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From Evidence to Practice: Transferable Competencies and Skills in Engineering Education

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This chapter synthesises the transferable competencies and skills addressed in Part 2 and reframes them from a systemic perspective to contextualise their progressive development within modules, as part of curriculum development and across programmes in engineering education. It argues that competencies and skills are rooted in modules but best developed progressively. It identifies cross-cutting themes such as scaffolding, authentic learning, reflection, feedback literacy, interpersonal collaboration, and the critical use of technology, and discusses overlaps between skills, contextual sensitivity, and tensions between standardisation and individual adaptation. By making transversal structures explicit, the chapter positions Part 2 as a toolbox for module design, curriculum development, programme coherence, and institutional alignment. Finally, it prepares educators for the assessment focus of Part 3 by highlighting how intentional, contextualised skills development needs to align teaching practices and assessment with intended learning outcomes in engineering education.

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1 Conceptual foundation and aim of this chapter

This handbook intends to give you evidence-based practical guidance for integrating transferable competencies and skills into your teaching practice. However, developing competencies and skills is not trivial. Unlike building a body of knowledge in students and teaching them to apply predefined methods, competency and skill development is shaped by our understanding of the concept itself. It makes a difference whether we focus on performances or dispositions, and whether we incorporate cultural, historical, or regulatory aspects into our practice.

Part 1 elaborated that terms such as *competence*, *competency*, and *skill* carry conceptual weight and have normative implications. These aspects are not merely an intellectual exercise. Instead, they have direct implications for educational practice. They tell us how intended learning outcomes are phrased, and how assessment is conceptualised with reference to a given institutional context or established frameworks.

In this respect, this chapter builds on Part 1, taking these insights as the foundation for reflecting on the chapters in Part 2, which address individual transferable competencies and skills and are grounded in these conceptual assumptions. Part 2 moves from that conceptual level to the practical yet complex reality of transferable competencies and skills in engineering education. The individual chapters each define and describe competencies and skills within different educational contexts, providing you with inspiration on how to shape your own practice, giving you food for thought, and, hopefully, stimulating you to discover new points of view. The goal of this reflection, however, is not to summarise each chapter in turn or repeat what has been laid out in more detail for each skill. Instead, we want to take a step back and look at the bigger picture by discussing the following questions:

- How can the chapters individually and collectively deepen our understanding of transferable competencies and skills in engineering education?
- Which intersecting themes and tensions run across the chapters of Part 2?
- What to take forward to Part 3, whilst thinking about assessment?
- In what way do individual competencies and skills relate to curriculum development, programme level change, and institutional transformation?

In short, this reflection acts as a bridge. It builds on the conceptual foundations of Part 1 and connects them with the concrete practices of Part 2, while also paving the way towards the assessment focus that follows.

2 Connecting individual transferable competencies and skills

Part 2 has been structured around three thematic clusters that are derived from the Engineering Council's (2020) UK Standard for Professional Engineering Competence and Commitment (UK-SPEC). These clusters reflect core areas of professional formation that are also widely recognised across European engineering education and accreditation frameworks, including the Engineering Education (ENAEE) EUR-ACE

learning outcomes, the Engineers Europe EUR ING standard, and the European Qualifications Framework (EQF):

- Theme I. Responsibility, project management, and leadership (Chapters 2.2 – 2.5);
- Theme II. Communication and interpersonal skills (Chapters 2.6 – 2.12);
- Theme III. Professional commitment and lifelong learning competencies (Chapters 2.13 – 2.18).

When looking across these themes, you may notice common threads, overlaps, and complementary aspects. While each chapter stands by itself and provides an evidence-based, practice-oriented deep dive into the skill covered, you will find adaptable and transversal insights into strategies, methods, and approaches across all chapters that may inform your individual situation. To this end, each chapter, multiple chapters, or all chapters together will contribute to a deepened understanding and informed educational practice. This is a common characteristic of transferable competencies and skills, and mastering these overlaps in practice makes it easier to shape a holistic approach to teaching.

However, several useful insights also sit at the boundaries between these themes. In practice, engineers rarely draw on one competency or skill at a time: they combine and switch between them as situations evolve. Reading across the three themes helps to show how transferable competencies connect and reinforce one another in real engineering work.

The interconnected competency loop. Read together, the chapters show that transferable skills are not add-ons but an interdependent system. For example, feedback literacy (2.11 and 2.12) and self-regulated learning (2.13) support adaptability (2.14) and resilience (2.15) by helping engineers monitor performance, learn from input, and adjust to changing conditions. Looking at these chapters together shows that these processes are central to effective engineering practice, not an optional extra.

From individual attributes to relational processes. Across leadership (2.5) and interpersonal communication (2.10), competency is framed less as an individual trait and more as something enacted with others. In combination, these chapters emphasise the relational nature of engineering: how engineers collaborate, influence, and work within teams and wider networks.

The sociotechnical grounding of professional ethics. Risk management (2.4), information literacy (2.16), combined with ethical awareness as discussed by Bruzzone and Gherardi (2024), position ethics as something delivered through everyday professional practice. For instance, weak interpersonal communication (2.10) is not only a presentation issue: it can limit how well engineers engage stakeholders and integrate critical information, with implications for safety and decision making.

3 Identifying interconnecting themes

Competencies and skills do not exist as isolated entities. Thus, there are always aspects that cut across individual competencies and skills, and, by extension, individual chapters. We have, therefore, identified interconnecting themes that span multiple chapters in Part 2 and address tensions such as prioritising one over the other or the entanglement of autonomy and heteronomy that arise from them. We explicitly invite you to interpret these tensions as productive friction within this debate. They may be catalysts from which constructive approaches to competency and skill development in specific learning situations can emerge. We hope the aspects discussed below provide an additional perspective on the chapters of this part and contextualise them within a broader, overarching narrative, possibly even inspiring a renewed reading of earlier chapters.

3.1 Progressive development and scaffolding

As with technical skill, transferable competencies and skills need deliberate development. In your role as an educator, once you create a fruitful learning environment where students can develop these skills, you gradually reduce your support, allowing them to further build competency. By shifting from direct instruction to process-focused scaffolding that alternates between task-specific problem-solving guidance and metacognitive strategic prompts, learners are enabled to assume increasing autonomy (Reiser, 2004). A consistent message across the Part 2 chapters is that you cannot realistically *cover* a complex skill in a single module and expect students to master it. As instructors, we need to think in terms of staged development across an entire programme.

This may mean, for example, starting with basic project skills in the first year, such as simple planning and time management (Chapter 2.2), and then gradually increasing complexity in later years by adding risk management (Chapter 2.4) and meeting facilitation (Chapter 2.3). A similar logic applies to oral and written communication and reporting (Chapters 2.7 and 2.8): early tasks focus on clarity and basic structure, while later tasks ask students to tailor messages to different audiences, negotiate meaning in teams, or justify design decisions.

Self-regulated learning (Chapter 2.13) also benefits from this staged approach (Zimmerman & Kitsantas, 2005). In the early years, the focus is on raising students' awareness of how they study and on fostering self-reflection (Education Endowment Foundation, 2025). As students progress, you increasingly expect them to set their own goals, monitor their learning, and adapt strategies independently (Pintrich, 2004; Zimmerman, 2002). Programme-level thinking is essential here: you design a trajectory rather than a collection of isolated activities (Crawley et al., 2014).

3.2 Authentic and experiential learning

The chapters emphasise that transferable competencies and skills become meaningful for students when we embed them in authentic disciplinary contexts and link them to real-world, application-oriented practices and scenarios. Rather than teaching

communication or *project management* in abstract ways, we invite students to apply and practise these skills in realistic engineering tasks and projects.

To achieve this, we may, for example, use interdisciplinary, project-based modules where students work on open-ended engineering problems or create writing tasks (Chapter 2.8) that mirror professional genres such as design reports or technical briefs. Similarly, meeting skills (Chapter 2.3) are more convincing when students encounter them in real or realistic professional situations, such as industry-linked projects, internships, or stakeholder meetings, rather than in purely artificial classroom exercises.

The common thread is to design learning activities that feel relevant to engineering practice and require students to apply particular competencies and skills. Students come to see why the skills matter because they use them to address authentic tasks, develop a sense of self-efficacy, and experience learning as a holistic, integrative process (Johannsen, 2023; Kolb, 2015).

3.3 Reflection and feedback literacy

Although having concrete experiences is important in learning, many chapters make clear that experience on its own is insufficient. Students need structured opportunities to pause and reflect on what they did, how they did it, and what they might do differently next time (Hermsen et al., 2023; Kolb, 2015). In other words, reflection helps them to turn their experiences into learning outcomes (Chapter 2.13).

Across all chapters, authors provide different strategies that help students in cultivating reflective habits that not only support a single competency or skill but also their broader personal and professional growth. As elaborated in Chapter 3.6 on portfolios, it can help your students to keep short reflective journals (Chapters 2.13 and 2.15), write brief commentaries on their team roles, or use frameworks such as Gibbs' or Kolb's cycles to systematically think through critical incidents (Gibbs, 1988; Kolb, 2015; Moon, 2004). Over time, these repeated practices become standard, help students to identify patterns in their behaviour, and take more ownership of their own development.

Alongside reflection sits feedback literacy (Chapters 2.11 and 2.12), understood as the knowledge, skills, and dispositions needed to effectively engage with feedback (Carless & Boud, 2018). Recent work (e.g., Carless & Young, 2024; Coppens et al., 2025) highlights the central role of self-reflection in developing this literacy: students become more able to interpret feedback, evaluate the quality of their own work and that of others, and connect external input to their learning processes when they are prompted to articulate their thinking and monitor their progress. To cultivate these capacities, students need support in recognising the diverse forms feedback can take, managing the emotional dimensions of critique, and translating suggestions into concrete action (Tai et al., 2018). Several chapters show how you can embed this into your teaching practices through structured peer feedback activities, dialogue around criteria, and opportunities to revisit and revise work.

3.4 Interpersonal relationships and collaboration

Across the three themes, interpersonal relationships play a central role. Leadership (Chapter 2.5) is presented less as an individual status and more as something that happens in and through a team. Consequently, teamwork (Chapter 2.6) plays an important role and relies on communication (Chapter 2.11), conflict resolution, negotiation, and shared decision making (Driskell et al., 2018; Xyrichis & Ream, 2008).

You will already know from practice that simply putting students into groups does not guarantee that they will develop teamwork skills. The chapters in Part 2 underline this: we need to be explicit about expectations, provide models and language for productive interaction, and give students space to talk and reflect about what did and did not work in their collaboration.

3.5 Technology, emerging tools, and contextual sensitivity

Several chapters also touch on the role of technology and emerging tools, including (generative) artificial intelligence, in shaping how we approach competency and skill development. Digital platforms, simulation environments, and AI-supported tools can open new possibilities for practice (Chapter 2.8) and feedback (Chapter 2.12). Yet they also bring new challenges, for example, on critical evaluation, information literacy, and ethical use, as well as a temptation to rely on easy solutions that might backfire and trigger a deskilling and attrition of cognitive abilities of learners and users (Arnold et al., 2023; Hughes, 2021). Developing ethical awareness is critical for educating responsible engineers of tomorrow, and it therefore needs to be given an integrated place within the curriculum. One effective approach is to create opportunities for students to engage with ethics by embedding it in projects, exploring it through teamwork, or using it as a focus for critical reflection during classroom activities (Bruzzone & Gherardi, 2024).

At the same time, you cannot treat these developments as universal. What counts as authentic and appropriate use of technology will depend on your institutional setting, the engineering disciplines you work with, and the norms of your local context. The chapters collectively encourage you to remain open and critical: use technology where it genuinely supports learning and remain alert to its limitations and risks.

3.6 Overlaps and cross-pollination

In Part 2, the chapters show that competencies and skills do not live in separate boxes. No single competency or skill can be isolated and developed independently of its context. Self-regulation (Chapter 2.13), autonomous motivation (Chapter 2.17), and perseverance (Chapter 2.18) connect tightly: when students set their own goals and track progress, they are more likely to stay engaged and push through difficulties. Self-efficacy, thus, is highly relevant for academic achievement (Khine & Nielsen, 2022). Feedback literacy (Chapters 2.11 and 2.12) and communication (Chapter 2.10) reinforce each other: students cannot make good use of feedback if they do not understand how to ask for it, evaluate and discuss it, and translate it into action.

Seeing these overlaps helps to design learning activities with double benefits. A well-planned team project (Chapter 2.6), for instance, can support communication, responsibility, leadership, and self-regulated learning all at once, if those goals are made explicit and students are given time to reflect on them. Having explicit learning goals for these competencies — and for how they come together through project work or complex problem-solving tasks — is essential for students to understand what they are about to learn. Having reflective moments where students can review and evidence their growth is equally important.

3.7 Intended learning outcomes and assessment

Finally, if you want to develop transferable competencies and skills, you will need to start from these intended learning outcomes and consider, as we have argued, your distinct context (Biggs & Tang, 2011). The chapters in Part 2 provide ample guidance on how you can go about it in your educational practice. However, you will need to not only build on didactical and pedagogical methodology but also align assessments accordingly. Building on a deepened understanding of the nature of transferable competencies and skills and insights into how to develop them in students, assessment needs to address their performative nature. Part 3 provides you with evidence-based guidance regarding assessment, covering various forms of assessment, from peer to self-assessment (Chapter 3.2 and 3.3 respectively), rubrics (Chapter 3.4), observations (Chapter 3.5), portfolios (Chapter 3.6), and inclusive and ethical assessment (Chapter 3.7).

3.8 Common themes in Part 2

Looking across all chapters in Part 2, you can see a common trajectory or shared direction of travel. Focus shifts from students simply knowing about a skill to them being able to use it in practice. That shift carries several transversal structures and tensions that are helpful to make explicit.

All chapters, in different ways, advocate for competency development that goes beyond basic knowledge and understanding, much like how we want our students to excel in their technical expertise. Such competency development also encompasses abilities and motivation that are aimed at (professional) performance and are the object of lively debate, as Chapter 1.2 has shown. It follows that we are not just helping students to recall definitions of teamwork and leadership; we are supporting them to act as competent team members, emerging leaders, or self-directed learners in specific engineering settings.

This application-oriented approach requires you to design learning activities where students are encouraged to use the respective skill in context, collect feedback, reflect, and try again. It also requires you to think carefully about how you describe your learning outcomes. For example, '*students can explain principles of project management'* leads to very different teaching and assessment than '*students plan and coordinate a small engineering project within a team'*.

This approach is commonly referred to as constructive alignment (Biggs & Tang, 2011). If we want students to develop particular competencies and skills, we need to

align learning outcomes, teaching methods, and assessment tasks. As such, alignment takes into account a number of stages and inputs; we first observe the educational goals and how they are formulated, then we look at how we, as educators, develop relevant learning material and engineering learning contexts through which students can learn. These two bring out the intention and the execution but may still not necessarily lead to competency development in engineering practice. To see how these intended and taught elements come together, we need to see the learning outcomes in which student levels of competency and skill development are visible, potentially including those that were not initially intended in the first place (Kovacs et al., 2023). Developing and mapping an overview of how to achieve alignment in the intended, taught, and learnt curriculum, therefore, requires multifaceted reflection on our own curricular intentions, but also on how we construct learning materials and even how we teach transferable competencies and skills, including through our own modelling of professional engineering practice. Part 2 thus leads to Part 3 of the handbook, which focuses on assessment. By reading about and experimenting with the skills in Part 2, you are already laying the groundwork for more coherent assessment practices by clarifying what matters, where your activities are best situated within your programme, and how you might recognise progress in students' engineering work.

A transversal tension may result from the level of standardisation of your approaches. On the one hand, you benefit from shared frameworks and tools. Among these are a common language for self-regulated learning, agreed criteria for communication, or standard templates for project planning. These can support consistency for students and staff. On the other hand, each programme, institution, and student cohort is different. Strategies that work in a small, project-heavy programme may not translate directly to a large, lecture-based curriculum. As always, context matters significantly. The message to take home from Part 2 is to treat frameworks and tools as resources to interpret and adapt, rather than fixed prescriptions.

This entails working in a space where theory informs practice, but where practice remains sensitive to context. We draw on established models, but we also listen to our students, colleagues, and institutional constraints when deciding how to implement them. That also means that you are never alone on this journey: every step you take to improve your educational practice is rewarding for you and for the people around you, whether they are students or colleagues. Often, all it takes is courage and a leap of faith to try something new.

Finally, many chapters highlight ethical and social aspects that cut across individual skills. Risk management (Chapter 2.4), for example, is connected to questions of who carries risk, who benefits, and how decisions affect different groups. Leadership and responsibility (Chapter 2.6) are linked to values, power, and accountability. Lifelong learning and information literacy (Chapters 2.13 and 2.16) are tied to broader debates about inclusion, access, and social justice. You can use these transversal themes as prompts in your own teaching. When students design a solution, you might ask them to think about whose problem they are solving, whose voices are missing, and what

unintended consequences might arise. In this way, we link individual skill development to wider questions about engineering's role in society and can contribute to a holistic education.

4 A toolbox for the transition from reflection to application

Another way to look at Part 2 is to think of these chapters as a toolbox rather than a checklist. It brings together a set of skills, concepts, and teaching approaches that you can draw on and adapt, depending on your aims and constraints. Every chapter provides orientation on a specific competency or skill by offering insights, evidence, helpful recommendations, and further readings to follow up. Consequently, Part 2 is not a call to implement everything everywhere; instead, it offers options and examples to work with.

We believe that this handbook provides a rich resource to enhance educational practices. To ensure maximum benefit, we would like to share a few helpful pointers to be considered when using this toolbox. First, skill development is always shaped by its context. Institutional culture, existing curriculum, and assessment practices will influence what is possible. Second, this is a developmental process, not a single intervention. Competencies grow through repeated, structured practice and opportunities for reflection. Third, instructors play a key role in shaping how students encounter this process, both in their teaching and across the wider programme. There are several practical ways you might use the chapters in Part 2:

Mapping your curriculum. The skill descriptions and implementation ideas can help you see where competencies already appear, where they cluster, and where gaps may be forming. This supports more coherent learning trajectories and can reduce unnecessary pressure on individual modules.

Designing or revising modules. You can adapt examples of project-based learning, reflective tasks, or feedback approaches from the chapters. If a particular approach is relevant to your context, pilot it in one module first and then decide whether to scale it across the programme.

Creating competency profiles. The chapters can help you articulate what graduates of your programme should be able to do. These profiles can be useful in discussions with colleagues, students, and external stakeholders. For more examples in other institutions, see Part 4 of this handbook. Across all of this, iteration matters. Experiment, gather feedback, reflect, and adjust. We hope that, over time, Part 2 becomes not only a toolbox but also a set of shared reference points for ongoing conversations about competencies and skills within your programme.

We would like to emphasise that competency and skill development is a team effort that needs to be based on strategic curriculum development and will be much more successful if it is supported by educational staff at the programme level. However, someone needs to take the initiative. So, start small but think big, because you, as an individual, have agency in this process and may even drive it.

As you move on from this reflection, we would like to share some of our top tips:

Start with one change. Try one new activity or adapt an existing one: a small reflective task, a revised project structure, or a clearer progression within a skill. Piloting something in a single module is often enough to reveal what could scale.

Make skills explicit within what you already teach. Show how competencies and skills connect to disciplinary content and authentic engineering problems, and where they matter. Show where they already appear in your modules, tasks, or curricula.

Revisit learning outcomes. Check whether the learning outcomes genuinely reflect the competencies and skills you value, and whether your teaching and learning activities make progress visible.

Form alliances. Share experience informally, create a forum to exchange practice, and build communities of practice that can support programme-level change and, over time, institutional transformations.

5 In closing

In this reflection chapter, we have first discussed various aspects from an abstract, more structural perspective. In doing so, we intended to illustrate how competency and skill development are context-dependent and that we must consider the specific learning environment within each module in which they take place. Competency-oriented educational outcomes, however, are more effective if their development is embedded in strategic interventions, i.e., if evidence-based, methods-guided competency development starts from intended learning outcomes, extends through curriculum development to programme-level design, and is, in due course, mirrored in institutional transformations.

Secondly, although competencies are individually embodied, a decisive role nonetheless falls to us educators and our concrete practice. Learners develop competencies and skills through experience-based, method-guided activities combined with coherently structured processes of reflection. In this interplay, sustained effort is required. The chapters of Part 2 provide guidance, recommendations and examples to this end. While each chapter provides a stand-alone approach to its competency or skill, they are complementary in nature, as there are significant overlaps. In this chapter, we have sought to summarise a comprehensive understanding of the concept of competency as it is developed in this handbook and to relate it to interconnecting themes and tensions within this part.

Reflecting on Part 2, thirdly, it becomes evident that competency and skill development occurs systematically and strategically rather than additively. To realise its full potential, it should be embedded across individual modules and should interdependently reinforce interventions. Again, this requires individual action and may start with minimal effort and, speaking from our own experience, a bit of courage. Building on that, individual activities may lead to the progressive development that is preferable for achieving the intended outcome. However, as you may want to start at module level, following the constructive alignment approach may prove most fruitful. Here, intended learning outcomes inform teaching and learning practice as well as

suitable assessment activities that address the specific performance dimensions of competencies and skills. Accordingly, Part 3 of this handbook covers assessment and explores various evidence-based methods you can employ.

Finally, in line with principles of progressive competency and skill development, it is essential to consider the respective stages learners transition through and may have reached when taking a particular module. In addition, from a more systemic perspective, it may prove useful to take into account various ways in which learning activities build upon and intertwine with one another. We believe that Part 2 of the handbook has demonstrated in what way individual competencies and skills are a necessary point of departure for teaching transferable competencies and skills. At the same time, we believe that their full potential may only be realised if these initiatives are embedded within overarching strategic decisions. As a coordinated endeavour, they reinforce each other. This systemic perspective, as discussed here, follows naturally from each chapter and, in conclusion, points towards the contributions in the following parts of this handbook. Most importantly, however, it is your everyday practice that these outcomes rely on. Only you can bring them to life for your students. The impact lies in the choices you make in your teaching, and in how you create the conditions for students to learn and apply what they have gained.

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