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Exploring the applicability of Tronto's ethics of care in first-year engineering education

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In this paper, we examine the different ways in which instructors implement and promote care in their teaching in a first-year engineering course. Using a case study informed by Tronto's ethics of care framework, this paper identified innovative actions and behaviours that instructors have used in their classrooms. Through in-depth interviews and class observations, we identified behaviours fitting each of Tronto's four ethical elements (Tronto, 1993), including being attentive to students, taking responsibility for meeting their needs, being competent, and understanding how students are responding to their teaching, by being responsive. For example, being available and in close proximity to the students by walking around the classroom and actively checking how students were responding, are examples of strategies satisfying the attentiveness element. The responsiveness element had the greatest number of distinct strategies identified. Based on student evaluation data, we were able to show the ways in which students valued these behaviours. This innovative study outlines a comprehensive list of specific teaching behaviours and techniques that educators who want to improve their teaching practices and student outcomes can use to successfully implement care in the classroom.

Keywords: ethics of care; case study; engineering education; first-year

Introduction

Students in engineering courses face an array of challenges. Khalaf et al. (2013) argue that the lack of real-world engineering problems in the first two years causes a number of problems, including low student retention in engineering programmes (see also Veenstra et al., 2009). This delay in making explicit connections to engineering can be addressed by using problem-based learning in first-year courses (Nielsen, 2020). A prevalent problem among first-year students, particularly in the engineering field, is a lack of a sense of community, which on the individual level can be viewed as a low sense of belonging. Scholars point to the broader culture of engineering education as exclusionary (Pearson et al., 2018).

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Looking at the broader higher education literature, there is a group of researchers suggesting that the central issue in teaching, generally, is a lack of care (Thayer-Bacon & Bacon, 1996; Barrow, 2015). According to Barrow (2015), caring teaching behaviours inspire students to meet and surpass instructors' expectations, create positive changes, and challenge the norms and boundaries imposed in the classroom. Another engineering education study, Hong & Shull (2010), explored the impact of professor attitudes on undergraduate engineering students. When asked about their worries and difficulties with the major, the students mentioned how upsetting they found it that the instructors did not even bother to find out which classes they had to take (Hong & Shull, 2010). When asked what they thought had positively impacted their learning in their engineering course, students mentioned they felt more connected with their instructors when they interacted with them outside of class and showed genuine concern for their success. Because of this connection, students had a more favourable image of professors and found them to be more approachable and easier to connect with. This, in turn, had a positive impact on their learning.

While this general literature tends to focus on individual instructors, we argue that the broader cultural landscape and how this impacts the classroom calls for a theorisation of care that moves beyond the impulses of an individual instructor. In sourcing a more critical approach to the topic of care, we were drawn to the theorisation of the ethics of care, as put forward by Tronto (1993). Specifically, we looked at work by Bozalek et al. (2014), who used Tronto's theory to evaluate a professional development programme at their institution focused on improving teaching and learning. Taking our direction from Bozalek, we designed a qualitative study looking at the implementation of care in a first-year engineering classroom, grounding our study in Tronto's conceptualisation of care, and exploring how care might be operationalised in lecturers' everyday teaching practices. The study was framed around the following research questions (RQs):

Overarching RQ: How is care understood, enacted, and experienced in teaching in a first-year general engineering programme at Virginia Tech?

Sub-RQ1: What were the instructor's intentions with regard to implementing care in the classroom?

Sub-RQ2: How did the instructors enact care in the classroom?

Sub-RQ3: What do students describe to be helpful for their learning as related to their perceptions of the instructors' enacted behaviours in the classroom?

Theoretical framework

The concept of the ‘ethics of care’ first appeared in a highly cited paper by Tronto in the 1980s, which had talked about how future feminist moral thinking must be broader and more theoretical, and despite the biological disparities between men and women, an ethic of compassion transcends these distinctions (Tronto, 1987). Since then, Tronto has gone on to emphasise the need for care and robust care policies in institutions (Tronto, 2010), in a paper which examined how to determine whether institutions offered quality care, and argued for the need for ‘care institutions’. Other researchers like Noddings and Bozalek have also significantly contributed to literature on care. Noddings, in one of her papers, initiated a basic framework of what care looks like, and attributed traits such as interacting, thinking critically, and responding reflectively in connection with care (Noddings, 2012). Tronto initiated the conversation about care and Noddings brought this conversation into the educational space more specifically and briefly defined what it might look like. From this, Bozalek and colleagues took this conceptualisation into the context of higher education by using a political ethics of care as a normative framework to evaluate a model of teaching and learning in professional development. In this paper, they identified the five elements of care as attentiveness, responsibility, competence, responsiveness and trust (Bozalek et al., 2014).

According to Tronto, showing care implies that one is there for something or someone else. Apart from self-care, care is normally neither self-referring nor self-absorbing when it is given (Tronto, 1993). The breadth and normative orientation of Tronto’s notion of care can be seen in this definition:

... a species activity that includes everything that we do to maintain, continue, and repair our ‘world’ so that we can live in it as well as possible. That world includes our bodies, ourselves, and our environment, all of which we seek to interweave in a complex, life-sustaining web (Tronto, 1993)

Tronto’s framework identified four phases of caring: caring about, taking care of, care-giving, and care-receiving. The *caring about* phase includes identifying a need and deciding whether or not it has to be satisfied to first acknowledge the need for care. To effectively complete this step, one must comprehend the need by placing oneself in the shoes of another person or group (Tronto, 1993). The *taking care of* phase involves acknowledgment of the need and subsequent decision-making toward its resolution. This stage is realising that action can be performed to address these unmet needs rather than solely concentrating on what the specific

needs are and not doing anything to address this. For *care-giving* to take place, this typically entails physical labour and almost always involves interaction between the caregivers and the people receiving care. The *care-receiving* phase recognises that a person in need of care will eventually respond to the care being provided to them. This is important to consider since this is the only way we can understand whether the caring needs have been met or not.

As a result of these four phases of caring, Tronto developed her four ethical elements of care. These include attentiveness, responsibility, competence, and responsiveness, which are discussed here in turn.

Attentiveness

Attentiveness indicates that we cannot possibly meet others' needs if we are not aware of these (Tronto, 1993). At its most basic level, caring entails recognising a need and meeting that need, which is why the first moral need for caring is to simply pay attention. The philosopher Simone Weil also emphasised that meaningful human contact requires the ability to pay attention (Tronto, 1993).

Responsibility

Tronto states that responsibility is central in an ethic of care, but it can also be problematic if viewed from a standpoint of political theory (Tronto, 1993). When looking at it through the lens of political theory, responsibilities are usually defined as the need to follow rules and regulations that are established by commitments we have made. Tronto emphasises that instead of continuing to utilise obligation (rather than legal provisions) as the foundation for understanding what individuals should do for one another, we would be better off focusing on a more open-ended view of responsibility (Tronto, 1993).

Competence

This element of care concerns whether the need for the care has been met or not. When proper care is not provided despite good intentions and even acceptance of responsibility, the need for the care is ultimately unmet. Competence is a crucial element to include as a moral dimension of care because of the bad faith displayed by individuals who would 'take care of' an issue without being willing to provide any type of care. Competence makes it possible to have the confidence that the care work is being done in an effective manner (Tronto, 1993).

Responsiveness

The last element of Tronto's ethic of care framework is responsiveness, relating to the receptivity of the recipient of care to the care being given (Tronto, 1993). This is also related to the competence element where, even though someone's care needs are being attended to and the intention of the care being provided is good, it is not necessary that this care will be well received by the care-receiver. Since the care-receiver's needs are ultimately the highest priority, we must understand how they are responding to the care and, if it is not well received, then the approach needs to be altered.

It should be noted here that Tronto later extended her four initial elements of care to include a fifth 'caring with' category which described the importance of the distribution of care and the need for all to care together (Tronto, 2013). For this study, however, we will only be using Tronto's four ethical elements of care from her earlier formulations.

When considering how an ethics of care might apply to engineering education, there seems to be a natural link to the significant literature that has emerged on the need to develop empathetic engineers (Walther et al., 2018). Furthermore, along with empathy being identified as a key factor in engineers' overall career success (Hecker, 1997), it is also associated with discussions regarding students' ability to consider the perspectives of other stakeholders and to incorporate these insights into the design and the decision-making process (Walther et al., 2018). In the context of engineering, empathy has been portrayed by scholars as being a fundamental element of ethical reasoning, since students require this attribute in order for their designs to satisfy customers' needs (Hess & Fila, 2016). Much of the empathy literature is mentioned in accordance with ethics and, in a way, empathy and care are interconnected in terms of both being qualities that humans need for the betterment of some external party.

This however is quite different from this study as much of the literature on empathy and ethics deals with student characteristics, mentioning how they are important characteristics that students need to have when they eventually become professional engineers. In this study, however, we look at how care is used and implemented in teaching specifically. As opposed to focusing on students exhibiting these characteristics, the emphasis is placed on the teacher to understand how care can be enacted in teaching in the classroom.

Research design

For this research, a qualitative case study was chosen since we wanted to explore in detail how care is understood, enacted, and experienced in the classroom. To do so, this study was conducted at Virginia Tech in the USA, a research-intensive university with a large engineering programme, taking in more than 2 500 first-year students annually, split into sections of 72 students per class. For this study, we focused specifically on the second course in the first-year general engineering programme's two-course sequence. This course serves as an introduction to the field by emphasising topics like data collection and analysis, mathematical modelling, engineering problem-solving, design, contemporary software tools, and professional standards and expectations (Virginia Tech, 2022). Moreover, instructors were chosen as participants who had taught this course at least twice in the past, as well as having obtained teaching-related awards. This yielded three instructors – and the sections they taught – as the focus of this study. These characteristics were chosen since we wanted to create a scenario where we were most likely to see care being implemented in the classroom.

For data collection, the three instructors underwent two semi-structured interviews, their classes were observed, and students completed evaluations.

The interviews were conducted to better understand the instructor's intentions with implementing care, hence answering the first sub-research question. The first interview was to gain a deeper understanding of the instructors' perspectives on care and its implementation, as well as their background, general opinions, and perceptions of care, and why they believed it might be important. The purpose of the second interview was to understand how instructors specifically considered and implemented care in accordance with Tronto's framework on the ethics of care, and hence the fundamental concepts used to design these interview questions came from Tronto's four phases of caring.

Three in-class observations were carried out to understand how instructors enact care in the classroom, hence answering the second sub-research question. These observations were spaced apart during the semester since each class is roughly divided into three portions throughout the course of the semester. Tronto's four ethical principles served as the foundation for the creation of an observation protocol. Following the initial observations of each instructor, the observational framework was adjusted in light of the findings. Since it was anticipated that this observational framework would improve with each observation, a few minor adjustments were made each time an observation was made.

The final data collected were student evaluations conducted every semester at this institution. These were used to answer the third sub-research question. One of the questions asked in this survey was, ‘What did the instructor do that most helped your learning?’ Responses to this question provided rich data on students’ experiences.

With regard to analysis, both interviews were conducted and recorded through Zoom. This meant that transcripts could be generated at the conclusion of both interviews along with the timestamps. To understand the main themes, descriptive coding and pattern coding were carried out. Descriptive coding involves assigning a word or a short phrase to summarise the basic topic of a segment of data (Saldana, 2014). Finding themes that were shared by the descriptive codes in the first cycle coding was essential in order to connect these themes to the various components of Tronto’s theoretical framework. To carry out this process, pattern coding was carried out for the second cycle of coding in order to search for the common themes and patterns from the first-cycle codes, and these were matched against Tronto’s ethic of care framework (Miles et al., 1994).

When analysing the in-class observations, each of these behaviours was compared with the initial observational framework for each instructor. Any new actions seen by instructors were added, and the observational framework was updated.

When analysing students’ evaluation comments, tactics used by their teachers that students frequently identified were noted. Since the comments were open-ended, many students provided extensive responses, indicating that they had given careful thought to their observations, and their opinions were important to take into account. Therefore, these remarks were also considered in this analysis.

Findings

This section answers the research questions by presenting the different *intentions* and *approaches* participants used in *implementing* (Sub-RQ1) and *enacting* (Sub-RQ2) care that were mentioned in participant interviews, seen through classroom observations, and *described by students* (Sub-RQ3) under each of the four ethical elements from Tronto’s care framework. Table 1 presents the strategies identified in the findings, which are discussed in more detail in this section.

Table 1: Summary of instructor strategies for each of Tronto's ethics of care elements

Ethical Element	Strategy
Attentiveness	Signalling availability and building proximity
	Carrying out check-ins
Responsibility	Student relevance
	Making students do the work
	Promoting verbal interactions
	Flexibility
	Clear communication
	Implementing student feedback
	Providing a well-organised and planned system of learning
Competence	Assessing students
Responsiveness	Soliciting student feedback

Attentiveness

Regarding this element, the instructors' *availability and closeness to the students*, as well as their propensity *to check on the group's progress*, were found to be the two key techniques they mentioned in their interviews. To be available and in close proximity to the students, instructors mentioned how they placed a high priority in *moving around the classroom to observe students' needs*. In relation to checking on the group work, instructors depicted how they found it necessary to *approach each student group and spend time with each one to ask them questions* and gain an understanding of how each individual student group was progressing in relation to their project.

From the in-class observations, to signal their availability and build proximity, instructors were observed walking around the classroom while students were working. Two of the instructors were observed going directly to the students and checking on them to see how they were doing, while one instructor preferred to be more passive and walked around the classroom close to the students' desks. This action made students feel more comfortable in asking questions since the instructor was nearby and students did not have to call out for help if required. To specifically emphasise their availability, all the instructors were observed verbally

telling the students that if they had any questions or concerns, they were able to simply put up their hands and either the instructor or one of the teaching assistants would attend to them.

With the aim of soliciting student feedback, instructors were observed going up to each individual student group and briefly asking them questions and checking on their progress. One instructor had also taken a pen and paper and spent five minutes with each group to take notes on tracking each team's progress. Another approach instructors used was to ask students at the start of the class how things were going. This resulted in students feeling more at ease in discussing their degree programme, other classes, and when they had further exams and assignments due. One instructor had also added a question slide in his Google Slides and made this available to all students. This created an opportunity for students to ask him any questions about the class, or anything generally. The purpose behind this was to get students who were more hesitant in opening up in person in the classroom to raise their voices.

The analysis of the student evaluation comments found that students mentioned that their instructors were 'very attentive and helpful' since instructors would always 'walk around during the class and so this made it easy to ask questions'. Students also described instructors to be 'very accessible and close by' if they needed anything. Along with this, students also described how they found the instructors very approachable and stated that they 'felt very human and approachable and always told us to come up to them if we had any questions'. The availability of instructors was seen as helpful since 'either the instructor or the teaching assistant was always available to answer questions', and the instructors would 'always give us the option to go to their office hours'. On top of this, students appreciated the instructors regularly checking in on them too. They stated in their evaluation surveys that instructors 'always set up times to meet with us as a team to make sure we were on track'. This was described as useful since students mentioned that if instructors had not gone around individually asking each student team questions 'we would have not asked some of the questions if we had to direct them towards the whole class, rather than to the instructor personally'.

Responsibility

Regarding responsibility, the teachers suggested the following strategies in their interviews: student relevance, making students do the work, student engagement, flexibility, clear

communication, implementing student feedback, and providing a planned and well-organised system of learning.

Some of the methods instructors mentioned they liked to employ included providing culturally/technologically relevant courses, putting oneself in the students' perspective, building on prior knowledge, focusing on prior struggles, and using inclusive examples. Instructors also emphasised the importance of allowing students to figure out things on their own and make them do the work. To achieve this, instructors stated they liked to give students the freedom to explore as well as allowing them to learn from their own mistakes and guiding them in this process as opposed to directly giving them the answers.

Having clear communication was another strategy – instructors mentioned in their interviews that they aimed to consciously give clear and concise instructions. This included sending out regular announcements and updates but also included giving better instructions for assignments. They also highlighted the significance of explaining how whatever material they taught was related to the learning outcomes of the course to aid students in making this connection. Regarding the implementation of student feedback, instructors stated how they did this by employing the use of a common themes slide, ensuring that they responded to the classroom generally and not specifically to individual students as well, as by filtering useful and non-useful feedback. The final strategy mentioned under this element was to provide a well-organised and planned system of learning, and to achieve this, instructors spoke about the need to have an organised system of learning in the classroom.

In relation to making students do the work, one instructor was clearly seen to make students take ownership of their own learning and actively participate in their work. To do this, the instructor would ask questions to the class regarding a certain topic and would divide them into smaller groups, followed by full class discussion. The instructor would encourage students to find the answers and would simply fill in any gaps that they had about the concepts, as opposed to telling them the answers.

To promote verbal interactions in the classroom, some of the instructors were observed to start the class by asking the students, 'Tell me something I don't know'. Many of the students raised their hands quickly, showing that they were interested and excited to share the facts they had prepared. One of the instructors was observed to take the first five to seven minutes of class to just generally converse with the entire class about how their lives were going.

Instructors also described the importance of flexibility, and this was seen in the classroom when one of the instructors allowed a student to submit their assignment late. This instructor also cancelled one class session to allow student groups extra time to work together on their project. While the other instructors were not observed to give any extensions to students, they were observed to regularly tell students that if they did need an extension, they were able to ask for this.

In relation to clear communication, it was seen that at the commencement of the class, all the instructors did well in making any necessary announcements and outlining the main points of the lesson. The instructors typically took five to ten minutes to explain to the class where they were in the course, where they were headed, what assignments and deadlines were coming up, and what they would be doing in class during that time. One instructor went into great depth to provide directions for a particular assignment. They were observed taking 10 to 15 minutes during this class period to look over all the tasks that would be due in the upcoming four weeks.

Instructors were also observed to respond to the feedback they had received from students generally and made sure to not do so specifically with regard to each student. One instructor was observed summarising their feedback to students where the instructor had posted a question that most students would have asked initially and then addressed this problem by including the solution on the slideshow and holding a discussion with the class about it.

In the analysis of the student evaluation comments, it was shown that students believed instructors put in effort to make the courses relevant to the students. They described how instructors had ‘always used examples we could easily relate to and presented the assignments and lessons in a way that all students could understand’. This shows how instructors prioritised the inclusive nature of their classroom. Students also mentioned how the examples used were always relatable, as one student depicted ‘I liked how they used real-world examples that we could understand and relate to before giving us tasks’.

Students also spoke about the extent to which instructors allowed them to take control of their own learning. They described how they felt as though they were able to figure things out on their own, and how the instructor’s ability to allow them the freedom to explore things on their own helped in their learning. One of the student comments explained how the instructors ‘allowed us a lot of freedom and choice in our learning’ and how ‘they allowed us to have creative freedom in the class’.

Instructors providing an engaging and interactive classroom environment were also mentioned in many of the students' evaluation comments. Students reported how the class environment felt very comfortable and positive, and as a result, they always felt encouraged to come to class. One student stated that 'the instructor did a good job in creating a welcoming environment, allowing for student interactions and bonds to develop'.

In relation to the flexibility strategy, most of the student comments were about instructors being flexible with office hours as well as assignment due dates and the ability to submit work later. One student mentioned how one instructor was 'flexible and understanding of delays or personal life that could affect grades/due dates which I appreciate'.

Students also mentioned the instructors' ability to always provide clear communication in the classroom. Students mentioned how one of the instructors would regularly explain the purpose behind every task being carried out in the classroom and noted that 'the instructor explained both the practical applications and educational reasoning behind every activity and assignment. Everything we did felt like it had a purpose and was valuable'.

Not many students spoke about the instructors implementing their feedback. In fact, there was only one student who explained how instructors would 'make sure to get our feedback, listen to it and take it into account'.

There were however many student comments in relation to how each instructor was very organised and had a well-planned system of learning in the classroom. Students described how each class had a regular structure to it which made it easy for them to understand what to expect from each class. They explained how 'the structure of each class period was the same throughout the entire semester. This made it easy to lock in and focus on the class because I knew what to expect'. Due to this regular structure, there were no surprises and students said that they 'had no issue in trying to figure out what we had to complete during the week'. Students also explained that an important element of this organised learning was the instructors' ability to provide feedback: 'it was very helpful that they could provide timely and thorough feedback, both on assignments and general questions'.

Competence

The *assessment of students* was the only strategy that came out of the instructor's interviews in relation to the competence element. The approaches instructors discussed to carry out this

assessment included the *general assessment of learning outcomes which used assignments and projects to talk to students in and out of the classroom* to ensure students were on track to achieving the learning outcomes of the course, and to also talk to other faculty members so that there was more information available on what the concepts and topics were that students in the programme struggled with.

In the classroom observations, it was seen that all the instructors would regularly go up to students to talk to them and ask questions. However, what exactly these questions were and whether they were informally assessing students' knowledge of the material in the course was undetermined.

The students' evaluation comments talked about how the instructors 'looked out for the well-being of the students and checked if we understood the material or not'. Students felt as though instructors wanted to make sure that students understood the content being covered in the class and that they understood everything. One student explained this by saying 'they kept asking us questions to ensure we understood the content, and if we didn't know, they would go over it again so we could do well and succeed in the class'. The idea of instructors ensuring that students understood the material was reinforced by another student's comment: 'they were always coming around to ask us if we had any help, any questions and whether we understood what was going on'.

Responsiveness

Since this element revolved around instructors understanding how students were responding to the care being provided, one strategy instructors mentioned in their interview was to *actively solicit feedback from the students*. To carry this out, instructors talked about how they *used in-class reflections, exit surveys, mid-term evaluations, conversing with students* as well as *peer evaluation and student evaluation responses*.

In the classroom, like the competence element, instructors asked the students questions. This could be in relation to how students felt the instructing team was doing as a form of obtaining feedback from them. Since the specific conversations were not heard, the content of these questions could not be determined. The only other strategy the instructors used to obtain feedback from students was exit surveys. Instructors were observed to ask their students a series of questions about their experiences with the activity they completed in class, the things they found difficult, and what they would like to see more of in the future. Instructors then gave

students this survey as a miscellaneous assignment to complete and submit before the next class meeting to successfully obtain this feedback.

Students mentioned in their evaluation comments how instructors did a combination of conversing generally with students in the class and carried out class reflections to obtain students' feedback. One depicted that the instructor 'was always very open to feedback as they always like to hear from us, which I liked a lot since it makes us all more engaged'. Students also mentioned how they appreciated the fact that they felt that their opinions were heard: 'they would always ask us how the class was going and wanted our feedback on it and would take our ideas into account'. Another student went on to describe how even though they found the process of giving feedback annoying, they respected the fact that their voice was heard: 'the reflections, while annoying, were helpful to help the instructor understand how the class could be better'.

Discussion

This section presents a discussion of the main strategies from the instructor's interviews in relation to how they intended to implement care in the classroom and the relevant literature on the topic.

Attentiveness

The instructors mentioned two main strategies they used to satisfy the attentiveness element: availability and proximity, and student check-ins. To be available and emphasise instructor availability to the students, instructors mentioned they liked to walk around the classroom to be close to the students. The latter was mentioned as useful since students were more inclined to ask questions as a result, and they also felt less hesitant to reach out to the instructor. Interestingly, Dyer et al. (2018) also describe the benefits of close instructor proximity to the students but for a different reason. They depict how students are more likely to be off task and pay less attention if a teacher is further away, and that the inverse also holds true (Dyer et al., 2018). In this sense, the findings of this study did not directly connect with what literature currently says on proximity since the instructors who mentioned and were seen doing this were doing so for the express purpose of making students feel comfortable asking questions.

The instructors also talked about how they believe emphasising their availability and walking around the classroom was effective in making sure they could be aware and recognise

if students had questions or certain needs. The importance of walking around the classroom and emphasising availability was also emphasised in a study by Cole (1999). She described how going around the classroom to check up on students or teams of students for roughly half a minute could be useful to better understand whether students might have questions and were on task or not. She emphasised that the main purpose of this strategy was to obtain an immediate assessment of the students' work by talking to them (Cole, 1999). This study presents the act of walking around the classroom and talking to students as a way of informally assessing the students. In our study, however, the instructors mentioned that the benefit of walking around the classroom specifically satisfied the attentiveness element, while talking to students to ask them if everything was making sense satisfied the competence element, and the two approaches can be viewed separately. This disaggregation is due to our use of Tronto's framework and the definitions of each element.

The effectiveness of student check-ins in order to be aware of the different student needs was another strategy instructors mentioned that satisfies the attentiveness element. To carry out student check-ins, some approaches instructors mentioned involved carrying out team check-ins as well as putting up slides of prompts to encourage students to ask any questions they might have. The benefit of carrying out team check-ins was further emphasised by Cole (1999), who discussed how sitting down with a group for a longer period of time and interacting with them and watching them work was a lot more beneficial in understanding what issues students might have, and what they might need from the instructor. An approach one of the instructors mentioned was to carry out check-in questions with students for the purpose of understanding how they were doing in the semester and to also better understand their needs (see Saphier et al., 1997).

Responsibility

As mentioned previously, the responsibility element saw the greatest number of approaches being mentioned by the instructors, and these approaches were divided into seven main strategies. The first strategy was about making the material being taught in the classroom relevant to students. Instructors spoke about the importance of making sure all the material being presented in class was relevant to students and that more inclusive examples and learning styles were to be used. The significance of this is also represented in literature about culturally relevant teaching, indicating how it will help embed students' background and culture into the course curriculum, and will hence help negate any of the adverse effects of the more dominant

culture (Leonard & Guha, 2002). The instructors in our study also spoke about approaches suiting what some of them termed different students' learning styles. Leonard & Guha (2002) describe similar points when explaining how a part of conducting student-relevant teaching is to ensure instructors remain aware of and cater to students' unique ways of knowing, behaving and communicating.

There were also many approaches the instructors mentioned that centred around the idea that students should be made to 'do the work'. This includes approaches such as making them take control of their own learning, learning from their mistakes, and generally imparting lifelong learning. Literature also aligns with the instructors' thinking as it has been shown that independent learning is beneficial for students as this increases their general motivation and confidence, improves their academic performance, allowing them to better be aware of what their own limitations are, and to understand how to better manage this (Meyer et al., 2008).

Some research, however, does mention that despite the benefits of allowing students to take control of their own learning to a certain extent, what learners prefer may not necessarily always be what is best for them (Kirschner, 2013). This was a difference between the findings of our study and the literature, since this point was not clearly emphasised by the instructors at any point. Instructors mentioned their priority of making students manage their own learning process and this is a form of self-directed learning, a process by which learners are in control of and manage their learning process, which has been shown to positively correlate with lifelong learning (Boyer et al., 2014).

Other strategies mentioned in relation to this element included promoting verbal interactions between students and engaging them to be flexible, as well as communicating clearly. Promoting verbal interactions between students and allowing them to form peer relationships has been shown to engage learners (Leach & Zepke, 2011). Research has also shown that allowing students to have verbal interactions that lead to their engagement in a range of different educational activities provides them with a higher quality of learning (Coates, 2005). What is not emphasised in literature is not merely interactions between students and the instructors, but also promoting interactions between students and their peers, which was made explicit in the findings of this study. The instructors in the study also spoke about the importance of being flexible in their teaching practices and having flexible policies for students. There is some research that talks about flexible teaching, and this has been linked with what is termed 'open learning'. Open learning, similar to what instructors in our study

have mentioned, refers to having flexible policies in the classroom as well as through online measures, which means that students have increased access and choices in their learning (Lundin, 1999). These flexible policies for university students specifically have been researched to mimic the work patterns and professional needs of adult learners (Lundin, 1999).

Clear communication was another strategy instructors talked about in relation to responsibility. They specifically explained the importance of communicating assignments, announcements, and updates as well as the relation of all the in-class activities to the learning outcomes of the course with students. Clearly communicating expectations around assignments, for example, helps students manage the time they spend on important educational tasks (Hunt, 2003). Literature, also shows that the lack of clear communication decreases students' motivation to do well (Hunt, 2003). Along with communicating expectations, to clearly communicate and explain how the class activities are related to the learning outcomes of the course, was also stressed by the instructors. Currently, literature supports the idea of not only having well-defined goals and learning outcomes, but also making sure these are clearly expressed to the students. Redelius et al. (2015) explain how when the learning outcomes of the course are both well-defined and expressed to the students, the clarity of this practice motivates students to talk about what they are learning and to make better sense of it.

With regard to student feedback, the instructors spoke specifically about the implementation of this feedback; not just simply taking or giving feedback. The instructors in our study mentioned they liked to address this via a 'common themes slide', and to make sure the feedback was implemented in a timely manner. Leckey & Neill (2001) indicate that there are many instructors who do not view student feedback as being very valuable and are sceptical of the process. One of the reasons for this is that students are not assessors and, in spite of the fact that the lecturer has much more experience than them, if the students' opinions goes against the lecturer, the students' responses can usually not be challenged (Leckey & Neill, 2001). Literature has shown this to be troublesome since there are many benefits to implementing student feedback that include increased student self-esteem, motivation and personal satisfaction (Clynes & Raftery, 2008). Additionally, multiple studies show that students, for the most part, are willing and appreciate the opportunity to participate in a process of course revision and evaluation (Brew, 2008; Carless & Boud, 2018).

The final strategy of the responsibility element was instructors providing a well-planned and organised system of learning. One of the approaches employed to do this was to align the

in-class activities with the course learning outcomes. There is extensive literature that deals with the importance of instructors providing well-organised and planned systems of learning in their classrooms, since this establishes an effective learning environment and also prevents most conduct problems (Brophy, 1983). Furthermore, Biggs (2001) emphasises the importance of making sure learning activities and assessments are aligned with the intended learning outcomes of the course.

Competence

It was mentioned in the theoretical framework section that it is ultimately important to understand whether the student's caring needs have been met or not. In the context of the classroom, this relates to whether students were achieving the learning outcomes of the course, and hence, one strategy mentioned to satisfy this element was to assess the students. This was through approaches involving assessing the learning outcomes (formal assessments), talking to students generally (informal assessments), as well as seeing if anything stood out in the comments in student evaluations. In order to understand whether students are achieving these learning outcomes, general assessment is a vital tool (Suskie, 2008). The instructors however, along with the literature, mentioned just talking to students as an approach to assess them. Saphier et al. (1997), who was cited earlier in this section, explained that as instructors talk to students in and out of class, they get the chance to ask them any relevant questions about the course which is a good way to assess their understanding.

When it comes to competence generally, literature currently does not explicitly mention many strategies in relation to being a competent instructor. Literature states that to be competent involves actions like ensuring instructors can communicate with a diverse range of learners, and being able to involve and include as many of the class as possible (Hollins, 1993). Where this differs from the findings in our study is in the definition of Tronto's element of competence, as opposed to the general definition of competence. This is because the competence element in Tronto's framework highlights the importance of understanding whether the need for care has been met or not. Most of the actions that literature recommends instructors can do to be generally 'competent' fall under the responsibility element in the framework guiding our study. In other words, these are specific actions that instructors might take to positively influence a situation (in the context of study, this is to effectively implement care in the classroom).

Responsiveness

Responsiveness centres around the idea that instructors need to find a way to understand how students are responding to the care being provided to them. This is different to the responsibility and competence elements since Tronto mentions how it is not enough to take responsibility for providing the care or even to ensure that the care needs are met; it is equally important to understand the students' receptivity to the care being provided. The main strategy mentioned here was obtaining student feedback about the instructor and the course experience. Some approaches mentioned were peer evaluation tools. Other methods such as giving general class reflections, exit surveys, or just talking to students were also discussed. When comparing these approaches to the literature on obtaining student feedback, Richardson (2005) explains how surveys that use formal instruments are typically quite effective. This is because these instruments can document student experiences in a systematic manner and are able to gather information from the entire student population. However, Richardson (2005) also mentions that feedback can be obtained through casual comments in the classroom with the students, and meeting groups of students. This is interesting as it relates to the findings of this study where instructors mentioned how they like to generally talk to students in and out of class.

Conclusion

Engineering education faces significant challenges, particularly regarding first-year students' sense of belonging. Research highlights that the prevailing engineering culture often makes newcomers feel excluded and doubt their place in the field (Pearson et al., 2018). This exclusionary environment is further exacerbated by the attitudes of some instructors. Hong & Shull (2010) found that students frequently feel demotivated when they perceive their professors as indifferent.

However, implementing care in teaching can mitigate these issues by fostering a supportive and motivating learning environment. Our case study explored how three instructors incorporated care into their teaching practices within a first-year general engineering programme. This study utilised Tronto's political ethic of care framework, adapted for educational settings, which includes four key ethical elements: attentiveness, responsibility, competence, and responsiveness.

In terms of attentiveness, instructors should be consistently available and accessible to students, maintaining close contact. Regular 'check-ins' with students or groups ensure their

well-being and provide an opportunity for addressing questions or concerns. For the responsibility element, course content must be relevant and engaging for students. Promoting active student participation and verbal interactions within the classroom is essential. Clear communication is crucial, including explaining how assignments relate to learning outcomes. Flexibility and responsiveness to student feedback are essential, along with maintaining an organised learning environment. To fulfil the competence element, regular assessments, both formal and informal, help gauge student progress and address their needs effectively. For responsiveness, instructors should seek and act on student feedback to understand their perspectives on the teaching and the course overall.

The study demonstrated that these strategies are effective in a first-year team-based engineering course with about 72 students. It can be seen from the findings however that these strategies are general and can be employed in any teaching context, and not only in a first-year team-based engineering course. Furthermore, while this study was conducted in the US, the approaches seem more widely relevant. While some adjustments might be necessary for different class sizes or more theoretical courses, the core principle of caring for students remains applicable and beneficial. It is notable that it is Global South scholars such as Vivienne Bozalek led the way in bringing Tronto's work into the tertiary classroom.

In conclusion, incorporating care into teaching practices creates a positive atmosphere conducive to learning. This approach fosters student motivation and engagement, addressing the sense of exclusion often experienced in engineering education. By implementing the outlined strategies, instructors can significantly improve the educational experience and outcomes for their students.

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