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# Designing for inclusion: A pilot study on cultivating inclusive mindsets in engineering students

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ABSTRACT

In response to persistent challenges in attracting and retaining underrepresented groups in higher education, a pilot project at a Belgian university was developed, aimed at embedding inclusive design principles within the curriculum. Efforts to improve diversity and inclusion in higher education often focus on supporting underrepresented groups through targeted interventions. While valuable, such approaches risk overlooking structural and cultural dimensions of exclusion. The project presented in this paper focused on cultivating an inclusive mindset among students through targeted curricular interventions. Three case studies were developed to explore inclusion across course types, discipline-specific fields (i.e. engineering), and stages of the bachelor's programme. These interventions addressed (1) diversity in the engineering profession, helping students imagine diverse future selves; (2) diversity in teamwork, encouraging inclusive collaboration; and (3) cultivating reflection on the students' own biases and positionalities.

Findings suggest that even small-scale, discipline-anchored interventions can foster awareness and critical reflection on diversity. The paper concludes with lessons learned for educators and institutions seeking to structurally embed inclusion in engineering education and outlines future directions for sustaining inclusive practices across curricula. We underscore that inclusive education requires more than goodwill. It needs structures, tools, and visible practices aligned with core educational goals.

**Keywords:** curriculum design, inclusive mindset, sense of belonging, diversity and inclusion, DEI

## Introduction

Inclusion in higher education remains a persistent challenge. Despite increasing diversity in Western populations, higher education continues to struggle with recruiting and retaining individuals from underrepresented groups. In Belgium, 8% of new bachelor's students at Flemish universities have a disability, and 17% come from a migration background (Vlaamse Interuniversitaire Raad, 2025). Engineering education, in particular, remains one of the least diverse study domains: across Europe, nearly 73% of students enrolled in engineering, manufacturing, and construction programmes are male (Eurostat, 2024). Meanwhile, engineering faces persistent labour shortages (European Labour Authority & Fondazione

Giacomo Brodolini, 2024). Attracting and retaining a more diverse student population is therefore both a moral and an economic imperative.

Having a diverse engineering team within professional practice is also technically advantageous because it enhances innovation and problem-solving capacity in engineering practice (Atadero et al., 2018). Diverse teams bring broader perspectives, which could enhance creativity and lead to more robust solutions (Page, 2017; Stahl & Maznevski, 2021; Wang et al., 2019). Diverse teams are better equipped to critically interrogate assumptions, identify blind spots, and ensure a broader range of user needs. In this way, diversity is key to better, more inclusive, design (Waller et al., 2015).

While many initiatives focus on attracting students from underrepresented groups, equal attention must be paid to the learning environment they encounter once enrolled. Inclusive education requires that all students experience a sense of belonging and are accommodated within teaching practices. This is particularly crucial during the first year of study, when attrition rates are highest among students from underrepresented groups. Underrepresented groups often struggle with various issues like a lower motivation, reduced academic performance and higher dropout rates (Diekman et al., 2019; González-Pérez et al., 2022; Villa et al., 2020). These outcomes are rooted in systemic and cultural barriers within the learning environment, including implicit biases and subtle forms of exclusion, such as lowered expectations or stereotype-based assumptions (Morreel et al., 2021).

### From individual responsibility to institutional change

Efforts to address inequality in engineering education have often concentrated on individual-level interventions. Examples are mentoring or outreach programmes that aim to change underrepresented students (Blosser, 2020; Campbell-Montalvo et al., 2022; Ong et al., 2018). While valuable, these interventions risk reinforcing narrow portrayals of engineering and are often grounded in deficit ideology. This is a belief system that locates educational disparities within the perceived shortcomings of underrepresented students, rather than in institutional structures and norms (Gorski, 2011). Such an approach legitimises remedial or compensatory interventions and focuses on learning diverse cultural groups to adapt to the cultural scripts and norms of the majority group, rather than questioning and transforming that culture itself (Morreel et al., 2021).

In contrast, recent scholarship advocates for a shift towards institutional responsibility, emphasising the role of educational systems in addressing inequality (Atadero et al., 2018; Moreu et al., 2021). Inclusive design frameworks guide teachers in actively working to include diverse student experiences and backgrounds from the outset through the creation and adaptation of flexible learning environments (Fornauf & Erickson, 2020). Universal design encourages anticipating diversity and offering multiple means of engagement, representation and expression (Capp, 2017; Rose, 1999). In doing so, diversity is viewed not as a problem to be managed, but as a resource that strengthens learning for all students. Achieving such transformation requires systemic commitment – from policy and curriculum design to daily classroom practices.

### Cultivating inclusive mindsets

Awareness of diversity, and how to accommodate it among staff and majority-group students, is a crucial first step towards inclusive learning. That is why a central aim within the project presented in this paper is

the cultivation of an inclusive mindset. As Tongkaew and Lomberg (2024) define the factors of an inclusive mindset, it involves developing awareness of one's own biases, valuing diversity as integral to learning, being motivated, and having the necessary knowledge to act inclusively in everyday practice.

Cultivating inclusive mindsets is not just an add-on, but part of redefining what it means to educate engineers for contemporary societies. Additionally, research has shown that the normalisation of such a mindset within university culture improves underrepresented groups' sense of belonging and retention (Isaac et al., 2023; Page, 2017; Palid et al., 2023). Cultivating inclusive mindsets among students and educators is, therefore, a crucial component of institutional change.

## The context: Towards a more inclusive engineering learning environment

This paper presents a pilot project initiated at the Faculty of Engineering Technology (FET) at KU Leuven (Belgium), aiming to embed inclusive design within the engineering curriculum and create a more welcoming and supportive environment for all students. The general project focuses on cultivating an inclusive mindset among students and teaching staff, raising awareness of the benefits of diversity, and developing supporting tools for inclusive course design.

The Faculty of Engineering Technology (FET) at KU Leuven (Belgium) exemplifies the recruitment and retention challenges discussed earlier. In the academic year 2024-2025, the total number of students was 4.801, with 1.065 being new bachelor students. Despite targeted recruitment efforts, the student population remains highly homogeneous: in 2024, only about 10% of new students were women, and even less had a migration background - defined as students with a Belgian home address and Belgian secondary education diploma, whilst they themselves, at least one parent, or two grandparents did not have Belgian nationality at birth (KU Leuven, 2022) - with significant higher dropout rates for the latter group than for other students.

In response, KU Leuven's 2021–2025 strategic plan outlines a diversity-responsive approach to inclusion, employing a twin-track strategy (KU Leuven, n.d.). Firstly, the university adopts a universal approach grounded in universal design principles, aiming to provide education that appeals to a diverse audience. Secondly, recognising that not all barriers can be addressed in this way, the university offers facilities and reasonable adjustments to the educational environment to maximise accessibility for all, like a mentoring programme for female engineers.

The university has launched several initiatives to embed diversity and inclusion structurally across the institution. These initiatives include training programmes designed to strengthen the diversity competencies of teaching staff and efforts to diversify the university personnel. Another important domain for the implementation of this strategic plan is everyday teaching practice. Research shows that creating a sustainable culture of inclusion within higher education requires cultivating inclusive practices at the faculty level (Atadero et al., 2018).

A survey conducted within our faculty assessed educators' attitudes, self-efficacy, and intentions regarding inclusive education. While staff generally reported positive attitudes and high levels of confidence in their ability to teach inclusively, their intention to adapt teaching practices showed greater variability (Craps et al., 2025). The results suggest that, for some educators, an intention–action gap persists: they value inclusion but struggle to translate these beliefs into practice. Through various workshops with the faculty teaching staff, several structural and cognitive barriers were identified, including limited time, uncertainty

about the relevance of inclusive approaches in technical subjects, and a lack of concrete examples or institutional support.

The project presented in this paper, *Towards a More Inclusive Learning Environment*, focused on curricular interventions, approaching inclusion not solely through the lens of students or teachers, but through their shared space: the learning environment. These efforts align with recent calls to move beyond symbolic gestures and to institutionally embed inclusive teaching practices (Fornauf & Erickson, 2020). The project more generally aimed to:

1. Foster students' inclusive mindsets throughout the curriculum;
2. Raise awareness among teaching staff about inclusive design and its relevance across all course types; and
3. Develop co-created tools with teaching staff to help educators identify blind spots in their course design and optimise them through inclusive curriculum development.

To address the first two objectives, the project team (first, second, and last author) worked together with teaching staff to select three case studies and implement targeted interventions supporting students' inclusive mindsets. These cases demonstrate that small, targeted interventions can lead to meaningful change in both teaching and learning practices. The following sections present the three cases in more detail, outlining the selection criteria, describing the interventions, and concluding with lessons learned that may inspire educators in other disciplines and contexts on their journey toward a more inclusive learning environment.

## Case studies

The selection of the case studies was guided by several criteria, carefully designed to capture the variety of courses within the engineering programme. These criteria included (1) the course orientation, (2) the engineering field, (3) the phase within the bachelor's programme, and (4) the angle from which we focus on an inclusive mindset. Table 1 provides an overview of the three case studies and their alignment with the selection criteria.

**Table 1** overview case studies and criteria

| Case study | Course orientation | Disciplinary field | Phase implementation | Inclusive mindset focus |
|---|---|---|---|---|
| Case study 1 | Non-technical | Common programme | First bachelor year | Engineering practice |
| Case study 2 | Technical | Electromechanical Engineering | Second bachelor year | Engineering team |
| Case study 3 | Non-technical | (Bio)chemical, Electromechanical & Electronics-ICT Engineering | First, second and third bachelor year | Self |

*Criterion 1: Course orientation of the course*

The project aimed to make teachers aware that creating inclusive learning environments is relevant regardless of course content. The engineering programme consists of technical or discipline-specific courses

and courses that address non-technical subjects such as ethics and enterprises. Non-technical topics, such as communication, team dynamics or project management, are also integrated in the main project work called Engineering Experiences. These competencies are recurring in every bachelor year through the learning path professional competencies. The goal was to show that interventions for an inclusive environment can and should be implemented in all courses.

#### *Criterion 2: Disciplinary field of the course*

The second criterion is related to the engineering fields. After the common first bachelor year, second-year students choose a major in one of three areas: electromechanical engineering, (bio)chemical engineering, electronics-ICT engineering. One case was selected in the common programme, whilst the other two were specific to certain majors. We aimed to implement interventions in all majors so we could have the broadest reach.

#### *Criterion 3: Phase of implementation of the course*

The third criterion aimed for distribution across the three-year bachelor's programme. One-time interventions are not sufficient, fostering an inclusive mindset requires a continuous and integrated approach, embedding these themes consistently and within course content and pedagogy. Therefore, the case studies are situated across different years in the bachelor's programme.

#### *Criterion 4: The inclusive mindset focus of the intervention*

The final criterion involved attention to the multiple dimensions of diversity that characterise the field of engineering. Cases were selected to implement interventions that appealed to these different dimensions: gaining knowledge by looking at the diversity in the engineering work field, acting inclusively in teamwork and reflecting critically on one's own biases and competence to become a responsible engineer.

The guiding criteria resulted in the selection of the following three case studies:

1. The first case study addressed diversity in the workplace through a job-shadowing activity, paired with a reflection exercise where students have to think about how they would improve diversity and inclusion in their future workplace.
2. The second case study focused on teamwork within a technical course, and how to construct a safe environment for students to build their resilience.
3. The third case study consisted of an online portfolio on professional competency development, in which students are invited to reflect critically on their own perspectives and biases regarding diversity.

Together, the three case studies constitute a curriculum-level progression: Case 1 introduces awareness on inclusion and diversity, Case 2 engages students in enacting inclusive skills through teamwork, and Case 3 fosters ongoing reflection on their own perspectives and biases. This sequence supports the gradual and continuous cultivation of inclusive mindsets across the bachelor programme.

The following sections describe the case studies in greater detail. It is important to note that, whereas the first case has been implemented and evaluated at time of this publication, the second and third case are implementation-ready interventions for which no student outcome data is as of yet available. Accordingly, our discussion focuses primarily on the design rationale and development process underlying these interventions.

## Case study 1: A small-scale intervention to create awareness of diversity in engineering practice

The first case study was embedded in a teaching activity of the first-year course *Enterprise and Ethics*, specifically the *Day with an Engineer*. In this teaching activity students apply insights from the theoretical lectures focusing on enterprise on the one hand, and ethics on the other hand. *Day with an Engineer* is a job shadowing activity where students follow a practicing engineer for one day, and gain insight into what it is like to be an engineer. Afterwards, students share their experiences and reflections amongst peers, and write a group paper about common observations, (un)expected experiences, the engineers' trajectories, etc., and conclude with a final reflection about themselves as future engineers. Students have one introductory lesson and two workshops to prepare and guide them through the process. This course is part of the common programme.

The goal of this case study was to explore whether a small-scale and low-threshold intervention could positively influence students' pro-diversity mindset – a concept that is closely related to, but more specific than, the broader notion of an inclusive mindset. Miville and colleagues (1999, p. 303) defined pro-diversity attitudes as "an attitude that recognises and accepts the differences and similarities". In this study, the pro-diversity mindset was interpreted as understanding the value of diversity and being motivated to improve diversity, as well as being comfortable and welcoming towards diversity (Cannaerts et al., 2024). To do so, we implemented small modifications in the regular activity. To follow up on the impact of this small-scale intervention, a control and an intervention group were created by splitting the student group in half.

### *Intervention design*

The intervention was set up as follows: In the first preparatory workshop, the intervention group received a short additional explanation on diversity and inclusion, while the control group received one on stakeholders. The intervention group was taught what diversity and inclusion meant, why it matters for engineers, and was given concrete examples of the consequences of technological applications that lacked inclusive design (e.g. higher mortality rates for women in car-crashes due to not including female bodies in car-testing; Linder & Svensson, 2019). Additionally, a reflective exercise was included in the final group assignment about the diversity in the company of the engineer they followed, and about how they – as future engineers – could improve diversity and inclusion themselves. The control group had a similar preparation and exercise, but with a focus on stakeholder management and how they would interact with stakeholders in the future.

### *Key insights*

To measure the impact of the intervention on the students' pro-diversity mindset, we used a survey with pre- and post-test measurements. The intervention and surveys were approved by the Social and Societal Ethics Committee, and Privacy and Ethical Review of KU Leuven (G-2022-5665). The students who participated in the surveys also gave consent to use their information for research purposes. A pilot study of the intervention was run in 2023 (N=88) and further implemented in 2024 (N=53). To measure this construct, three subscales were defined:

1. **Diversity Initiatives**, which assesses students' support for institutional efforts to promote diversity (e.g. "Hiring a diverse team of teachers should be a top priority of the Faculty of Engineering Technology").
2. **Personal Attitudes**, which captures individual beliefs about the relevance and benefits of diversity in engineering (e.g. "I would like to learn more about the benefits of diversity in the engineering field").

3. **Comfort**, which measures students' ease in interacting with people from different backgrounds (e.g. "I feel most at ease with people who are similar to myself" – reverse coded). Items were rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Findings of the pilot study (for detailed results: Cannaerts et al., 2024) revealed that students who attended the lecture on diversity and inclusion showed a modest but statistically significant improvement in their personal attitudes towards diversity and inclusion, as well as an increased comfort level in interacting with peers from diverse backgrounds. The results from the second case study showed similar trends than the pilot study, however, without a significant p-value. Namely, all scales slightly declined through the semester, but the intervention group declined less for the personal attitudes scale and comfort scales, when looking at the change scores of the pre- and post-test. While responses were low, it is promising that comparable results were achieved. The full overview of the results can be found in Table 2.

**Table 2** Overview of the results of case study 1

| **Pilot study – YEAR 1** | **Diversity initiatives** | | **Personal attitudes** | | **Comfort** | |
|---|---|---|---|---|---|---|
| | **EXPERIMENT** | **CONTROL** | **EXPERIMENT** | **CONTROL** | **EXPERIMENT** | **CONTROL** |
| ***N*** | 31 | 34 | 31 | 34 | 31 | 34 |
| ***MEAN CHANGE SCORE*** | -0,15 | -0,12 | -0,04 | -0,18 | 0.10 | -0.15 |
| ***SD*** | 0,7 | 0,64 | 0,68 | 0,38 | 0.75 | 0.48 |
| ***W*** | 512 | | 673,5 | | 655 | |
| ***P*** | 0,58 | | 0,03 | | 0,05 | |
| ***EFFECT-SIZE*** | 0,02 (/) | | 0,24 (small) | | 0,21 (small) | |
| **Case study – YEAR 2** | **Diversity initiatives** | | **Personal attitudes** | | **Comfort** | |
| | **EXPERIMENT** | **CONTROL** | **EXPERIMENT** | **CONTROL** | **EXPERIMENT** | **CONTROL** |
| ***N*** | 32 | 21 | 32 | 21 | 32 | 21 |
| ***MEAN CHANGE SCORE*** | -0.14 | -0,06 | -0,28 | -0,55 | -0.19 | -0.63 |
| ***SD*** | 0,69 | 0,51 | 0,67 | 1,11 | 1,45 | 1,08 |
| ***W*** | 376.5 | | 285 | | 278 | |
| ***P*** | 0,77 | | 0,18 | | 0,15 | |
| ***EFFECT-SIZE*** | 0,10 (small) | | 0,13 (small) | | 0,15 (small) | |

This intervention illustrated that even brief, targeted framing within existing curricular activities can enhance students' awareness of diversity and contribute to the cultivation of an inclusive mindset early in their studies.

### Case study 2: A trajectory in course redesign for inclusive student teams

The second intervention was situated in a teaching activity in the second-year course *Engineering Experiences*, where students in electromechanical engineering need to apply the technical content from all other courses in one large, authentic challenge or project. The focus of this teaching activity is on data acquisition. The course was selected because the course coordinators were already preparing a redesign. As electromechanical engineering represents the largest student group on campus, several teaching assistants are involved in guiding and coaching student teams. The coordinators wanted a redesign for several reasons

with the most important ones being: (1) the need to create safe but challenging learning environments that strengthen students' resilience, (2) the wish to increase inclusive mindsets in students that promote collaboration between the diverse groups within the teaching group, and (3) the need for support for teaching assistants in guiding diverse teams. In the second year, local and international students work together at the campus for the first time, so we focused primarily on interventions to promote their interactions while also considering the needs of other student groups, such as neurodiverse students.

The intervention targeted the teaching team involved in the course, with two primary goals: (1) to raise awareness of how different student groups may experience the course, and (2) to collaboratively adapt the course structure to promote inclusion. To achieve this, we organised 3 informal interviews with the teaching team, conducted a literature study on inclusive approaches to resilience (Allard & Craps, 2026) , pilot tested our a tool for support teaching staff through inclusive curriculum development (Craps et al., 2025), and compiled practical recommendations that we presented to the instructors.

### *Intervention design*

The renewed course, which will be implemented during the second semester of the academic year 2025-2026, will bring students together in small, multidisciplinary teams in which they work on a smart home project connected to a larger – teaching group level – smart city context. Within this setup, students will design data acquisition systems, make engineering decisions collaboratively, and regularly exchange insights across teams through 'city hall' meetings. It will be set up in a game-based format, where teams will compete against each other while encountering various artificially set-up challenges that they will have to solve on a teaching group level. The teaching staff also wished to accommodate various skill levels and therefore designed smart home cases at multiple challenge levels, ensuring these differences will be communicated in a non-judgmental manner so that students at an easier challenge level will not feel discouraged.

Our sessions with the teaching staff led to a supportive trajectory to include inclusive design in their course. The redesign offered opportunities to integrate universal design learning (UDL) principles (Rose, 1999) within a challenging course environment that, next to building technological knowledge and skills, also aimed to build resilience for all learners. While resilience is often framed as an individual trait, its development is strongly influenced by students' personal background and the learning environment. Neurodivergent students, for example, may find open-ended tasks and high-stress situations particularly challenging without sufficient scaffolding (Sankalaite et al., 2025). We worked with teaching staff on how to accommodate these different student experiences and foster a safe space to fail and learn from the mistakes that are – almost inevitably – made during project work (Feigenbaum, 2021; Nunes et al., 2022).

The course redesign aims to encourage the development of inclusive mindsets of the students in several ways. First, the team-based game format situates technical learning within a collaborative context, where teams will create smart home solutions as well as joint smart city outcomes with the other teams. The teamwork, at a smaller and larger scale, will require constant negotiation, perspective-taking, and interest in diverse ideas. Second, the multiple challenge levels within the project, as well as the explicit differentiation of different engineering roles (see, Craps et al., 2022), will allow all students to contribute to the project on an equal footing, fostering recognition of diverse talents.

### *Key insights*

The teaching staff found the meetings with the project team very valuable. They reflected: "We were already working on inclusivity without really naming it. It was enriching to start thinking about it

consciously and to receive frameworks that helped us structure our ideas". And added that "We learned that inclusivity involves more aspects than we initially thought, not only different learning speeds or cultural backgrounds, but also mental and physical limitations". By providing support during the redesign phase of the course, inclusion was structurally integrated by the teaching staff and was not seen as an afterthought. The teaching staff emphasised that the reflection sessions with the project team were key in fostering sustainable change.

### Case study 3: A structural embedment of challenging personal bias

The third case study focused on revising the 'professional competencies portfolio', an e-portfolio that supports students' professional development and lifelong learning attitude. The e-portfolio encourages students to assess and reflect upon a range of transferable skills such as communication, teamwork, and critical thinking (Dujardin et al., 2024). In all bachelor years, each semester, students select one competency to focus on, formulate a development plan and receive feedback at three moments throughout the semester. The e-portfolio follows the five-step personal development process: *identifying gaps* in competencies, *preparing* for learning by setting goals, *acting* on this plan, *monitoring* the learning process and *reflecting* on how the learning process can be improved (Patel et al., 2013).

#### *Intervention design*

Within this project, the e-portfolio was revised to foster students' critical self-reflection regarding diversity and inclusion. Two modifications were introduced. First, a new competency was added to the first step of the portfolio (*identifying*) as a rubric-based self-assessment. Table 2 presents the rubric developed. Although the *diversity competency* rubric was based on the Cultural Intelligence (CQ) model, it does not adopt CQ's four-domain structure (metacognitive, cognitive, motivational, and behavioural) (for more information see, Deardorff, 2006; Leung et al., 2014; Peng et al., 2020). Rather, it follows the portfolio's established four-level format, where students assess themselves on a scale from beginner to expert. While an alternative approach, like developing a separate rubric for each sub-domain of the CQ model, was considered, this was not pursued given the already extensive scope of the portfolio.

**Table 3** Rubric for diversity competence

| Levels | Description |
|---|---|
| **Beginner** | I rarely reflect on how my background (such as my home situation, culture, or habits) shapes my view of the world. I know little to nothing about topics such as diversity and inclusion. |
| **Developing** | I recognise that people can experience or understand things differently, but I usually still think and act from my own perspective. |
| **Proficient** | I am aware that both my own background and that of others influence our interactions. I mainly notice this when the differences between myself and others are very clear. I try to take these differences into account. |

| | |
|---|---|
| **Expert** | I am aware that even the things I take for granted in my thinking and actions are not universal. I actively consider situations from multiple perspectives and acknowledge that my view is neither the only nor the complete one. I apply this reflection systematically in my interactions with others and in my work as an engineer. |

Second, complementary to the rubric-based self-assessment, a critical incident question was added to the final step of the portfolio (*reflecting*) to stimulate deeper reflection across all phases of study. Students are invited to describe a specific situation that surprised or challenged them in relation to how others thought, worked, or communicated, and to reflect on their reactions, underlying assumptions, and lessons for future collaboration. This question follows a simple reflection cycle: (1) recalling a concrete situation, (2) becoming aware of personal feelings or judgments, and (3) exploring alternative responses and lessons for future teamwork.

### *Key insights*

The portfolio with the rubric will be piloted in academic year 2025-2026 at three campuses of the faculty, and monitored in subsequent academic years. The critical incident question will be added at a later stage. Through these adaptations, the portfolio aims to integrate inclusivity as a core professional competency, encouraging students to view diversity as intrinsic to engineering practice.

Based on preliminary data from one campus (N=170), only 4% of the students positioned themselves at the *Beginner* level of the rubric. 31% scored themselves as *developing*, 54% as *proficient,* and 11% as *expert* level on this diversity competence. This means that over half of all students consider themselves as being aware of their own background and that of others in social interactions and try to take these differences into account.

This self-assessment is also reflected in the comments written by some students (N=12) in the rubric. Many of the students expressed an openness to differences and intended to consider these. Students wrote “I am open to differences, but I can still deepen my sensitivity and understanding” or “I always try to take each person’s background into account and how their perspectives relate to mine”. One student described how their own personal background helps them connect with others, writing “I have Albanian roots myself, so I can easily build bridges with people from diverse cultures”, other students noted how they have tried to be aware of their personal biases like one student saying that “sometimes I have prejudices about people, but I still give everyone equal opportunities” or “[…] I try to keep my prejudice in mind but not to rely on it (and compare it with what we learned )[…]”. These students scored themselves on the developing level.

One student questioned the relevance of the rubric, placing themselves on the *e*xpert level but writing “I do not find this fully applicable within an engineering context, because a solution either works or it does not, without diversity being directly involved. I am able to take it into account, but I consider it secondary to quality”. This shows that not all students are yet convinced of the importance of an inclusive mindset in engineering. It underscores the need to clearly demonstrate how engineering is shaped by society, how technologies affect diverse users, and why awareness of personal biases is essential. Embedding discussions on inclusion and diversity throughout the curriculum, and showing its relevance in technical courses, may aid to decrease scepticism in the student population.

## Lessons learned

This project provides valuable insights for educators and institutions seeking to embed inclusion across curricula. We have divided our lessons learned with regard to teaching staff and students.

### Teacher perspective: Structurally embedding inclusion in the disciplinary practice

A first lesson is the need to anchor inclusion in the disciplinary practice. During several workshops with teaching staff as part of the project, some participants questioned the applicability of inclusive education practices to highly technical content (Craps et al., 2025). It is therefore important to frame knowledge about diversity and interventions to increase the inclusive mindset of students as a crucial part of their professionalisation, be they engineers, social scientists, or others. This disciplinary anchoring not only legitimises inclusion within the broader faculty culture, but also facilitates its translation to concrete teaching strategies.

Due to the time constraints faced by many educators, it is essential to acknowledge the inevitable time investment required to design and implement more inclusive learning environments. Adopting new pedagogical approaches or integrating additional inclusive elements into a course always requires a baseline level of preparation and adaptation. However, this investment can be substantially reduced through targeted support. Faculties can play a crucial role by providing accessible, domain-specific examples illustrating how inclusive practices can be embedded within existing courses. Aligning it with planned course revisions can further enhance efficiency, as it allows this work on inclusion to be integrated into ongoing development processes. Finally, approaching inclusive design through incremental, small-scale adjustment can make the process more manageable and sustainable, enabling educators to build inclusive learning environments gradually without overwhelming existing workloads.

This project depended on individual teaching staff who voluntarily participated and adapted their courses and teaching practices. While individual teachers can initiate change, sustainable transformation depends on institutional structures that support and coordinate their efforts. Establishing teaching communities is therefore recommended to support ongoing dialogue and reduce the isolation felt by educators already engaging in inclusion work. These learning communities should be fostered by faculty management, as research has shown that informal faculty networks are often more effective in sustaining pedagogical innovation than top-down mandates (Thomas & Macnab, 2022). At KU Leuven, the next phase of projects will focus on training and supporting teachers and key management actors across faculties to ensure a sustainable embedding of diversity and inclusion within all teaching practices.

However, we should not abandon the role of policy. Embedding inclusive teaching criteria within curriculum review and quality assurance processes ensures that inclusion becomes part of the faculty's long-term pedagogical standards. Institutions may align certain incentive structures, like teaching evaluations, with inclusive education goals. This ensures that inclusion measures are not confined to symbolic policy documents but have a tangible impact.

### Student perspective: Developing inclusive mindsets across the curriculum

At the student level, we wish to highlight that the first year of university is a formative period in which students' sense of belonging and self-efficacy affects their socio-academic integration and persistence (Chen et al., 2021; Morrow & Ackermann, 2012; Robbins et al., 2004). It is therefore imperative that

discussions about inclusion and diversity, which are also opportunities to feel seen and valued, begin in the first semester of study. Embedding inclusive perspectives at this early point may hopefully have a lasting effect on how students understand what it means to *be* an engineer and help create an inclusive climate from the start.

That said, it is of equal importance to note that an inclusive mindset needs to be cultivated throughout the *entire* curriculum. This means involving courses in all programmes, both technical and non-technical, and across all years of the bachelor's degree. Students need iterative engagement with concepts such as inclusion and diversity across time and contexts to truly grasp their meaning and impact (Biggs & Tang, 2011). They benefit from repeated, sequenced engagement in which they first build foundational knowledge and awareness, before applying inclusive principles in team contexts. Consistency across semesters, programmes, and instructors is therefore essential.

This progression is also reflected in the three cases discussed: case 1 focuses on building foundational knowledge and awareness, case 2 engages students in enacting inclusive skills through teamwork, and case 3 provides an ongoing moment for reflection and critical insight into one's own social biases. Structured tools such as rubrics and reflection prompts help scaffold this process and guide students from surface understanding to critical self-awareness (Panadero et al., 2023).

Similarly to teaching staff, it is important that the integration of inclusive elements does not lead to a disproportionate increase in students' workload. As illustrated in the cases presented in the paper, discussions or activities aimed at cultivating students' inclusive mindsets can be embedded within existing learning tasks. By integrating these components into activities that students are already required to complete, the development of inclusive competencies does not create additional burdens but becomes a natural part of their learning process.

Additionally, change can begin with small, low-threshold interventions (Walton, 2014). As demonstrated by the first case study, even brief and targeted interventions can have a modest but statistically significant impact on students' attitudes toward diversity. Adjusting a lecture, integrating a reflective question, or diversifying examples can already shift students' perception.

## Looking forward: Measuring and sustaining inclusion work

Though we wished we could support all our teaching staff towards inclusive design, time constraints limited the extent of our engagement. It therefore became equally important to create tools that enable educators to reflect on and adapt their own courses autonomously. As part of this project, we developed the *Inclusion Scan*, a practical instrument designed to help educators and programme committees identify blind spots and plan concrete steps for embedding inclusion across curricula (see Craps et al, forthcoming).

Given that the project only lasted one year, we were unable to conduct quantitative or qualitative evaluations of the interventions. This is the biggest limitation of our project. The pre- and post-measurements from Case 1 yielded promising results; however, future studies should compare the effects of several types of interventions to better understand their impact.

The short project duration also required us to make choices regarding the scope of diversity addressed in each intervention. Diversity is a broad, multidimensional concept that needs to be researched in all its

complexities. Due to time constraints, we either approached it in a general, overarching way (as in Case 1 & 3) or focused on specific dimensions (as in Case 2). Within the faculty, previous initiatives have primarily focused on gender diversity and students with a migration background. However, with the increasing number of international students in recent years, it is equally important to identify which aspects of the learning environment support their inclusion and sense of belonging. This will be taken up in future research.

An additional limitation is that we did not incorporate student perspectives into the design of the interventions. While our project strongly emphasised co-creation with teaching staff, it is equally valuable to involve students as partners in shaping inclusive learning environments, ensuring that their experiences and needs inform the development of these. Similar iterations of this work could address this limitation by incorporating student input through focus groups, participatory workshops, or by collaborating with student-researchers.

## Conclusion

Despite ongoing effort, engineering education in many western institutions remains marked by unequal representation and participation. This pilot project responds to that challenge by working to increase the awareness surrounding diversity and inclusion and embed the ideas of inclusive learning design within the engineering curriculum. However, the need for such initiatives extends well beyond engineering. In higher education more broadly, there is a need to create learning environments in which students feel like they belong (Fong et al., 2024).

Embedding inclusion within higher education requires both structural and cultural shifts. From the teacher perspective, disciplinary anchoring and institutional support are essential to legitimise inclusive practices and translate them into concrete teaching practices. From the student perspective, inclusive mindsets must be cultivated progressively across the curriculum, beginning in the first year and reinforced through iterative engagement. The three case studies in this project demonstrate that this is both feasible and impactful. They also showed that targeted interventions can contribute meaningfully to students' understanding of diversity within the disciplinary field (cf. engineering), and that even small adjustments in the course content or pedagogical approach can make an impact. We hope to have shown that diversity work can be meaningfully aligned with core educational goals. In an increasingly diverse society, inclusion can no longer be treated as an optional or peripheral concern but must be embedded as a core dimension of teaching practice and institutional culture.

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The Inclusion Scan can be found at: https://iiw.kuleuven.be/onderzoek/ether/inclusiviteitsscan

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