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Community in classrooms: Practical strategies to foster engineering students' sense of belonging

Holly McCarthy[a]; Rachel Abel[b]; and Christopher C. Tisdell[c].
Office of the DVC-A, UNSW, Sydney[a,b] , School of Mathematics & Statistics, UNSW, Sydney[c], Institute for Teaching & Learning Innovation (ITaLI), University of Queensland, Brisbane[c]
Corresponding Author Email: cct@unsw.edu.au

ABSTRACT

CONTEXT

"Loneliness, defined as a subjective experience of social isolation, has been identified as the next public health epidemic of the 21st century" (Lim, 2018). When combined with the recent impact of COVID-19 on engineering education, advancing our understanding of belonging and community forms a critical and timely challenge. Mounting evidence points to student belonging as a foundation of engaged learning, persistence to graduation and student wellbeing. However, understanding *how* to foster a sense of belonging to a community remains elusive as there is an absence of scholarly literature pointing to the practical activities and approaches that can be applied to develop inclusion and a sense of close connection between students and their learning communities.

PURPOSE

The purpose of our work is to explore the aforementioned gap in the literature, and to establish a foundation for practical methods to foster students' sense of belonging to learning communities within undergraduate engineering classrooms. Our scope includes pre-COVID and during-COVID timelines, and thus includes face-to-face, blended and fully online learning environments.

APPROACH

As part of a case study research design, informal pedagogical interventions were designed and delivered within face-to-face, blended and online tutorial and lecture settings, aimed at building relationships and fostering students' sense of *membership, partnership* and *ownership.* The cohorts included undergraduate engineering mathematics courses with ~500 local and international students. Our mixed method approach captured quantitative and qualitative data relating to students' experiences of interventions and their sense of belonging to the learning community.

OUTCOMES

Our results indicate that there are practical activities and approaches that teachers can incorporate to give students a sense of feeling included or believing they are closely connected to a learning community in face-to-face, blended and completely online environments. Successful strategies involved flexibility, friendliness, interactivity, encouragement, and support.

SUMMARY

Our work supports the position that students' sense of belonging can be enhanced in the classroom through teacher-led pedagogy. Furthermore, instilling in teaching staff an awareness of the importance of cultivating community and enacting pedagogical warmth is also impactful and can lay the necessary foundation for more specific interventions.

KEYWORDS

Community in the classroom, belonging, practical strategies, COVID-19.

Introduction

The recent impact of COVID-19 on engineering education has highlighted the importance of learning communities and belonging in universities. The challenge of belonging in education has captivated researchers for decades, and there is mounting evidence that points to student belonging as a foundation of engaged learning, persistence to graduation and student wellbeing (Allen et al, 2018).

In particular, a growing body of literature points to the impact of teacher behaviour on students' sense of belonging and sense of community in the classroom (Allen et al, 2018). For example, Astin (1993, p.223) draws on studies that show increased frequency of student-faculty interaction is related to students' satisfaction with college, and that interaction between students and faculty has a stronger relationship to student satisfaction than any other variable. Furthermore, Endo and Harpel (1982) concluded that informal interactions between faculty and students have a stronger impact on more student outcomes than do formal interaction. In addition, Felten (2019) takes the position that:

> *"if students perceive academic staff to be approachable, helpful, and encouraging, they are likely to be open to interactions with staff and to thrive at university; if students perceive staff to be remote, discouraging, or biased, they are likely to avoid interactions and to disengage from their studies".*

However, the recent and rapidly evolving context of COVID-19 is yet to be fully understood with regards to community and belonging. In particular, understanding practical examples of *how* teachers can foster a sense of belonging to a community remains elusive. There is an absence of scholarly literature pointing to specific strategies, case studies and approaches that can be applied to develop inclusion and a sense of close connection between students and their learning communities.

Herein, we aim to explore the aforementioned gaps with the purpose of establishing a foundation for practical methods to foster students' sense of belonging to learning communities within undergraduate engineering classrooms. Our scope includes pre-COVID and during-COVID timelines, and thus includes face-to-face, blended and fully online learning environments.

As part of a case study research design and action research, informal pedagogical interventions were designed and delivered within tutorial and lecture settings, aimed at building relationships and fostering students' sense of *membership, partnership* and *ownership* motivated by the work of Schreiner (2010).

We evaluated the impact of our interventions via the assessment of student perceptions involved by employing surveys, leading to a qualitative and quantitative analysis. Our interpretation indicates that there are practical activities and approaches that teachers can incorporate to give students a sense of feeling included or believing they are closely connected to a learning community in face-to-face, blended and completely online environments. Successful strategies involved embedding flexibility, friendliness, interactivity, encouragement, and support.

Research Design

The Intervention in More Detail

Tinto (1997, p.599) describes the classroom as "the crossroads where the social and the academic meet", making it the ideal site in which to build learning communities. In the context of this paper, we include face-to-face, blended and online environments as classrooms.

The case in our case study falls within the domain of a large, first-year class in mathematics termed MATH1131 at University of NSW. MATH1131 is a large, compulsory first-year course for all engineering undergraduates at UNSW. Its syllabus for our intervention included an introduction to vectors, complex numbers and matrices, see Tisdell (2021) for more context of this course.

Our intervention involved two, ten-week terms: firstly, during Term 3, 2019 in blended mode; and secondly, during Term 3, 2020 in fully online mode. In each of these terms the timetable of classes involved: 5 hours of lectures per fortnight, and 2 hours of tutorials per week.

The population size over the two terms was approximately 500 students. Our case study MATH1131 ran in Term 3 during each year which is traditionally a popular time of international student intake at UNSW, and so most of the students in our study were international (and male).

Our teacher-led strategies throughout the intervention periods may be summarized by the teacher

- Being friendly and welcoming
- Offering students choice and flexibility
- Fostering interactivity between students and teacher
- Displaying encouragement and support.

Let us unpack these behaviours briefly.

During our intervention, the teacher promoted a position of "relentless welcoming" (Felton, 2019). For example, at the beginning and end of each class, whether it was face-to-face or online, students were warmly greeted or thanked in a polite and friendly way to communicate that their presence was gladly acknowledged and received. This was done collectively ("Hello everyone and welcome back to MATH1131"), but also at the individual level when each student entered "the room". The use of individual student names ("*Welcome, Lingtong!*") was particularly easy for the teacher in the fully online live-streamed classes due to the names of all participants appearing on the computer screen. These actions align with the belief that teachers displaying friendly and welcoming behaviour has the potential to ensure everyone in the community feels welcome and a part of the group, fostering relationships that have the potential to thrive (Felton, 2019). An inclusive learning environment, one that creates a sense of belonging and connectedness, helps students to feel cared about and supported (Allen et al, 2018).

Throughout each term, the teacher offered flexibility and choice to the students. An example of this involved decisions regarding revision for medium stakes assessments. Students could choose when and how much class time was devoted to revision (e.g., A revision lecture to be held one week or one day before the mid-term? For a full lecture or just 30 minutes?). Another example involved tutorials, where the teacher was completely open to each student choosing to work on specific ideas that interested them during each class, such as the students: undertaking an online weekly quiz, exploring the practice questions from the textbook, or something else related to MATH1131. These actions acknowledged the position that teachers providing students with real choices in the classroom can boost engagement, motivation and sense of ownership, enabling them to capitalize on their strengths, and enable them to meet their individual learning needs (Parker et al, 2017; Wolpert-Gawron, 2018).

The teacher consistently created opportunities for interactivity with the students. For instance, the teacher regularly arrived at each class approximately 20 minutes before its timetabled start and stayed another 20 minutes after its timetabled conclusion. These actions opened a window for regular "*how are you*?" dialogue and presented opportunities to get to know students on non-academic levels. In addition, during tutorials at the start of each term, students were encouraged to introduce themselves and share some personal stories with the class. This was reciprocated by the teacher, and academically balanced by the

teacher asking questions and probing students' understanding during classes, enabling students to reflect and develop their ideas (DfEE, 1998, p. 8). These actions recognize that teacher interaction plays the most important form of interaction within classrooms (Johnson, 1981) and has the potential to influence belonging and community within this social network of relationships.

Finally, the teacher engaged in an encouraging and supportive practice. This was embodied, for example, by listening, noticing, boosting morale, praising effort and input, and celebrating. Some key catchphrases employed by the teacher included "I'm glad you asked that question" and "you *can* do it!". These actions align with the position of Evans (2005) that the more students are encouraged, the more belonging they experience, and that encouragement is an enabler of embedding "social interest" and "psychological hardiness" in individuals (Griffith & Powers, 1984).

Methodology

Our methodology for this work draws on elements of case study research, action research and impact evaluation which are appropriately aligned with our study in the following ways.

Case study methodology is a well-known research genre in the social sciences (Day Ashley, 2017, p.114) and involves "an empirical investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence" (Robson, 2001). A recognized advantage of case study research design in its ability "to enable the research to intensively investigate the case in depth, to probe, drill down and get at its complexity" (Day Ashley, p.114). Case study research is well-matched with our setting due to our intervention taking place in MATH1131 over two terms, which form the cases under investigation.

Action research has a long history in educational research and is becoming increasingly popular in other fields (Munn-Giddings, 2017, p.71). Action research is based within practice and not separated from it, that is, the researchers are part of their research context. One of the acknowledged advantages of this way of working is that being an insider "brings both a unique and rich knowledge base to their research" (Munn-Giddings, 2017, p.72). Action research aligns with our study due to one of the researchers also being the lecturer and tutor for the courses under consideration.

Our approach to interpret the experiences of students within our intervention draws on the concept of impact evaluation, which is a long-standing and popular way of working in the social sciences. Higgins (2017, p.145) describes impact evaluation as an assessment on the effects of initiatives or other intentional change that may include the perceptions of those involved. One of the strengths of impact evaluation is in its ability to guide scholarly-based policy and decision-making in education (Gertler, 2016).

Instruments and Data

To help us interpret the experiences of students, we employed surveys as our central instrument. Survey research forms a suitable tool for this due to its ability to gather information about population groups to "learn about their characteristics, opinions, attitudes, or previous experiences" Wang (2009, p.128) and thus is well aligned with the intentions of our research. Morerover, Murphy, Hill and Dean (2013, p.1) capture the essence of survey research: "Conducting survey research is at its core, a social interaction between a researcher and a (potential) respondent – a conversation with a purpose". Survey methods have enjoyed increased popularity in recent decades to form an important, accepted, cost-effective and time-efficient way of enabling research within the social sciences (Berends, 2006).

In Table 1 we summarize our evaluation overview, including the two sets of survey statements that we employed, the timing of the surveys and their focus.

Table 1: Evaluation Overview

Approach	Timing	Years	Evaluation Focus
Bespoke Survey	Both post intervention and at end of term.	Both run in 2019 and 2020	Interpreting the impact on students' attitudes regarding their experiences under the intervention
Institutional Course Survey			

The statements in our surveys are captured in Table 2. Their form and intent can be aligned with the four dimensions on belonging and community identified and discussed in the previous subsection.

Table 2: Statements in Surveys (Bespoke *A*-*K*, Institutional *L*)

Item	Statement
A	The teacher makes me feel like I am a member of this course.
B	The teacher encourages me to devote time and effort during this course.
C	The teacher sharing personal experiences and stories has helped to build a relationship between teacher and students.
D	The teacher is friendly.
E	The teacher is helpful and supportive.
F	Students are given opportunities to share their thoughts and opinions during class.
G	The teacher provides opportunities for students to make some choices about learning activities.
H	The teacher makes me feel like I have input into the learning group.
I	I feel like I am part of a learning community in MATH1131.
J	I feel a sense of learning partnership with my MATH1131 class.
K	I feel a sense of learning partnership with the teacher.
L	I felt part of a learning community.

In each survey, students were asked to respond to the each of the statements in Table 2. For our bespoke survey, students could respond at a high level for Items ***A-K*** by selecting either: Disagree (D); Mildly Disagree (MD); Neither Agree nor Disagree (N); Mildly Agree (MA); or Agree (A). For the institutional course survey, students could respond to Item ***L*** by selecting either: Strongly Disagree (SD); Disagree (D); Mildly Disagree (MD); Mildly Agree (MA); Agree (A); or Strongly Agree (SA). We note that there are two sets of scales here, however, according to Allen and Seaman (2007) "there's really no wrong way to build a Likert scale" and that augmenting these two sets of data for each term gives us the potential to triangulate. Participants were not forced to make a choice regarding any of these statements. If they did not wish to answer then they could simply leave it blank.

Each statement was followed by a free text box where students could elaborate more on their thoughts regarding their experiences and attitudes towards the statement. Once again, if students did not wish to provide additional comments they could leave this part blank.

In Tables 3 and 4 we have reported the spread of data captured from our bespoke and institutional course surveys over 2019 and 2020. Note that due to an oversight Item ***K*** was accidently omitted from the 2020 survey.

Table 3: Bespoke Survey Data 2019, 2020 (Terms 3)

	Term 3, 2019						Term 3, 2020					
Item	D	MD	N	MA	A	n	D	MD	N	MA	A	n
A	2	2	10	42	62	118	0	0	4	21	57	82
B	2	4	12	46	54	118	0	0	5	32	45	82
C	3	4	24	35	52	118	0	0	7	30	45	82
D	3	0	2	20	93	118	0	0	0	16	66	82
E	2	1	5	32	78	118	0	1	2	17	62	82
F	2	1	15	40	60	118	0	0	5	21	56	82
G	2	5	11	47	53	118	0	1	6	28	47	82
H	2	7	16	44	49	118	0	0	7	27	48	82
I	3	5	13	30	67	118	1	0	4	27	50	82
J	4	6	18	34	51	113	1	1	7	31	42	82
K	0	6	15	34	59	114	Not asked					

We can see in Table 3 that there was a total number of respondents of ~200 to the bespoke surveys, and in Table 4 that there was a total of 240 respondents to the institutional course survey.

Table 4: Institutional Course Survey Data 2019, 2020 (Terms 3)

	2019							2020						
Item	SD	D	MD	MA	A	SA	n	SD	D	MD	MA	A	SA	n
L	3	0	5	15	78	73	174	0	0	1	8	21	36	66

Analysis and Discussion

To analyze the data from the previous section we employ quantitative and qualitative approaches below.

We established a 5-point Likert scale for our bespoke surveys (D = 1, MD = 2, N = 3, MA = 4, A =5) and a 6-point Likert scale for the institutional course survey (SD = 1, D = 2, MD = 3, MA = 4, A = 5, SA = 6). Table 5 contains the mean score, confidence interval (CI) and standard deviation (SD) for each of the sets of responses which have been rounded to two decimal places. In addition, we provide some high-level data via the Overall Agree %, which is defined as those percentage of responses of: Mildly Agree; Agree; or Strongly Agree. Finally, we have included the effect size (Cohen, 1988), where we compare the standardized mean difference between 2019 and 2020 data. Although there is no “control group” at play here, we thought it would be interesting to compare to see if there was some improvement in the 2020 intervention above the 2019 intervention.

We can see from Table 5 that all mean scores were between 4 and 5, or between 5 and 6. In 2019 most scores remained in these ranges when applying the lower end of the confidence interval. In 2020 all scores remained in the above ranges when applying the lower end of the confidence interval. This suggests that overall, we may interpret the students as agreeing or

mildly agreeing with the statements in Table 2 regarding their experiences of our intervention.

Table 5: Analysis of Bespoke Survey Data 2019, 2020 (Terms 3)

	2019		2020		
Item	Mean, CI* (SD**)	% Overall Agree***	Mean, CI (SD)	% Overall Agree	Effect size
A	4.36 ± 0.15 (0.84)	88	4.65 ± 0.12 (0.57)	95	0.40
B	4.24 ± 0.16 (0.89)	85	4.49 ±0.13 (0.61)	94	0.33
C	4.09 ± 0.18 (1.00)	74	4.46 ± 0.14 (0.65)	91	0.44
D	4.69 ± 0.13 (0.75)	96	4.80 ± 0.09 (0.40)	100	0.18
E	4.55 ± 0.14 (0.77)	93	4.71 ± 0.12 (0.58)	96	0.23
F	4.31 ± 0.15 (0.85)	85	4.62 ± 0.13 (0.60)	94	0.42
G	4.22 ± 0.16 (0.91)	85	4.48 ± 0.15 (0.69)	91	0.32
H	4.11 ± 0.17 (0.97)	79	4.5 ± 0.14 (0.65)	91	0.47
I	4.30 ± 0.18 (0.99)	82	4.52 ± 0.15 (0.71)	94	0.26
J	4.08 ± 0.20 (1.07)	75	4.37 ± 0.17 (0.79)	89	0.30
K	4.29 ± 0.16 (0.89)	82	Not Asked		
L	5.21 ± 0.14 (0.93)	95	5.39 ± 0.18 (0.76)	98	0.22

*Confidence interval at 95%, **SD is the standard deviation

***Overall Agreement is defined as those responses of: Mildly Agree; Agree; or Strongly Agree.

We also note that items ***D*** (friendliness), ***E*** (helpful and supportive) and ***A*** (membership) were the three highest scoring items across both years, suggesting that the teacher's behaviour had more of an effect here than in other areas, such as items ***J*** (peer to peer partnership) and ***C*** (sharing stories), which where the two lowest scoring items across both years. This suggests student felt more strongly about the first set of items than the second set.

In addition, we observe that the effect size ranges from 0.2 – 0.47 across all of the items except one (***D***) which was very high already in 2019. This suggests small to medium improvements between the 2019 intervention and the 2020 intervention. One way of explaining this is due to maturation – the teacher was probably more adept at the intervention the second time around, even though this was within a completely online environment.

Over 600 free text comments were collected as part of our bespoke surveys. The data was analysed via NVIVO to produce a frequency of terms. We established word stems, so "help" and "helping" would be coded together. The rankings are presented in Table 6.

Table 6: Ranking of Coded Themes from Bespoke Survey Data 2019, 2020 (Terms 3)

Theme	**2019 Rank**	**2020 Rank**
Question, questions	1	1
ask, asked, asking, asks	2	11

helpful, helping, helps, help	3	N/A
encourage, encouraged, encouragement, encouraging	4	5
answer, answered, answering, answers	5	4
friendly, friend	6	7
share, shared, sharing, shares	7	6
time, times	8	N/A
understand, understanding, understandable	9	N/A
approachable	10	9
interact, interactive, interactions, interaction	11	10
discuss, discussion, discussed	12	8
engaging, engaging, engages	13	12
learn, learning, learns	14	13
motivated, motivation, motivates, motivating	15	14
student, students	N/A	2
chat, the chat, in the chat	N/A	3

If we consider Table 6 then we notice that the identified themes relate to the concepts of community and belonging discussed earlier in this paper. For example, the responses of "question", "asking", "interact" and "discussion" can be linked with the concept of fostering interactivity. In addition, "Helpful", "encouraging" and "understanding" can be aligned with the dimension of support and encouragement. Overall, Table 6 can be interpreted as the students providing consistent feedback across both years acknowledging the impact of our intervention on their sense of community and belonging.

Conclusion

By designing and applying basic teacher-led interventions such as friendliness, choice, interactivity and encouragement, we gained valuable insights into *how* teachers can apply practical strategies to create conditions and opportunities that foster students' sense of belonging to community. These small, practical strategies were grounded in established theories of belonging and community, and were consistently and positively received by students. Our rerunning of the intervention resulted in a small to medium improvement. More work needs to be done, including further explorations of what kinds of practical community-building strategies work best, and for whom?

We encourage teaching staff to build on this work, and cultivate community and enact pedagogical warmth in their own way that is meaningful and impactful within their own classroom environments.

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