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Perceptions of Classroom "Surroundings" after COVID-19: Application of the Community of Inquiry Theoretical Framework*

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In a study on systematic reflection in a flipped fluid mechanics course to drive metacognition, engineering undergraduates were asked to reflect on the impact of the classroom surroundings on their learning. The reflection question described surroundings as the "*conditions and objects*" that surround you. Based on an emergent content analysis, *peers* were mentioned as positive classroom "surroundings" in 46% of the reflections in the fall 2021 and fall 2022 semesters upon return to campus after the COVID-19 pandemic. We had expected reflections related to physical classroom surroundings, such as layout, size, furniture, temperature, or infrastructure. Although students identified the classroom's physical features as "surroundings" with both positive and negative influences, they more frequently identified *peers*, the *instructor,* and/or *in-person instruction* as their positive "surroundings." To situate and understand this unexpected result, we applied the Community of Inquiry (CoI) theoretical framework. This framework has been applied in multiple contexts with its three interdependent presences that drive learning – cognitive, social, and teaching. Interestingly, when students identified their CoI as part of their positive "surroundings," they less-frequently mentioned non-supportive physical classroom features. Our results suggest that an interactive classroom with notable social presence can have a positive impact on perceptions of the classroom "surroundings" that influence learning. Students' identification of the CoI with their classroom surroundings suggests the importance of community in higher education, particularly during times of disturbance to educational practices.

Keywords: Community of Inquiry; CoI; classroom surroundings; flipped classroom; peers; COVID-19

1. Introduction

In the realm of ecology, an ecosystem consists of a community of interacting organisms and their physical environment [1]. In our in-person flipped fluid mechanics classroom immediately after the COVID-19 pandemic, which can be likened to an ecological ecosystem, students interacted with one another and with the instructor during in-person active learning. During the period of fall 2021 to fall 2023, students identified their *Community of Inquiry (CoI),* which included their peers, instructor, and in-person instruction, as their classroom "surroundings" within the classroom ecosystem. This unexpected finding was in contrast to the physical and environmental features that one might more-readily identify as classroom "surroundings." This finding emerged from a three-year study on the impacts of systematic weekly reflection for metacognitive skills development [2–3]. The study was funded by the National Science Foundation and entitled *Collaborative Proposal: Structured Use of Metacognitive Activities in a Flipped Undergraduate Engineering Course to Enhance Learning and Professional Skill Development* (NSF Awards 2019664 and 2020504).

To understand this interesting finding related to classroom "surroundings" during the semesters immediately following the COVID-19 remote instructional period, we adopted the *Community of Inquiry* framework. The *Community of Inquiry (CoI)* theoretical framework is an instructional design model for achieving meaningful learning in environments including online and e-learning [4–7]. It was originally developed by Garrison and colleagues to ensure and enhance community in online environments [8]. Building community in an online environment is important because it positively impacts student learning, engagement, and motivation [8]. The Community of Inquiry framework was recently identified as a way to understand or address the unfortunate issues that arose with remote, online learning during the COVID-19 pandemic, including decreased student motivation, collaboration, and feedback [9]. Although our flipped classroom was conducted entirely in-

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person during fall 2021, this was the first semester of fully in-person instruction following the pandemic; therefore, students were just emerging from remote, online instruction and its relative isolation. The unexpected findings from this study are important for us as educators to be aware of. Just as vaccine researchers are researching and preparing for the next pandemic, we as educators likewise need to be informed of "antidotes" for potential disruptions to our classrooms [10–11].

2. Background and Literature Review

2.1 Community of Inquiry Framework

As asynchronous online learning gained popularity in the late 1900's, it was generally believed that interactions between the students and instructor would suffer. However, colleagues Garrison, Anderson, and Archer believed otherwise and designed the Community of Inquiry (CoI) framework (based on transcribed online discussions) to ensure connectedness and collaboration in this environment [12]. Although the CoI framework was created for post-secondary, asynchronous online education, the developer noted that the framework may be applicable in different contexts as well as for blended learning [13]. He also indicated more recently that the CoI framework could be used to understand educational approaches beyond electronic learning, such as face-to-face instruction [5]. This literature review will describe various adaptations of the CoI framework beyond asynchronous education, including the flipped classroom before and during COVID. This suggests the flexibility and applicability of the framework with respect to the flipped classroom. First, however, the framework will be thoroughly defined and described to provide context for the reader.

In the CoI framework, deep and meaningful learning occurs through the integration, interaction, and tandem operation of three elements – cognitive presence, social presence, and teaching presence [4, 6–7]. The assumption of the CoI framework is that teaching and learning are interactive by nature – hence the terms "community" and "inquiry" [9]. The integration of the three presences creates a community in which collaborative-constructivist learning is nurtured [6]. *Cognitive presence* is the ability of participants within a community (e.g., students) to construct meaning through sustained critical communication, discussion, and reflection [4, 14–15]. *Social presence* is the ability of a student to relate to their classmates, communicate with them, and develop productive relationships that support collaboration [6]. *Teaching presence* involves facilitating and directing instruction for meaningful learning within the Community of Inquiry [6]. A similar framework is that of Situated Learning Theory (SLT), which holds that knowledge exists in a community of practice and that learning occurs via transactions between a student and the social environment [16–17].

2.2 Cognitive Presence

Cognitive presence is the CoI element that is most basic to higher education, representing the core purpose of a Community of Inquiry [4, 6]. Through earnest communication and sustained reflection, participants in the community (i.e., students) "construct" meaning [4, 14]. Cognitive presence involves connecting information to form ideas (i.e., gaining insights) and applying ideas to solve a problem or complete a learning exercise [4]. Cognitive presence aligns with acquisition of higher-order knowledge and its application and is closely associated with critical thinking [14].

2.3 Social Presence

This CoI element has the primary role of supporting cognitive presence by supporting the critical thinking process that must occur for learning [4]. Social presence has three categories – (1) expression of emotion, (2) open communication, and (3) group cohesion [4]. Emotional expression involves sharing feelings and/or disclosing personal information that can lead to enhanced trust [4]. Open communication involves two-way, respectful exchanges, such as recognition of one another's individual contributions [4]. Such communication is supportive, appreciative, encouraging, and complimentary to others [4]. *Peers* are known to provide companionship, help, and emotional support, which enhances student motivation [18]. However, the converse is also true, as academic motivation has a positive impact on social presence by way of motivated students' ready engagement in course-related group activities [15].

The third category of social presence, group cohesion, relates to group commitment and sense of belonging, which drives the quality of the discourse needed for knowledge construction [4]. Sense of belonging is also an important affective variable for performance and retention in STEM [18]. Social presence also supports the affective outcomes of enjoyment and personal fulfillment, which likewise drive learner retention in the community [4]. In summary, social presence drives a sense of belonging to a community, supports free expression, and sustains cognitive presence [15]. In short, social presence directly supports collaboration, connections, and a functioning community [6, 12].

2.4 Teaching Presence

Teaching presence has three components – (1) design of the educational experience, (2) facilitation of discussion in the community, and (3) direct instruction [4, 6, 8]. The first component (i.e., design) entails setting the curriculum, selection and organization of content, and development of learning and assessment activities [4, 8]. The second component (i.e., facilitation), which can be provided by any member of the community, involves items such as setting the climate for learning within the course and encouraging or acknowledging student contributions; and the third component (i.e., direct instruction) consists of items such as presenting content, questioning, summarizing discussion, assessment, and providing feedback [4, 8]. Teaching presence has the role of supporting social and cognitive presence to achieve educational outcomes, sustaining a collaborative community, and providing leadership and management of the learning experience [4, 6, 12].

The teaching presence in a flipped classroom is characterized by the instructor as both a content provider as well as a consultant who interacts with students, addresses their questions, and assists during class. With a flipped classroom, students are provided with video lectures, readings, or even adaptive lessons for pre-class preparation, and these are readily accessible before the team-based, in-class active learning exercises with the instructor present for support [19–20]. Evidence-based teaching methods, such as the flipped classroom, are associated with increased student motivation, engagement, retention, collaboration, and learning. For example, a study of a flipped numerical methods course at three different engineering schools found (via open qualitative responses) that 41% of students felt the flipped classroom enhanced their learning or learning process [20]. Also, 34% felt the pre-class preparation, professional-type behaviors, and engagement were beneficial. Twenty-three percent (23%) said the alternative use of class time (i.e., group work, peer interactivity and support, active learning, support, questions, etc.) was beneficial [20].

2.5 Applications and Adaptations of the CoI Framework

The Community of Inquiry (CoI) framework has been used for design with the flipped classroom both before and after the COVID-19 pandemic. Prior to COVID, the CoI was used to develop a framework and design principles for the flipped classroom [21]. Upon the onset of COVID-19, the CoI was similarly used to develop design principles for fully online flipped instruction based on a review of health education studies [22]. The CoI framework was recently used to design the pre-class component of a flipped classroom [23].

The CoI framework has also been used to evaluate and assess flipped classrooms before COVID [24]. The same was done for the online flipped classroom upon the onset of the pandemic [25–26]. In these two online flipped classroom studies during the pandemic, social presence scored the lowest among the presences based on the CoI questionnaire, coinciding with the isolating impact of COVID. Another COVID-19 study found that social presence was the most important factor affecting the academic performance of university students during the March to June 2020 timeframe at the very onset of the pandemic [27].

The CoI framework was also used in graduate courses as a lens to view synchronous engagement approaches, such as online discussions [28]. In a case study with asynchronous graduate online education, application of the CoI framework was associated with enhancement of student engagement with online videos (which promoted cognitive presence) as well as follow-up discussion board posts (which promoted social presence) [7]. Finally, the CoI framework was adapted for a K-12 online setting with both asynchronous and synchronous learning through the addition of a fourth presence [29].

2.6 Learning Spaces

Learning spaces in higher education are underresearched, including with respect to their effectiveness, according to some authors [30–31]. Hence, the current work contributes to limited research on this topic. Interestingly, a review of the literature on learning spaces uncovered both physical as well as social components of these spaces. Ellis and Goodyear hypothesized that the influence of space attributes on learning outcomes may be mediated, or connected, by social factors [31]. In their review of the literature on students' experiences with and perspectives on learning spaces, Ellis and Goodyear found studies that suggested that learning spaces should be considered from an "ecological" standpoint, as does this paper [31]. Prominent scholar Maryellen Weimer noted that classrooms go beyond their physical aspects and are spaces where "great and magical things" can happen, including finding the motivation to learn, learning from other people, and (hopefully) encountering a psychologically safe space where all people are respected [32]. A conceptual model by Beckers et al. hypothesized that *both* physical (e.g., aesthetics) and social (e.g., interactive) dimensions of learning environments influence students' preferences for their learning spaces where they study [33]. Becker's

Table 1. Study participation rate

	Fall 2021	Fall 2022	Spring 2023	Fall 2023	Total
Participants (reflection respondents)	118	79	56	50	303
Enrolled students	128	102	68	64	360
% enrolled students who participated	92%	77%	82%	78%	84%

study found that students' learning space preferences were related more so to their perceived effectiveness and functionality versus their aesthetics and experience value [33]. Finally, one study defined an active learning classroom by its CoI elements – specifically a learning "environment" intended to enhance peer interaction and collaboration, student-teacher interaction, and teaching practices [34].

3. Methodology

3.1 Course Description

The fluid mechanics course in this study was a required part of the undergraduate mechanical engineering curriculum for juniors and seniors at a large university in the southeastern region of the U.S. The course offerings between fall 2021 and fall 2023 were included in this study, with the fall 2021 semester being the first fully in-person semester after the onset of the COVID-19 pandemic. The course covers topics such as hydraulic pressure, conservation of energy, Bernoulli's equation, and an introduction to the Navier-Stokes equations. The course was structured as a flipped classroom, in which students were provided with video recordings of the course content before class. In-class time was dedicated to a variety of items, including discussion of this content, student questions, examples, topics difficult to conceptualize, and problem solving. During every class session, an ungraded in-class assignment was provided, and students were encouraged to work with their peers to complete the assignment before leaving. The classroom atmosphere revolved around the interactions between students and the instructor and the collective understanding of the course material.

3.2 Student Participants

Fluid mechanics is taken by junior and senior-level mechanical engineering students. At the beginning of each semester in this study (fall 2021, fall 2022, spring 2023, and fall 2023), students were given the option to participate in a research study related to the use of repeated reflection and metacognitive skills development in the course. This research study was approved as exempt by the Institutional Review Boards of both participating universities (STUDY20060062 and STUDY001093). The number and percentage of enrolled students who provided a response to the reflection question in this study are shown in Table 1. The participation rate ranged from 77% to 92%, with a total overall rate of 83% of enrolled students.

3.3 Reflection Prompt

Throughout the semester, we collected weekly reflection data from the students. The weekly reflection prompts were open-ended questions resulting in responses consisting of several sentences to small paragraphs. One of the reflection questions asked students to consider their classroom surroundings and their impact on them. This reflection prompt was as follows:

> "Surroundings in a classroom are believed to have effects on student learning. These include the conditions and objects that surround you. What impact, if any, are the surroundings in this Fluids classroom having on YOUR learning and comprehension? In your reflection, please include why the surroundings are impacting you in these ways."

The motivation for asking this reflection question was to assess students' perceptions of their physical surroundings and the impact on their learning experiences. The research questions asked were as follows:

(RQ1) How did students define their classroom *surroundings* in an in-person engineering course after the COVID-19 pandemic?
(RQ2) Were there trends related to students' definition of their classroom *surroundings* in an in-person engineering course after the COVID-19 pandemic?

The expectation was for the responses to be related (primarily) to the quality of the physical classroom, furniture, layout, acoustics, temperature, etc. However, an unexpected positive aspect of their "surroundings" emerged from the reflections. This unexpected result serves as the basis for this article.

3.4 Emergent Content Analysis

The coding scheme was developed in an inductive fashion by the first author by initially reading all reflections during the first semester (i.e., fall 2021) and identifying the recurrent themes or patterns that emerged in the data. The reflections were divided between positive versus negative (i.e., deficits-based) aspects of the classroom surroundings related to learning and comprehension. The emer-

Table 2: Emergent coding scheme for positive aspects

Positive Aspects Category	CoI Presence	Description
Peers	Social	Peers help each other to learn Fellow students are focused/motivated & promote these qualities in others Peers generate questions in class
Instructor	Teaching	Instructor is supportive, answers questions in class, has discussions in class Instructor is engaging/interesting Instructor is easy to follow or understand Instructor makes use of helpful technology
In Person	Cognitive, Teaching	In-person instruction In-person problem solving during class
Good Room Conditions	Not applicable	Lighting, acoustics, sound level, temperature Room size, traditional classroom Seating/layout promotes visibility, audibility, comfort Clutter-free walls Large projector screen

Table 3. Emergent coding scheme for negative aspects

Negative Aspects Category	Description
Furniture/ Equipment	Furniture old or in disrepair Seats uncomfortable, furniture not ergonomic Equipment/infrastructure in need of improvement Room layout not preferable
Noise/Disturbance	High noise level in class (e.g., others talking) Disturbances, disruptions, distractions Acoustics poor
Lighting Issue	Lack of windows Lighting not good
Small Space	Classroom *not* large enough, insufficient seating Cramped/crammed conditions, small writing surfaces, small seats
Large Space	Classroom or enrollment too large Want smaller, more personal space
Temperature	Poor room temperature (too warm)
Aesthetics	Age of room, look and feel of room, paint color Cleanliness, scent

gent coding scheme for the positive aspects of the classroom surroundings is given in Table 2. There are four positive categories in the coding scheme, with the first three related to the CoI framework – peers, instructor, and in-person instruction. A fourth category captured desirable room conditions that supported learning and comprehension. As described in Table 2, those students who discussed *peers* as a positive "surrounding" said they helped one another to learn, including by asking questions in class. Students with focus and motivation promoted similar qualities in other students. Students noted the *instructor* as part of their positive "surroundings" by virtue of his interesting and engaging manner, clarity, communication with students during class, and use of instructional technology. Students also reflected that the *in-person* instruction and in-class problem solving were part of their positive "surroundings." Desirable room conditions with a positive influence included physical characteristics such as lighting, acoustics/sound, room size, temperature, seating, and layout.

Conversely, Table 3 provides the emergent coding scheme for the deficits-based (i.e., negative) aspects of the classroom surroundings. Specific categories for the negative physical features or conditions were used since our original hypothesis was that these negative physical features would dominate the students' reflections. Therefore, we wanted to collect specific evidence for potential remediation. Seven "negative" aspects of the classroom surroundings emerged and consisted of physical or environmental features related to furniture and equipment, noise/disturbances, lighting, size of the space, temperature, and room aesthetics, as described fully in Table 3.

The students' reflections about their surroundings were analyzed using a structured content analysis and emergent coding schemes informed by the raw data [35]. The content analysis and coding schemes enabled us to quantify the relative occurrence of the themes found in the reflection data. A large percentage (67%) of all reflections were coded by two analysts (i.e., double coded), with subsequent discussion to reach consensus on the final codes to assign. The first-time inter-rater

reliability was Cohen's $\kappa = 0.87$, suggesting strong agreement beyond chance [36].

3.5 Focus Groups

During the fall 2022 and fall 2023 semesters, in-person focus groups were conducted with fluid mechanics students from the previous fall semesters (i.e., fall 2021 and fall 2022, respectively). This was done to follow up on their perspectives regarding their "surroundings" in the classroom one year later. Six and three students participated in the fall 2022 and fall 2023 focus groups, respectively. The participants were not informed beforehand about the focus group topic. The first question posed during the focus groups was as follows: *When I mention "surroundings" in a classroom, or the conditions and objects that surround you and impact your learning, what do you think of?* The first author and a second analyst independently reviewed the participants' responses to this question and were 100% in agreement as to which responses related to the CoI and which responses related to physical classroom features.

4. Results

We determined the proportion of reflections that discussed various aspects of the CoI, namely one's peers, the instructor, and the mode of instruction. We also determined these various proportions over time from fall 2021 to fall 2023. Also of interest were the proportions of reflections that discussed at least one CoI component (i.e., peers, instructor, or in-person instruction), at least one positive classroom physical feature, and at least one negative classroom physical feature. These results are presented next, along with results from the focus groups related to RQ1.

4.1 Students' Reflections on their Surroundings (RQ1)

The consideration and prioritization of peers as "classroom surroundings" was an unexpected result. Negative physical characteristics were expected to dominate the reflections. However, during the fall 2021 and fall 2022 semesters, *peers* were identified as classroom "surroundings" in a positive way by 46% of respondents (Table 4). Thus, approximately one-half of the open-ended reflections freely mentioned peers as a type of "surroundings" that had a positive impact on their learning and comprehension, including helping one another to learn, generating questions for all to hear, and inspiring motivation within the Community of Inquiry (i.e., fellow engineering students). Other elements of the community were identified as positive classroom "surroundings," namely the *instructor* (i.e., interactions and qualities) and *in-person instruction*. Students who positively perceived the physical surroundings as supportive to their learning (i.e., 20%, 34%, 52%, and 48% over time, respectively) discussed a collection of items, including seating arrangement/layout, room size, temperature, projector screen size, lighting, and sound/acoustics.

Fifty-five percent (55%) of the reflections in the fall 2021 discussed one or more CoI elements (i.e., peers, instructor, and/or in-class instruction) as classroom "surroundings" that were supportive to their learning (Table 4). During the fall 2021, this percentage was higher than either the percentage of reflections mentioning at least one positive (supportive) classroom feature (20%) or the percentage mentioning at least one negative (non-supportive) classroom feature (54%) as classroom "surroundings."

4.2 Trends in Students' Reflections on their Surroundings (RQ2)

The relative mention of *peers* as positive classroom surroundings slightly decreased over time as shown in Table 4, although the proportions were still noteworthy. The same was true for the proportion of reflections that discussed at least one CoI element as a supportive classroom surrounding. As time progressed after fall 2021, the classroom physical features assumed a more prominent role in students' reflections about their surroundings. For example, the percentage of reflections with at least one positive physical classroom feature increased from 20% (fall 2021) to 48% (fall 2023), and these percentages were significantly different based on a z-test of proportions ($p \approx 0.000$). The percentage

Table 4. Definition of classroom surroundings

Percent of reflections that discussed:	**Fall 2021** (n = 118)	**Fall 2022** (n = 79)	**Spring 2023** (n = 56)	**Fall 2023** (n = 50)
Peers (Social)	46%	46%	38%	26%
Instructor (Teaching)	16%	28%	34%	22%
In-person instruction (Cognitive, Teaching)	14%	3%	13%	0%
At least one CoI feature (peers, instructor, in-person)	55%	51%	48%	32%
At least one positive physical classroom feature	20%	34%	52%	48%
At least one negative physical classroom feature	54%	47%	66%	72%

associated with negative physical classroom features also increased during this time from 54% to 72%, which was a significant change at $p = 0.03$. However, there was a decrease from 55% to 32% during this time in the mention of the CoI elements as classroom "surroundings," and these percentages were also significantly different based on a *z*-test of proportions ($p = 0.006$). Note that no respondents identified in-person instruction as "positive surroundings" at the end of the study (fall 2023), compared to 14% in fall 2021 and 13% in spring 2023.

Class occurred in the same classroom during the entire fall 2021 and 2022 semesters and for approximately half of the fall 2023 semester. During the fall 2023, the class had to be moved to a different room due to unforeseen necessary building maintenance. The spring 2023 classroom was different from any of the fall classrooms, with the spring 2023 classroom being less aesthetically pleasing in the instructor's assessment. This may have contributed to the higher (i.e., 66%) percentage of responses in the spring 2023 with at least one negative physical classroom feature.

Further, based on an analysis of the data, the perception of the CoI as positive "surroundings" may have diminished the perception of negative physical room conditions as non-supportive to learning. For example, in fall 2021, 54% of the reflections discussed one or more negative physical room features that were non-supportive to learning (Table 5). However, when one or more elements of the CoI were identified as a type of positive "surroundings" in these reflections, only 34% of these reflections also mentioned negative physical room conditions as non-supportive to learning. Further, when elements of the Community of Inquiry were *not* identified by students as a type of positive "surrounding" in these reflections, 79% of them mentioned various negative physical room conditions as non-supportive (Table 5). This same pattern is seen in all the other semesters.

4.3 4.3 Focus Group Results

4.3.1 Fall 2022 Results

A focus group was conducted in the fall 2022 with students from the previous fall 2021 semester. The purpose was to gather their perspectives on their classroom "surroundings" one year later, and particularly to determine if the CoI theme persisted. The results strengthened our initial finding about the CoI as classroom "surroundings." The students' responses indicated that the CoI was still a popular theme with respect to their "surroundings" one year after expressing this in the written reflections. This theme was the *first* theme mentioned by the focus group participants, as described below. The CoI theme was again mentioned in a series of six statements by the participants after they discussed various physical features of the classroom. All responses are described below.

Focus Group Q: When I mention "surroundings" in a classroom, or the conditions and objects that surround you and impact your learning, what do you think of?

- The first response was "People (other students and the teacher)."
- This was followed by 12 separate statements about physical features or conditions, including lighting, temperature, desks, chairs, scents, room size, the clock, and sounds.
- This was then followed by 6 more separate statements related to the community of inquiry, including statements about people, friends, the teacher, and the "vibe." One student made the following statement with excitement and humor – "The teacher is a surrounding!"
- This was then followed by 2 more statements about physical features.

After informing the focus group participants that the written reflections from the prior fall semester had discussed CoI elements as their "surroundings" in 55% of the responses, they were *not* surprised. We received the following statements from them:

- "I would rather have a great vibe than ideal furniture, such as a larger desk. The tiny desk doesn't matter as much."
- "Certain professors lead to greater vibes."
- "The instructor is a focal point, at the front of the class. You tend to forget some of the physical surroundings."
- "The real focus is learning, and I'm not going to be pulled away or distracted from that if my focus is 'on'."

Table 5: Trends related to surroundings definition

Item #	Percent of reflections that discussed:	Fall 2021	Fall 2022	Spring 2023	Fall 2023
1	At least one negative physical feature	54% (n = 118)	47% (n = 79)	66% (n = 56)	72% (n = 50)
2	At least one negative physical feature when a CoI feature also discussed	34% (n = 65)	28% (n = 40)	48% (n = 27)	50% (n = 16)
3	At least one negative physical feature when no CoI features discussed	79% (n = 53)	67% (n = 39)	83% (n = 29)	82% (n = 34)

The participants were actually surprised that the percentage was not higher than 55%, although we were initially surprised they had considered their peers as "surroundings."

4.3.2 Fall 2023 Results

A similar focus group was conducted in the fall 2023 with previous (fall 2022) students. The CoI theme again persisted and was the *first* theme mentioned by participants in response to the focus group question about surroundings. The CoI theme was also mentioned in the subsequent responses, in addition to the "physical" surroundings.

- The first response in the focus group was "Classmates."
- This was followed by the response, "My mind went directly to the temperature in the room and the physical surroundings . . . with respect to classmates, . . . I typically have two or three people around me, and I'm not distracted . . . if I miss, my friends can help me."
- The final response was, "A mixture of the above. I like to sit in the back because I become distracted. I isolate and focus. There are distractions from whispering or the chairs squeaking."

After informing the fall 2023 focus-group participants about our surprising CoI finding from the fall 2021 written reflections, one of the participants stated, *"I understand because it was just after COVID and it was depressing. We had all our friends back and the joy of this overrode any physical things like squeaking chairs."*

5. Discussion

As part of a larger study on reflection and metacognition in engineering education, students identified aspects of their surroundings that helped or hindered their learning and comprehension in class after the COVID pandemic. The physical features of the classroom, particularly negative aspects, were expected to dominate the responses. However, it was the elements of the Community of Inquiry (CoI) framework that dominated in a positive manner. Previously, perceived learning was found to be positively correlated with Community of Inquiry measures [37].

The CoI framework has been applied in multiple contexts beyond asynchronous online learning, as encouraged by Garrison, its developer. This includes the flipped classroom before and during COVID. The present study applied the CoI framework to understand and explain students' perceptions of their "classroom surroundings" in a flipped classroom upon return to in-person instruction immediately after the pandemic. Our findings demonstrated that "surroundings" in a flipped classroom can go beyond physical attributes to include elements of community. Recall that Weimer noted that classrooms go beyond their physical aspects and are spaces where things like finding the motivation to learn and learning from other people can happen [32].

In the fall 2021 semester, which was the first fully in-person semester at this university following the pandemic, 55% of the reflections mentioned one or more of the CoI elements (i.e., peers, instructor, in-person instruction) as positive "surroundings." In subsequent semesters from fall 2022 to fall 2023, 51%, 48%, and 32% of the reflections mentioned one or more of these CoI elements in a slightly decreasing fashion, respectively. When disturbances to an ecosystem occur, an ecosystem can return to its former condition with resiliency [38]. This may partly account for the trend observed between fall 2021 and fall 2023, in which students identified the CoI as positive "surroundings" to a decreasing degree over time. It is noteworthy that no respondents mentioned in-person instruction as "positive surroundings" at the end of the study. These results imply the importance of classroom community from the standpoint that students likely missed this during the pandemic. Recall that in prior online flipped classroom studies during the pandemic, social presence scored lowest among the CoI presences [25–26]. Thus, students may have naturally expressed their valuation of community when they first returned to in-person instruction.

The perception of the CoI as positive "surroundings" may have diminished the perception of negative physical room conditions as non-supportive to learning. Specifically, when students identified elements of the CoI as their "surroundings," they less-frequently identified physical classroom features as non-supportive to learning. Thus, CoI elements may potentially mediate (i.e., dampen) any impacts from negative physical classroom conditions. Perhaps these results regarding the "surroundings" should not surprise us. A prior study found that students tended to emphasize teaching and learning over the physical facilities, with concerns over teaching and learning potentially even "crowding out" any environmental issues [30].

Upon conducting focus groups with students one year after writing their reflections, the notion of peers and the instructor as "surroundings" persisted, thereby triangulating the initial results. In fact, students further named the "vibe" (i.e., the energy of the people and social environment) in the classroom as their "surroundings." Students indicated in the focus groups they valued their Community of Inquiry in the classroom and its "vibe" to a greater degree than the physical features that

surrounded them. The physical items such as the desks, other furniture, and temperature were not as important as the vibe that "surrounded" them. The students clearly wanted to view themselves as a community, and this was likely influenced by their isolating experiences during the COVID-19 pandemic. As one student said, *"You don't know what you have until it's gone."* Supporting this general claim, a study of engineering students (n = 928) in the middle phases of the pandemic found that *campus-based, in-classroom instruction including peer interactions* was the most-frequent valued college experience [39].

6. Conclusions

This article aimed to provide useful insight for engineering educators and students about the role of "community." A key implication of this study is the importance of community and interactions (i.e., a Community of Inquiry) in supporting students' learning. Specifically, a Community of Inquiry (CoI) may be important to students' perception of the surroundings in which they learn, and in particular during and immediately after "disturbances" to their in-person learning and interaction, such as COVID-19 created. This study has shown how community members in a classroom can play a key role in shaping students' perceptions of their surroundings and that "surroundings" can include members of the teaching and learning community. The powerful role of peer-supported social presence in the classroom was demonstrated by this study.

In fact, community may even compensate for physical room conditions that are not conducive to or supportive of learning. Therefore, if non-supportive physical features and conditions characterize a classroom or learning environment, an instructor may be able to better support learning and comprehension by bolstering feelings of community and belonging through group work, interaction, and moving throughout the classroom to assist students, which is facilitated well by flipped instruction and other active-learning pedagogies. This study lends support to the flipped classroom and other active pedagogies that support interactive classroom environments.

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