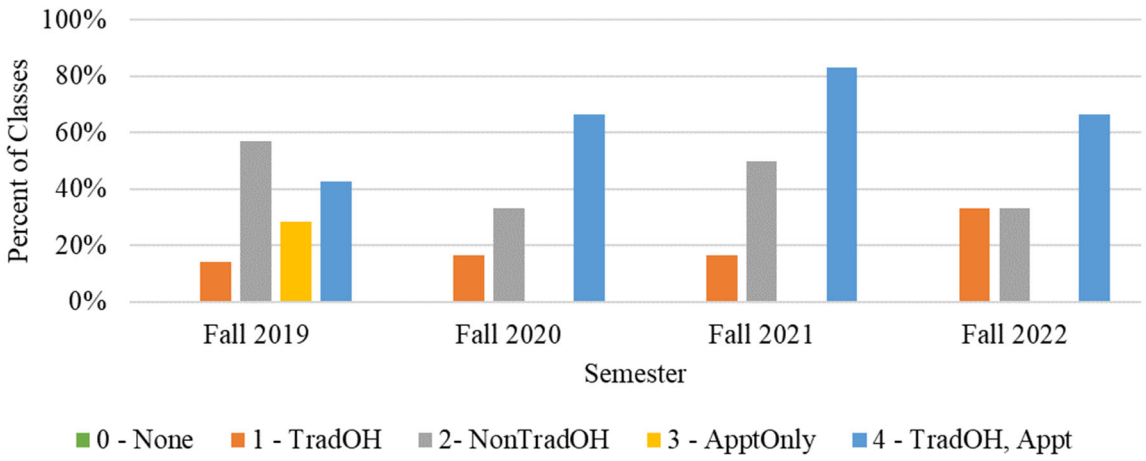

Figure 4. Percentage of Classes offering various types of office hours (GetHelp) across the Fall Semesters

The location of office hours by percentage of courses are shown in Figures 5 (Spring) and 6 (Fall). There is a decrease from Spring 2019 to Spring 2021 in the percentage of syllabi that lacked an office hour location or listed the location as TBD—to be determined (Figure 5) before increasing in Spring 2022 and 2023 above the low of Spring 2021. The availability of online office hours began during the disruption semester (C-Spring 2020) and continued in both Fall and Spring semesters until Spring 2023 when they disappeared. There is a consistently low percentage (less than 20% when present) of syllabi that listed the library as an office hour location in both Spring and Fall semesters, and none of the syllabi indicated the campus Learning Center as the office hour location.

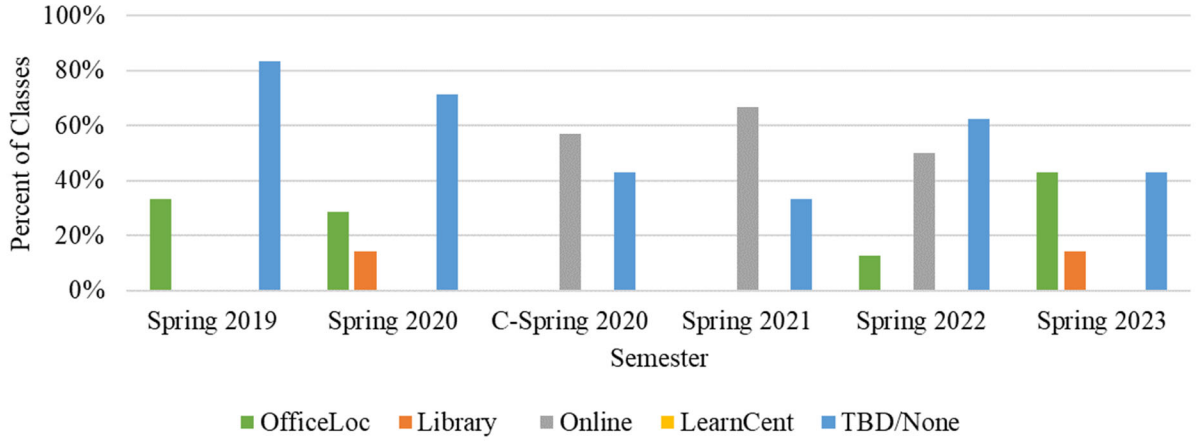

Figure 5. Percentage of Classes with office hours in various locations (OffHoursLoc) across the Spring Semesters

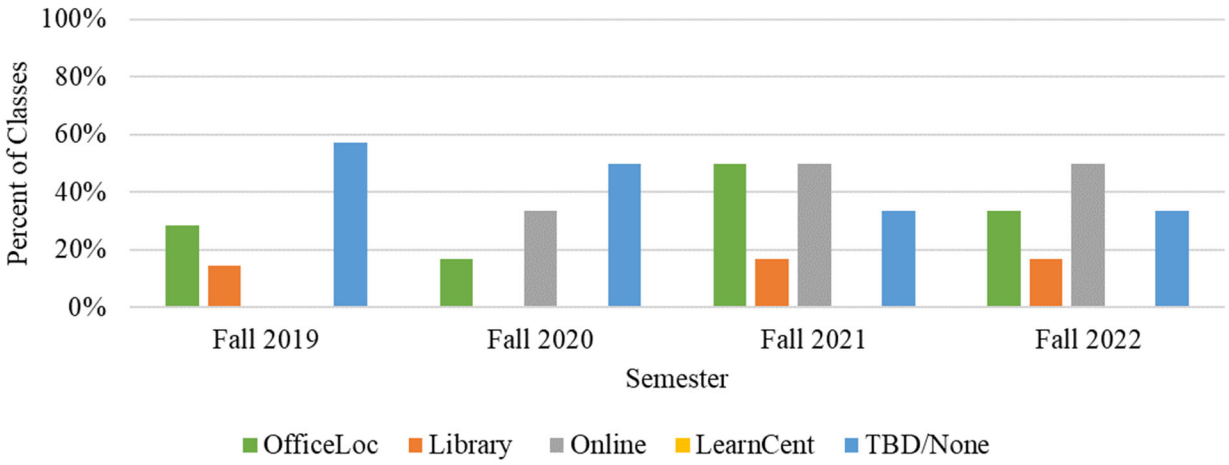

Figure 6. Percentage of Classes with office hours in various locations (OffHoursLoc) across the Fall Semesters

Peer-to-Peer Interaction

Figures 7 (Spring) and 8 (Fall) present the percentage of courses with peer-to-peer interactions. Figure 7 indicates that there was a complete drop in peer-to-peer interaction during the semester of disruption —C-Spring 2020—immediately followed by an increase in peer-to-peer interaction in Spring 2021. Fall semesters have higher levels of peer-to-peer interaction on average compared to the Spring Semesters, with the InClass_GrpActivity measure being particularly higher on average in the Fall compared to the Spring (Figures 7 & 8). InClassStuActivity was excluded from Figures 7 and 8 due to low percentage present across the dataset; it was detected in only four of the 66 total syllabi analyzed with no discernable pattern.

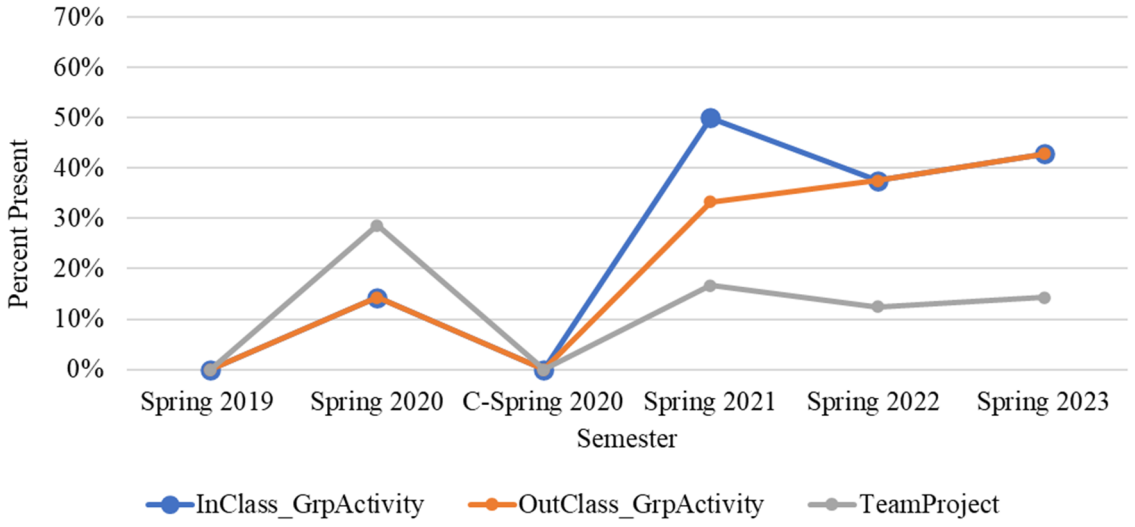

Figure 7. Percentage of courses with Peer-to-Peer Interactions across the Spring semesters

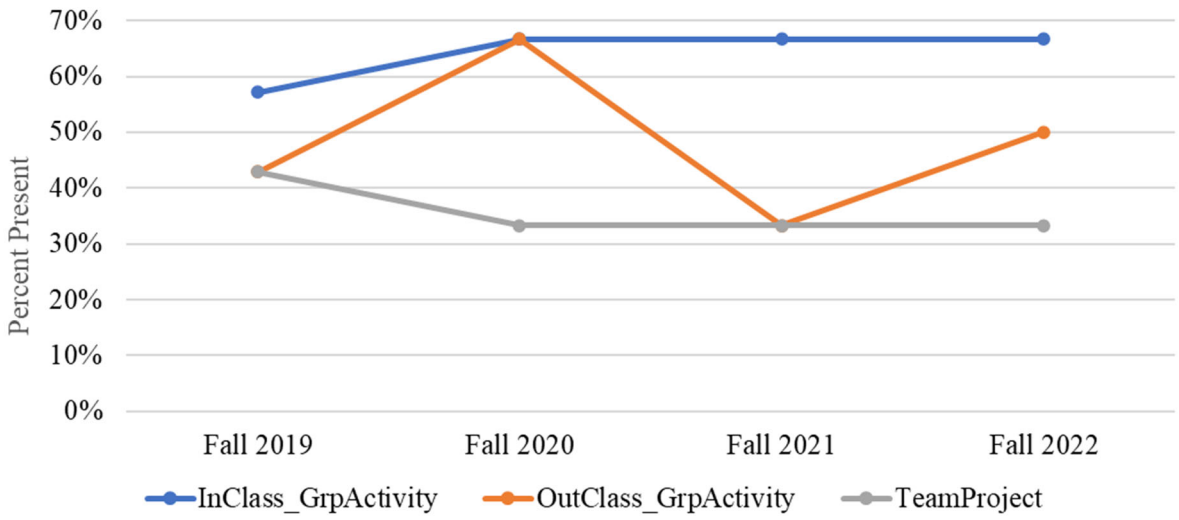

Figure 8. Percentage of courses with Peer-to-Peer Interactions across the Fall semesters

Institutional Interaction

The results for institutional interactions show the least variability. As seen in Figures 9 (Spring) and 10 (Fall), most syllabi excluded indications of campus resources for academic support.

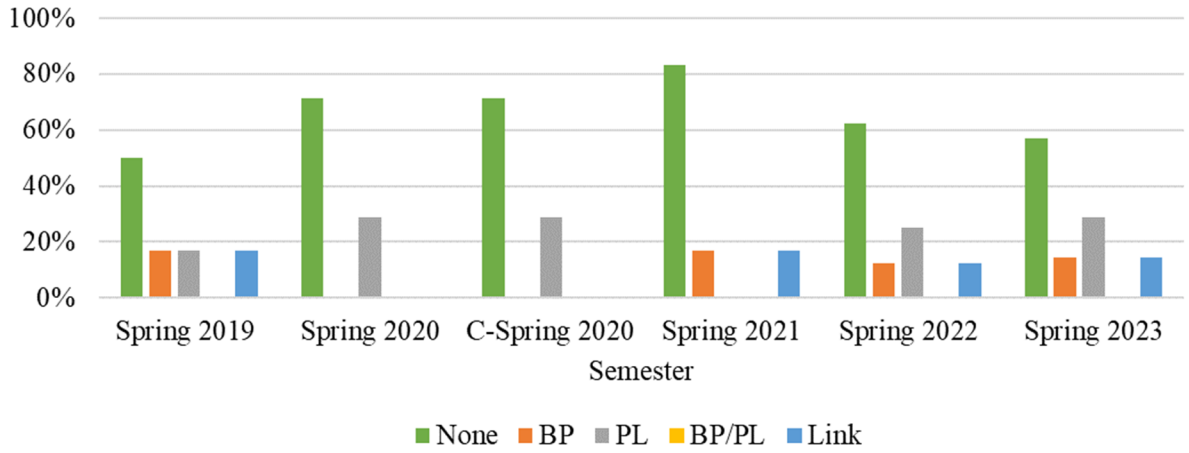

Figure 9. Percent of courses with mentions of on-campus supports for learning (Learning_On-CampusSupports) across Spring Semesters

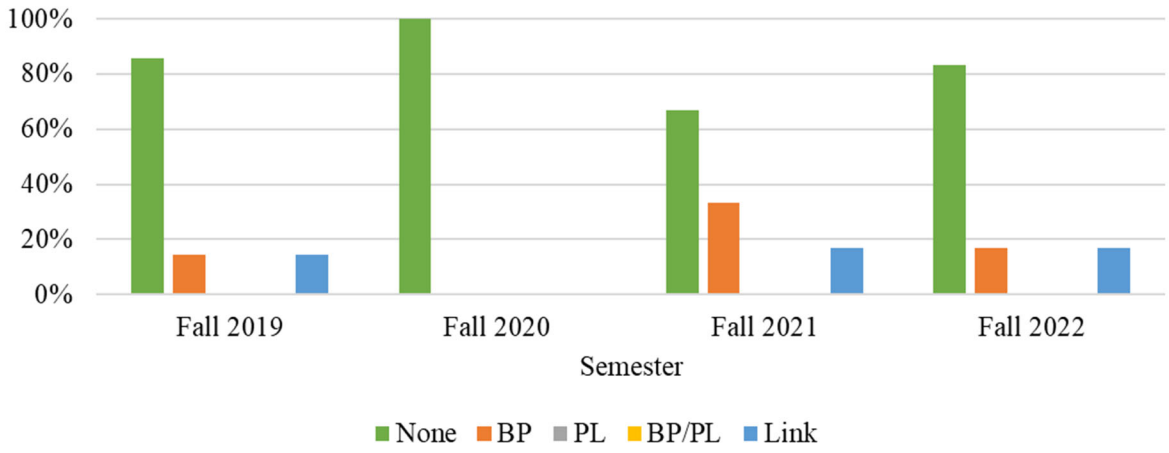

Figure 10. Percent of courses with mentions of on-campus supports for learning (Learning_OnCampusSupports) across Fall Semesters

For personal on campus support (Personal_On_CampusSupport), all but two syllabi in the entire data set contained information pertaining to this measure (Figures 11 & 12). Most syllabi included boilerplate statements, which steadily decreased in the Spring semesters (Figure 11) and steadily increased in the Fall semesters (Figure 12). For spring semesters (Figure 11), the percentage of courses that included a link to personal support services on campus increased after the disrupted semester (C-Spring 2020). A similar trend is not found in the Fall semester which remained unchanged from 2019 to 2022 (Figure 12).

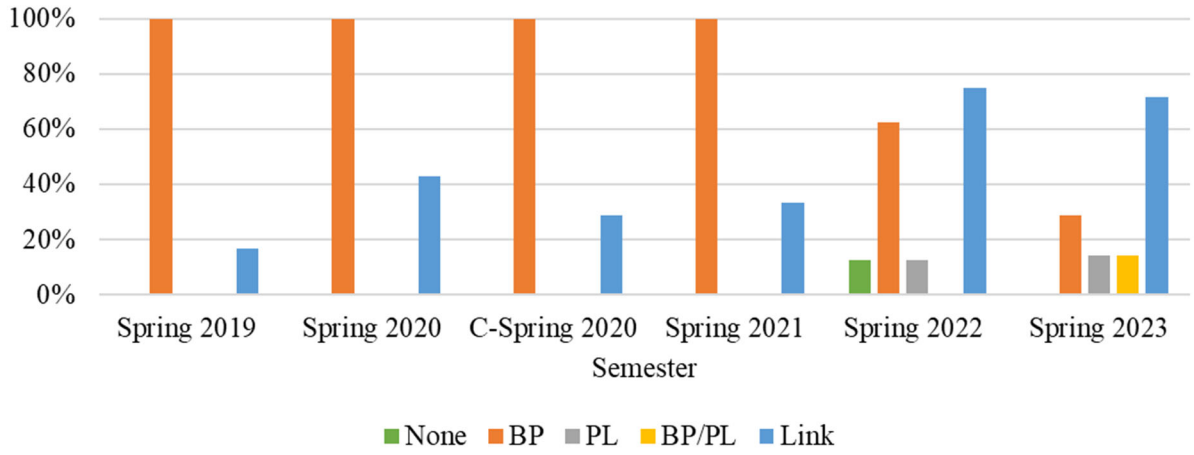

Figure 11. Percentage of courses with mentions of on-campus personal supports (Personal_On_CampusSupport) across Spring Semesters

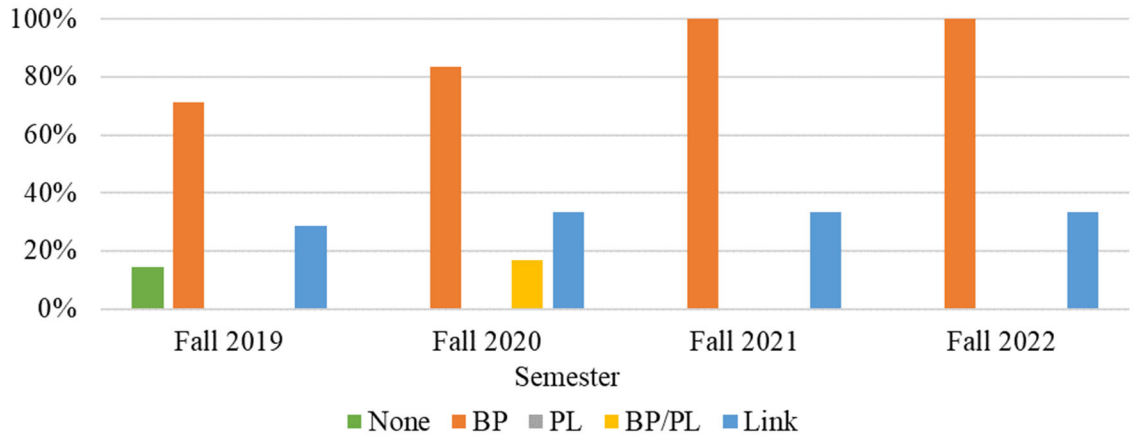

Figure 12. Percentage of courses with mentions of on-campus personal supports (Personal_On_CampusSupport) across Fall Semesters

Discussion

Instructor-Student Interaction: Instructor Response to Student Distress

While going through ERT caused by the COVID-19 pandemic, faculty experienced frustration with how to best support their students in an online format [16]. One way faculty appeared to respond to this frustration was to increase the number of office hours in the two semesters following the initial disruption in Spring 2020. This provided students with more opportunities to reach out to their instructors. Also, the data suggests that instructors lowered the social barrier to seeking help between themselves and their students in multiple ways. During the disruption semester and the two semesters immediately following, no courses offered office hours solely via appointment. Additionally, more syllabi indicated a virtual location to attend office hours, which makes seeking help more accessible to students who are not able to be on campus to attend in-person office hours [17]. The results suggest that instructors reacted to how the COVID-19 pandemic disrupted learning communities and specifically interactions between students and instructions, by offering their students more opportunities and modes to connect with instructors.

Peer-to-Peer Interaction

The results of this study, regarding peer-to-peer interaction, are consistent with student reports of isolation during the COVID-19 pandemic [8]. The results indicated a large decrease in peer-to-peer interactions during the semester of disruption (C-Spring 2020). In the semesters immediately following, the number of syllabi that indicated peer-to-peer interaction was higher than pre-pandemic levels. This is contrary to the literature, which reports a lingering sense of isolation and alienation multiple semesters following the initial disruption [8]. Hence, this data set shows a less drastic impact of COVID-19 on learning community presence in this regard, specifically pertaining to the duration of the impact.

Fall semesters had higher levels of peer-to-peer interaction on average compared to the Spring Semesters. When considering other variables that influenced this phenomenon in the data, it was

found that more lab classes were offered in the Fall than in the Spring. Since most lab activities in the civil engineering department are executed in groups, there is naturally more opportunity for peer-to-peer interaction to be embedded in the course syllabi. This is consistent with the commentary of Fiesel and Rosa on the objective of laboratory activities in undergraduate engineering education, specifically, to "work effectively in teams, including [a] structure [for] individual and joint accountability; assign roles, responsibilities, and tasks; monitor progress; meet deadlines; and integrate individual contributions into a final deliverable" [18, p.127]. This shows that the presence of labs in each semester may make it hard to decipher the effects of the COVID-19 pandemic on levels of learning community presence in syllabi.

Institutional Interaction

The lack of change as well as the boilerplate nature of statements pertaining to institutional supports align with results in the literature, pointing to a broader lack of institutional interaction in course syllabi. In terms of learning supports, a study conducted by Dubicki [19] found that only 30% of syllabi included institutional learning supports available to students, such as library sessions. The results are also antithetical to recommendations in the literature for instructors to, through syllabi, raise awareness of mental health resources available to students [11].

Recommendations

It is nearly inevitable that disruptions will impact instruction and create new demands of educational systems, especially concerning the academic and socioemotional well-being of students. This study suggests a proactive approach to learning community facilitation: systems that encourage learning communities need to be built into the frameworks of curriculum and classroom dynamics in times of normal instruction, to ensure a smooth transition and continued interconnectedness and belonging when a disruption occurs. Instructors can communicate the presence of these systems through syllabi. The following section will offer recommendations for learning community facilitation based on the three dimensions of the Learning Community Typology, informed by the results of this study and the literature.

Concerning Instructor-Student interaction, the data displayed that instructors responded to the pandemic by increasing opportunities and methods through which students seek help in the two semesters following Spring 2020. However, this increase tapered off afterwards, indicating a reaction as opposed to fundamental change. Consistency and continued increase in methods and settings where students can seek help creates a strong foundation of open and accessible instructor-student communication [12], [13]. Functionally, this can manifest as maintaining the number of office hours as opposed to decreasing after crisis, holding recitation more often with students, and increasing the number of methods to communicate listed in the syllabus.

Peer-to-Peer interaction is especially pertinent to engineering education, as asserted by ABET accreditation standards. ABET 5 particularly addresses "ability to function effectively in both single-discipline and multidisciplinary teams", because communication and collaboration are skills transferable to professional settings like industry or academia [20, p. 11]. Since it is the academic structure of the syllabi that caused the most variation in the data (that is, the presence of lab classes), this study recommends opportunities for cooperative learning between students

be present in all class settings to strengthen bonds within the classroom dynamic to proactively work against the isolation and alienation that crisis inevitably results in. This could present as assignments that involve peer-editing and peer-led team learning, as suggested by Felder and Brent [21].

Lastly, including statements that destigmatize the use of institutional supports enables instructors to use their position of social and academic authority to foster a culture of seeking various forms of help when needed, including emotional, cognitive, and academic assistance [11].

Limitations

There are several limitations to this research study. One of the variables that was not considered is the presence of teaching assistants and other professors in the classroom. If the responsibility of learning community facilitation is dispersed among a larger instructional team, such a phenomenon could account for some courses having many office hours, multiple methods of communication, and greater variety of ways to seek help outside of the classroom. Moreover, the changes in course offerings and instructors from semester to semester may impact the consistency of learning community evidence. There was an average of approximately 7 courses per semester, and, thus, the size of the dataset avails the results to be impacted by shifts such as instructor and course change. This likely impact is because learning community facilitation is greatly impacted by course structure and teaching style [22], [23]. Future work could entail expanding the dataset to include syllabi from other engineering departments aside from civil engineering to gain a broader perspective on learning community facilitation in university engineering classrooms.

Another variable that could be considered are the differences between core mid-level engineering courses (200- and 300-level) and capstone and design courses (400-level core courses). Design and capstone courses are typically meant to equip students with skills to undertake different design projects and work collaboratively with their peers in small groups, oftentimes outside of the classroom setting. Student teams are also required to meet regularly with their instructors' giving students and faculty more opportunities for communication and camaraderie, which allows for increased learning community facilitation. This course structure may be communicated in syllabi and instilled universally in 400-level core courses, while middle-year courses tend to lack such structure.

Finally, the syllabi collected may not all follow best practices in syllabi design or even institutional recommendations and thus leave out important aspects of the course details. Additionally, syllabi are a single course artifact and may not capture all components of a course. Capturing the entirety of a course from a single artifact was not the goal of the typology but instead the goal was to see if the application of the typology could detect changes without a more time-intensive endeavor of classroom observations. Future work can included additional course artifacts such as learning management system data.

Conclusion

Considering instructor-student interaction, peer-to-peer interaction, and institutional interaction as factors influencing learning community presence in a course, a realigned a priori coding scheme was used to measure levels of learning community facilitation in course syllabi from core engineering courses. This study focused on how learning community facilitation has changed before, during and after a significant disruption. The coding scheme was used to detect phenomenon in syllabi such as communication methods, information concerning office hours, ways that students can seek help outside of the classroom, and group activities in and outside the classroom. The results indicate that instructors maintained and increased use of certain dimensions of learning community presence in response to the crisis but did not always sustain their use for a prolonged period of time. Learning communities are important to study because their presence has a positive impact on the classroom setting in higher education, including by improving students' problem solving, exposing them to gaining new perspectives, and fostering inclusivity, sense of belonging, and feelings of support. The trends in this data were used to make recommendations for civil engineering instructors on how to integrate learning communities into the classroom experience, not only as a reactive measure in a crisis, but as a proactive measure in times of ordinary instruction.

Acknowledgement

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