2.15

Cultivating Student Resilience: Individual Capacity and Institutional Responsibility

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Future engineers face growing complexity and uncertainty when addressing global crises and societal challenges, including climate and technological change. This necessitates equipping engineering students with the ability to navigate complexity and adapt to career transitions, leading to an increased emphasis on resilience within degree programmes. Resilience, broadly defined as the ability to adapt to, and learn from, adverse situations, has become a focal point in policies and a desirable attribute for graduates. In this chapter, we define resilience and discuss reasons why its significance is growing within engineering education. Following this, we present ways resilience can be included within engineering education, notably through the use of problem and challenge-based approaches, design thinking, and teamwork. We conclude by cautioning against uncritically embedding 'resilience' into engineering modules. Instead, we emphasise the need for contextual and intersectional approaches that account for the systemic factors and structural barriers that differentially impact student experiences and mental health.

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1 Definition

1.1 Conceptualisation across disciplines

'Resilience' is utilised across disciplines and associated with several definitions. Within engineering education, it has been linked to students (as a personal attribute) and systems (Winkens & Leicht-Scholten, 2023), with the concept of 'resilience engineering' (Hollnagel et al., 2006) used in infrastructure design in relation to how systems perform under stress.

This chapter focuses on individual resilience. We draw on psychology, where definitions of resilience typically include reference to two concepts: adversity, and positive adaptation (Luthar et al., 2000). The American Psychological Association (2018a) defines it as "*the process and outcome of successfully adapting to difficult or challenging life experiences, especially through mental, emotional, and behavioral flexibility and adjustment to external and internal demands*".

Shared understanding of resilience involves establishing conceptual clarity and consensus regarding these elements. For example, adverse conditions range from single experiences, such as major disasters, to multiple minor events, with resilience mechanisms varying by severity. Importantly, these conditions are not exclusively negative, and it is argued that positive live events such as job promotions also require adaptive responses and thus engage resilience processes (Fletcher & Sarkar, 2013).

Similarly, indicators of positive adaptation vary across context. Luthar et al. (2000) caution against expecting individuals to exhibit adjustment across conceptually unrelated domains, but that uniformity is expected across similar domains or contexts. In practice, this means that students who appear to be resilient based on academic grades should also demonstrate constructive academic behaviours. However, such indicators are often grounded in Western psychological frameworks that prioritise individual achievement and interpersonal functioning, potentially overlooking the influence of sociocultural contexts (Ungar, 2011).

Given this variability, determining what counts as 'positive adaptation' is not straightforward. It requires careful consideration of which outcomes are most relevant in a given context, as well as the level of functioning (whether 'adequate' or 'exceptional') that constitutes resilience. Luthar et al. (2000) suggest that these decisions be guided by the nature and severity of the risk, and the extent to which adverse events (e.g., failing an exam) threaten key outcomes (e.g., progression). Finally, applying resilience to specific contexts requires defining an appropriate reference point for recovery or growth. In engineering education, resilience has been conceptualised as an internal competency, drawing on O'Leary and Ickovics (1995), who identify four possible responses to adversity: thriving, recovery, survival, and succumbing.

1.2 Frameworks and models

Resilience has been studied extensively in psychology. While some view it as a trait, "*an enduring personality characteristic that describes or determines an individual's* *behavior across a range of situations"* (American Psychological Association, 2018b), it is more commonly conceptualised as a dynamic process between individuals and their context and involves utilising protective factors to mitigate adverse effects of stressors (Masten, 2019).

Several frameworks and models can be used to inform resilience-based education. Martin and Marsh's (2006) five Cs of academic resilience and Ginsburg's (2014) seven Cs of resilience view it as an individual trait. Both models include the ability to control outcomes, confidence in one's own ability, and coping with stress or composure. In addition, Ginsburg's model incorporates competence required to handle situations effectively, connection with family and friends, character values, and contributing to the community and sense of purpose, with Martin and Marsh's model including coordination (planning) and commitment (persistence).

In comparison, several frameworks emphasise the role of broader systems. Those most relevant to education include the Building Assets, Reducing Risks (BARR) model (Jerabek et al., 2023), which adopts a strengths-based approach, and involves identifying and nurturing students' internal assets through intentionally designed supportive environments. The Academic Resilience Model (de Oliviero Durso et al., 2021) offers a multi-layered view, encompassing: individual factors, such as motivation and prior experiences; academic systems, including peers and assessment; and external influences, for example health, work, and family. Ungar (2011) views resilience as shaped by access to resources, community support, and culturally meaningful interactions, and Ebersöhn (2019) introduces the concept of flocking, rooted in Southern African Ubuntu philosophy, which frames resilience as a collective process.

Within engineering education, Bronfenbrenner's (1979) bioecological systems theory has been applied to map stress cultures and identify support needs across system levels (e.g., Jensen et al., 2023), offering a framework which can be used to understand resilience and its development (see Table 2.16.1).

Such models are useful in designing resilience-based interventions. Drawing upon the work of Kalisch et al. (2024), Schäfer et al. (2024) describe a need to select context-sensitive strategies and allow flexibility in matching coping resources and resilience factors in response to situational demands. This highlights the need to identify the characteristics of a situation and select appropriate strategies from a range of resources at a variety of levels.

In this chapter we focus on resilience specifically within adjustment domains relevant to engineering education. In so doing, we draw upon a definition from higher education literature, in which resilience is "*conceptualized as an effective adaptation to stress, adversity or change"* (Brewer et al., 2019, p. 5), primarily in relation to positive outcomes. We therefore consider the sources of stressors, adversity, and change as those experienced as a direct result of studying engineering, including transitioning to university; workloads and deadlines; challenging content and assessment; poor instruction; feedback and failure; problems involving uncertainty and complexity; competitive environments; difficult interpersonal relationships with educators and peers; and isolation and social pressure. Although macro- and chrono-level applications and implications can be incorporated into pedagogy through deliberate learning activities and discussions, this chapter focuses on micro- and meso-level systems.

Table 2.16.1: A summary of Bronfenbrenner's (1979) bioecological systems model adapted from Jensen et al. (2023) for students in engineering education contexts.

Model level	*Description*	*Examples*
Microsystem	People or elements that regularly impact individuals	Cohort peers, friends, family, educators
Mesosystem	A system of microsystems comprising the interrelations among two settings in which a student participates	Multi-setting participation whereby a student participating in curricular and extracurricular activities, forms an interconnection between settings. This creates a first-order social network allowing for inter-setting communication and knowledge
Exosystem	Environments in which students are not directly placed, but which impact them	Higher education and academic policy, education funding and resources
Macrosystem	Broader cultures	Job market, social norms, current policies
Chronosystem	Broad changes occurring over several years	Changes resulting from globalisation, COVID pandemic, technological advancements, shifts in social norms and political views

2 Why teach resilience?

Even before the COVID-19 pandemic intensified the focus on resilience as a contributor to student success (Brammer, 2020), its importance in engineering had been recognised. This focus appears to be driven by a presence of several adversities, including perceived heavy workloads (e.g., Jensen et al., 2023) as well as reported rates at which engineering students suffer mental health issues relative to those studying other disciplines (Danowitz & Beddoes, 2018). These factors may contribute to the high rates of attrition among engineering students (Hunsu et al., 2021). In their systematic literature review, Winkens and Leicht-Scholten (2023) found several reasons why being resilient is essential within engineering education: persistence in completing studies; adapting to changes to educational settings as a result of COVID-19; learning from failures and errors; coping with stress, adversity, and challenging situations. The development of resilience is thus considered necessary for students to successfully complete a degree, enabling them to pursue an engineering career and succeed in the workplace, as well as withstand shock and burnout.

The importance of resilience is reflected within wider HE literature, where it is considered as a graduate outcome and included within employer surveys. Research has highlighted the need for it to be taught to help ensure that students develop the necessary skills to navigate the workplace (Jackson et al., 2007), where it is referred to as 'graduate resilience' (Hodges, 2017) and 'career resilience', the latter being defined as "*a person's resistance to career disruption in a less than optimal environment*" (London, 1983, p. 621).

Whilst many of the adversities, stressors, or changes experienced in practice bear similarities with those within universities, those associated with the latter are often bounded, developmental, and structured, and include conceptual difficulty, individual competition and regular feedback loops. In comparison, workplace experiences are frequently open-ended and high-stakes and include project failures, design constraints, organisational politics and change, job insecurity, and safety or ethical dilemmas, all of which may carry legal and financial consequences. Accordingly, while educational experiences enable cultivation of capacities that support later professional resilience (Ginsburg, 2014; Martin & Marsh, 2006), these capacities are not entirely generalisable, nor independent of context. In this chapter we draw attention to underpinning psychological and behavioural processes involved in both contexts and focus on pedagogies by which to foster forms of resilience that prepare students for professional contexts.

3 Implementation

Despite the emphasis on resilience, there is limited work detailing associated competencies and skills or teaching approaches (Winkens & Leicht-Scholten, 2023). However, there are many opportunities for educators to incorporate its development in individual modules and entire programmes. Here we highlight characteristics and features of resilience-based learning activities before discussing appropriate pedagogies which can be utilised during delivery. In so doing, we make use of the definition of resilience provided within section 1, which refers to the presence of "*stress, adversity or change*" and "*effective adaptation*" (Brewer et al., 2019, p. 5).

3.1 Characteristics and features of resilience-based interventions

This section outlines interconnected characteristics and features of learning activities designed to support the development of resilience. Some focus on exposing students to challenge, while others emphasise strategies enabling positive adaptation and successful coping. Where relevant, examples are included to illustrate how these features may be applied in practice.

The intention is that these ideas function as a flexible 'menu' from which to select and adapt approaches for your specific teaching context. In doing so, consideration should be given to level of study and scaffolded progression. Supporting development of resilience involves equipping students with appropriate tools and support structures (thus strengthening positive adaptation), before gradually introducing structured and unstructured challenges.

To demonstrate how these features can be integrated coherently, the section concludes with a final example (Example 4). This extended illustration shows how multiple characteristics can be brought together within a single engineering module.

Exposure to stress, adversity, and change

Engineering is commonly viewed as a challenging discipline and there are many stressors present within degree programmes. However, this section encourages you to consider ways in which to present structured challenge.

Engineering modules that include project management content offer opportunities for students to learn stress management under pressure (Čavrak et al., 2019; Vadapalli et al., 2024). While you should start by providing students with fixed deadlines, as they progress you can change project scope and resource availability, necessitating adaptation. Authentic problems and challenges can expose students to incomplete information, uncertainty (Čavrak et al., 2019; Neumeyer & Santos, 2023; Silva et al., 2020), and failure, requiring iteration and continuous improvement (Membrillo-Hernandez et al., 2019), fostering resourcefulness and providing opportunities to positively adapt.

The use of teamwork, which can involve interpersonal conflict and contribution fairness (Čavrak et al., 2019; Steen & Pollock, 2022), offers another way to scaffold development of resilience. For example, team diversity can impact stress levels (Graßl et al., 2023), and students can be pushed out of their comfort zone through the integration of interdisciplinary and inter-year communication and collaboration (Vadapalli et al., 2024).

However, it is important to acknowledge the risk that students become overloaded or struggle with interpersonal conflict and inequitable group work, or are exposed to stereotypical views and deficit narratives that emphasise what they lack rather than the strengths and resources they bring. Therefore, it is important to be mindful of the way they are differentially impacted, and that you have resources to support them to succeed, as will be discussed in the next section.

Effective adaptation

Resilience is a capacity that develops through interaction between individuals and their learning contexts. Although the capacities described here are often framed as individual attributes, they do not emerge in isolation and are cultivated through design of curricula, pedagogies, and environments that legitimise reflection, iteration, and help seeking. The strategies that follow therefore describe individual capacities as structurally enabled within educational programmes.

At the individual level, resilience is strengthened through development of the ability to self-regulate, grounded in self-awareness and meaning making. Structured reflection (as outlined in Example 1) and meditation tasks (Huerta et al., 2021) enable students to recognise stress indicators, monitor emotional responses (e.g., Täks et al., 2014), and regulate emotional states (e.g., Mapaling et al., 2024) before stress escalates into burnout or disengagement. Making explicit links between thoughts, emotions, and behaviour allows students to become better able to tolerate uncertainty, anticipate challenges (Winkens et al., 2024), and identify when further learning is required (Nobutoshi, 2023). This regulatory capacity is reinforced when programmes support physical and mental well-being. Practices include sport, art therapy, breathing exercises, gratitude work, and reframing techniques (Gubaryeva et al., 2024), Self-awareness and reflection also provide the foundation for students to connect developing competencies to meaningful personal and professional goals. Encouraging students to articulate how their abilities align with future aspirations enhances motivation, adaptability, and decision making (Balart et al., 2024). Activities such as purpose mapping help students integrate values, academic learning, and professional identity, strengthening commitment in the face of challenge. Professional skills and employability-focused modules provide a natural context for embedding this integrative work, particularly in engineering education where lifelong learning is central.

Example 1. Reflective resilience and well-being in engineering projects

Level/context. *Design, lab, or prototyping modules with iterative technical tasks and regular deadlines.*

Time needed. *1-2 Hours for an initial workshop, plus 10-15 minutes per week for guided reflection and well-being activities.*

Resources. *Reflection prompts, journals, purpose-mapping templates, brief guided meditations, movement breaks, or creative exercises.*

Output. *Weekly journal entries noting stress indicators, emotional responses, coping strategies, and links between tasks and personal and professional purpose; evidence of using well-being practices to sustain focus and engagement.*

Assessment and marking. *marks for engagement with reflection and well-being practices, demonstration of emotional regulation, and articulation of purposeful alignment with learning and future engineering practice.*

However, resilience is not sustained by individual capacity alone and is shaped by learning environments which normalise help seeking. When educators model supportive communication, students are more likely to access support (Jensen et al., 2023), enhancing their ability to manage adversity (Mapaling, 2024). Interventions can be built into the structure of a module as shown in Example 2.

Example 2. Normalising help seeking in engineering projects

Level/context. *Team-based engineering modules with high uncertainty or open-ended problems.*

Time needed. *30-60 Minutes for an initial orientation, plus structured help seeking checkpoints throughout the project.*

Resources. *Clinics which encourage students to problem solve and resolve errors, consultation hours, question boards, examples linking help seeking to professional success, guidance on asking relevant questions.*

Output. *Documented questions, consultation participation, or evidence of applying feedback to project iterations.*

Assessment and marking. *Marks for timely and effective use of support, demonstration of learning from feedback and making adjustments, proactive engagement in collaborative problem solving.*

Closely related is the normalisation of failure. In engineering practice, iteration and continuous improvement are expected; framing academic setbacks as instructive thus mirrors professional reality (Membrillo-Hernandez et al., 2019). When failure is positioned as part of learning (see Example 3), students are more likely to adopt a growth mindset and persist through difficulty (Campbell et al., 2021). Content focused on time and project management can play a complementary role and be explicitly framed as resilience-enhancing (Antoniadou & Antoniadis, 2024). Teaching should prepare students to anticipate risk, assess the probability of failure, and develop mitigation strategies equips them with tools to navigate uncertainty proactively rather than reactively.

Resilience is also relational, with positive peer interactions and constructive teacher-student relationships contributing significantly to well-being and adaptive capacity (Martínez et al., 2023). Structured teamwork, collaborative problem solving, and supportive social networks provide opportunities for mutual reliance and shared regulation. Students can be guided to recognise how their behaviours influence others' resilience, manage challenging group dynamics, and support peers while maintaining appropriate personal boundaries.

Example 3. Normalising failure in engineering design

Introduce examples of engineering failures or examples that show how failure was avoided. Discuss how concerns were identified, highlighting proactive responses, effective remediation, and learning and adaptation. Seek to balance macro-ethical dilemmas with micro-ethical, 'every-day' mistakes which students may face during their career, and which may constitute 'failure in professional responsibility'. Macro-ethical examples including the Citicorp Center in New York, which required reinforcement following concerns over its ability to withstand strong winds (Witcher, 2020). At a micro-ethical level, examples include withholding uncertainty in calculations or models, selective data presentation, dismissing safety concerns, *failing to learn from safety incidences, prioritising cost above safety, and non-compliance with procedures.*

Context. *Professional skills or design-based modules*

Time needed. *1-2 Hours for introduction with additional time for activities.*

Resources. *Case studies*

Outputs. *Presentation outlining failures or near-miss situations and lessons for future projects; identification of transferable competencies and skills and their application; stories that illustrate challenges faced and demonstration of resilience. This could entail encouraging students to share a transformation based on an issue they have faced, such as getting a bad grade and the impact it had on their study habits.*

Assessment and marking. *Marks for identifying key learnings and making suggestions for improvements.*

Example 4. Example of integrating resilience into engineering design education

Set an individual or team-based authentic design task. Ask students to:

- *produce a project plan which anticipates and manages potential risks;*
- *use simulation, modelling, and prototyping to test designs in a safe space;*
- *provide evidence of their iterative process and adaption in response to feedback and/or self-evaluation.*

Additional challenge:

- *set design tasks which require the use of multiple concepts, or for which there are constraints and uncertainty.*
- *make changes to scope and information availability as the project progresses.*
- *increase team diversity.*

Facilitate conversations and reflection and offer consultation hours, making use of a coaching approach to pose questions which help students move through challenge.

3.2 Teaching approaches

This section describes teaching practices which may be adopted to foster resilience.

We first consider design-based learning (DBL), challenge-based learning (CBL) and problem-based learning (PBL), which all share conceptual roots in constructionist theory, and emphasise active, experiential, inquiry-led and self-regulated learning within an authentic (real-world) context, although each approach varies in terms of focus, the type of problems and challenges used to trigger learning, the activities involved, the type of solution students develop, and the role of the educator (Doulougeri et al., 2024). DBL is described first, since design may be enacted within

CBL and PBL. We then describe culturally relevant pedagogies (CRP), story-driven learning (SDL) and role-play, and game-based learning (GBL) and gamification.

DBL

Engineering design is considered central to engineering practice (van de Poel & van Gorp, 2006), with DBL allowing for application of knowledge and skills during design activities, leading to development of a prototype or solution.

Rothbucher and Rothbucher (2018) argue that product failure enhances the perceived value of final designs and has resulted in innovation, making failure an important part of professional routine. These ideas can be translated to the classroom to help normalise failure. For example, Simpson et al. (2017) describe framing failure as key to innovation, claiming that it is critical for engineers to engage in rigorous analysis and evaluation rather than discard failures, allows for knowledge transfer to other engineers and projects. To this end, they define failure as a feature of engineering and argue that learning from failure is an integral part of the engineering curriculum.

CBL and PBL

CBL and PBL have been proposed as approaches to foster the development of resilience (Winkens & Leicht-Scholten, 2023). While both are experiential, student-centred approaches to pedagogy, they differ in that CBL involves open-ended, real-world challenges and different types of knowledge stakeholder, whereas PBL relies more on tackling specific, structured, often disciplinary problems (Doulougeri et al., 2024). As such, the use of PBL and CBL together may be considered as scaffolding progressive development of resilience. PBL can provide opportunities for students to focus on process and act on frequent, formative feedback. This allows them to develop coping strategies, confidence, and adaptability without fear of the output being judged. Students can then be introduced to CBL, which involves gradually increasing complexity.

Service learning or community partnerships are considered as types of CBL which engage students with real-world challenges, requiring them to identify community needs, develop solutions, and reflect on experience to gain deeper understanding and civic engagement. This allows them to connect technical knowledge with meaningful impact, reinforcing self-efficacy, sense of purpose, and long-term motivation (Duffy et al., 2009). However, when adopting these approaches, it is important to focus on reciprocity and avoid exacerbating power imbalances by ensuring mutual benefits and equity for all stakeholders (Delaine et al., 2023).

These approaches are flexible and can be applied throughout the duration of semester-long modules or for shorter time periods. They offer several opportunities to cultivate resilience and one (or more) of the characteristics or features outlined in 3.1 may be incorporated according to student needs. For example, you may vary the levels of complexity, uncertainty, and constraints involved in a problem or challenge depending on the level of study or introduce unexpected scenarios during the project. Team composition can also be varied, for example by introducing members from different disciplines, which brings further challenge to communication.

CRP

Culturally relevant pedagogies (CRP) and related frameworks for culturally responsive and culturally sustaining pedagogies have been explored as approaches to cultivating resilience in engineering education, particularly among students from underrepresented racial and ethnic groups (Garriott et al., 2019; Versfeld et al., 2025). Grounded in asset-based perspectives such as Yosso's Community Cultural Wealth Model (Martin et al., 2016), they emphasise the value of various types of capital that students from marginalised communities contribute to educational spaces. Yosso argues that many educational systems have been influenced by Bourdieu's concept of cultural capital, which often privileges the norms and resources of dominant social groups. In contrast, the Community Cultural Wealth Model recognizes multiple forms of capital that support resilience, achievement, and success, such as *aspirational capital*, "*the ability to maintain hopes and dreams for the future, even in the face of real and perceived barriers*" (Yosso, 2005, p. 77) By actively affirming cultural identities within learning environments, educators can enhance students' sense of belonging and self-efficacy, which are key foundations of resilience (White et al., 2025).

In practice, CRP is enacted through a variety of strategies which can involve integration of mentorship from culturally similar role models, structured peer cohorts, and community-building activities. These initiatives create 'counter-spaces', allowing students to draw on cultural strengths whilst navigating the challenges of engineering (Martin et al., 2016). Another approach involves modifying curricula by reframing technical content through students' cultural contexts. This includes tackling problems that students observe in their own communities (McAlister et al., 2022) and integrating indigenous knowledge systems as legitimate engineering epistemologies, for example through land-based or indigenous-contextualised design (Mooney et al., 2025). Teaching methods can be adapted to reflect students' cultural values rather than defaulting to the individualistic and competitive structures typical of traditional education. For instance, collectivist assignment structures have been designed specifically to align module concepts with the value systems and communal orientations of Latinx students, with the aim or reducing retention and attainment gaps (Otero-Diaz et al., 2021). Similarly, the design of peer-led study groups has drawn on Ubuntu principles of mutual obligation and support, collective well-being and interconnectedness with the aim of supporting students to navigate adversity and foster resilient communities (Versfeld et al., 2025). These strategies can be implemented in different ways at different scales and integrate easily with pedagogies outlined in this chapter. For instance, culturally relevant principles can inform challenge or project-based learning (see Section 3.2.2) and can be tailored to specific cultural and institutional contexts.

SDL and role-play

Story-driven learning (SDL) can foster resilience by contributing to sense-making through reframing of experiences (Lee & Le Doux, 2025; Morgan et al., 2021), as well as self-awareness, reflection, self-regulation, and mental well-being. Use of narratives can empower students to reconcile learning experiences with engineering practice and their goals (Freitas, 2024), thus fostering a sense of purpose. Deliberate prompt selection can normalise failure by encouraging students to describe stressful instances and share strategies that helped them control outcomes or feel more confident in their abilities. For example, Whitnall and Hurley (2024) propose an approach whereby students share experiences of failure in a safe space, as well as guided visualisation tasks whereby participants envision achieving a pathway to success. SDL can also foster positive relationships with an audience, facilitating relational resource which can aid in resilience (Lee & LeDoux, 2025; Morgan et al., 2021).

Role-playing can be used to encourage students to consider different perspectives and reflect on opportunities to apply resilience in varying scenarios. For example, Martin et al. (2019) illustrate how role-play can immerse students in challenging conditions, prompting them to adapt and consider the sociotechnical consequences of their decisions.

Game-based learning (GBL) and gamification

Games can be used to enhance students' resilience through increased engagement (Bodnar et al., 2016), motivation (Gamarra et al., 2022), and self-esteem (Prihadi et al., 2018). Hypothetical scenarios introduce opportunities to make decisions under pressure and navigate hurdles. As intended goals are measured against outcomes, students can cultivate self-regulation while varying strategy. Games can also help normalise failure, particularly for individuals who find it difficult to cope with the negative consequences of decisions or challenging scenarios. In such cases, games provide a safe environment in which students can integrate knowledge and develop coping strategies (Türkoğlu, 2024).

Viewed collectively, these suggestions offer multiple entry points through which resilience can be embedded. While they provide conceptual and practical foundations, their success depends on thoughtful, scalable, and context-sensitive implementation aligned with institutional priorities and student needs, as outlined in the next section.

4 Recommendations for implementation and learning

4.1 Reflect upon the role of contextual factors in shaping students' perceptions and experiences of resilience

The conceptual ambiguity (Burke & Scurry, 2024) of resilience means it is essential to critically examine underlying values and assumptions associated with its inclusion in curricula, and to identify aspects that are relevant within specific educational contexts. Without providing clear definitions, there is a risk that it may be interpreted superficially or conflated with related but distinct concepts, such as grit. As Ladson-Billings (1995) argues, what counts as success, what resources students can draw upon, and how they navigate adversity, are mediated by the cultural environments in which learning takes place. There is also a need to consider how resilience presents. For example, in STEM contexts, disciplinary norms around what constitutes a 'good student' may inadvertently exclude students whose strengths manifest differently, for example through curiosity and community engagement rather than prior attainment

(Johnson & Elliott, 2020). Co-creating definitions with students may thus allow for recognition of diverse cultural perspectives.

4.2 Avoid the use of deficit-based language

Educators should make sustained, intentional efforts to avoid deficit-based language and approaches which fail to recognise sociocultural factors and structural inequalities that place the burden of developing resilience on individuals. This is important given findings which demonstrate students' beliefs that development of resilience is an individual responsibility (Wint & Direito, 2026). In practice, this may involve ensuring language focuses on processes over outcomes, and normalising failure. CRP can be used to foreground students' cultural knowledge, community assets, and lived experiences as resources for learning and adaptation rather than positioning culturally diverse students through a lens of deficit (Brown-Jeffy & Cooper, 2011; Ladson-Billings, 1995).

4.3 Balance exposing students to challenging situations with encouraging positive adaptation

A challenge when designing interventions is balancing the focus on exposure to challenging experiences and supporting positive adaptation, prompting broader reflection about supporting students in perceiving stress as a natural part of life and learning, whilst also protecting their mental health. Interventions should thus target both the individual level, for example through development of self-regulation, help seeking behaviour, and mindfulness to cultivate self-awareness and regulation of emotional responses, as well as the micro- and meso-level, for example by facilitating connection and a culture of help seeking. Considering the diversity, equity and inclusion (EDI) issues already present within engineering, including structural gender imbalances and the marginalisation of ethnic minority students, it is important educators understand, a1nd are responsible for, creating environments in which all students can thrive.

4.4 Provide scaffolded support for development

The need for balance between exposure to challenges and fostering supportive environments necessitates scaffolding of challenge level when introducing resilience-based teaching interventions. Students should be equipped with tools such as risk mitigation to help them navigate aspects such as complexity and uncertainty. Likewise, for team projects, providing guidance around expectations, open communication, and conflict resolution, can help students prepare not only for assignments and projects in class, but also for their career trajectory.

4.5 Start small

Educators may be averse to integrating resilience within modules for a variety of reasons including: perceived lack of need; lack of space in the programme; lack of confidence; and limited time and resources. However, integrating resilience does not necessitate extensive overhaul of lesson plans. You can start small by encouraging students to reflect on learning processes and opportunities for improvement. You may also look for existing opportunities to introduce concepts related to resilience. For example, design modules offer space to discuss the importance of failure and iteration, whereas engineering management modules can be used to introduce strategies used to adapt to changes in project scope, and resource and information availability.

4.6 Explore approaches adopted within other disciplines and cultures

As demonstrated in this chapter, psychology offers frameworks and interventions that can be adapted for engineering contexts. Insights may also be gained from research within fields such as nursing, social work, and medicine, in which discussions regarding development of student resilience are more advanced (e.g., Low et al., 2019).

You should also consider how resilience manifests across cultures and contexts (e.g., see Ungar, 2011) and explore non-Western and indigenous approaches to resilience (e.g., see Ebersöhn, 2019).

4.7 Resources and Further reading

Finally, in addition to the literature referenced in this chapter we also recommend the following two resources to deepen your knowledge, Abulfaraj et al. (2024) on resilience interventions and Khaira and Sayekti(2024) on resilience and well-being in higher education.

5 Conclusion

Resilience is a critical competency that can serve engineers throughout their academic and professional trajectories across the stressors, shocks, and complex challenges they encounter. We encourage educators to adopt approaches to fostering resilience in their teaching. Creating environments that support mental well-being, encourage positive relationships, and normalise help seeking and failure can better prepare students for the multiple challenges they will face throughout their career. Resilience is shaped by the socio-cultural environments in which learning takes place, and its development must be approached with cultural and contextual sensitivity. As Wissing et al. (2022) argue, well-being and resilience are relational and systemic, extending beyond individual traits to consider the ways in which cultural knowledge, values, and social structures shape human flourishing. This resonates with non-Western and African-centred approaches, which emphasise harmony, interdependence, and collective well-being (Wilson Fadiji et al., 2022), offering a richer, more situated understanding of how resilience is nurtured.

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AI statement

During the preparation of this work the authors did not make use of any AI tools.

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