4.11

Authentically Integrating Communication in the Undergraduate Engineering Curriculum within Cornell Duffield College of Engineering

Allison Hutchison[a], Traci Nathans-Kelly[b], Suzanne Lane[c], Cameron Mozafari[d], Rick Evans[e], and Hua Wang[f]

[a] Cornell University, USA, ORCID: 0000-0003-2432-0802;
[b] Cornell University, USA, ORCID: 0000-0003-4478-521X;
[c] Cornell University, USA, ORCID: 0000-0002-2350-8101;
[d] Cornell University, USA, ORCID: 0009-0008-4601-6733;
[e] Cornell University, USA, ORCID: 0000-0001-6937-1721;
[f] Cornell University, USA, ORCID: 0000-0003-1687-6050.

Keywords: *engineering curriculum, communication skills, curricular agility, technical communication, social cognitive learning theories, self-efficacy*

This chapter outlines the two interlocking frameworks developed within the Engineering Communications Program (ECP) at Cornell Duffield Engineering that guide curriculum, flexible module structure, and authentic integration of communication for engineering purposes: 1) core communicative competencies, and 2) curricular agility. ECP provides the majority of undergraduate engineering communication offerings and supports the accreditation across various degrees in Cornell Duffield Engineering. ECP authentically integrates communication into engineering curricula with sensitivity to disciplinary contexts. To achieve this integration, ECP introduces students to foundational concepts that define communication as contextual, socially situated, purposefully designed, and central to cultivating an engineering identity. Many modules are also partnered with engineering staff, allowing students to engage with not only the technical concepts but also the genres and rhetorical situations characteristic of particular engineering fields. In addition, ECP teaches conventions, genre analysis, problem solving, and working in teams — all of which are much-requested professional competencies. Modules draw on engineering and technology industries, such as approaches to project management and best practices, thus underscoring communication as a professional necessity rather than an auxiliary skill. To empirically ground the efficacy of our framework, ECP provides evidence from longitudinal survey data that shows students develop communicative self-efficacy as a result of engaging in authentic and integrated work. We present this framework as a pedagogical model that situates communication within engineering practice, offering guidance for programmes seeking to prepare students for the communicative demands of professional environments.

DOI: 10.59490/mt.266.95.

1 Introduction: context and history

Communication is irrefutably central to engineering practice, with professional surveys showing that engineers spend a large portion of their time engaged in communicative work (Cunningham & Stewart, 2012; Darling & Dannels, 2003; Kreth, 2000; Sageev & Romanowski, 2001). However, research shows that engineering graduates lack communication proficiency (Brumberger & Ellsworth, 2025; Khoo et al., 2020; Ramadi et al., 2016), with one study recommending further engineering education research on 'learning soft skills in context' (Hirudayaraj et al., 2021). We don't agree with the connotations of 'soft skills', which suggest that communication is easier or secondary to technical work, and we use this chapter to present a pedagogical model for teaching communication as an integral part of engineering practice. Above all, the ECP framework holds that engineers' communicative competence is integral to engineering education, not ancillary.

Prior research shows that engineering staff place high importance on students learning written communication skills, yet they often cite the substantial time it takes to grade written assignments as a barrier (Buswell et al., 2019). This struggle to balance staff and student workloads often results in undergraduates completing engineering communication work with little instruction or pedagogical support (Hutchison et al., 2021). The problem is compounded by the fact that many engineering staff lack training or familiarity with communication theories and pedagogies, which understandably can make them feel hesitant or uncomfortable teaching communication (Brumberger & Ellsworth, 2025; Paretti et al., 2014).

This chapter explores how the Engineering Communications Program (ECP) at Cornell Duffield College of Engineering (New York State, USA) provides unique, flexible communications module offerings, enabling undergraduate students to fulfil their graduation requirements. Module outcomes align with the Accreditation Board for Engineering and Technology's (ABET) student outcomes, which map closely to the European Qualification Framework (EQF) standards (Europass, n.d.)

We begin by describing how our communications programme fits in our institutional context, so that you can consider how your college, department, or programme differs from or aligns with ours. We then outline the theoretical grounding of ECP's approach, which centres on a four-part communications competency framework. In this section, we provide definitions and key sources to help exemplify our theoretical grounding. Next, we describe ECP's curriculum design, including both stand-alone and partner modules. Finally, we share survey data that supports our approach to teaching, learning, and assessment. Our hope is that you will adopt elements of this model to your context and consider using a similar survey to assess the impact of communication instruction on your own engineering students.

1.1 Common engineering communication pedagogy models

We first outline five major pedagogical approaches to teaching communication to engineers (Paretti et al., 2014) but add ECP's model (Evans & Gabriel, 2007) as the one we have found the most productive and agile for designing our engineering communication curriculum. Pedagogical approaches to teaching communication to engineers vary on whether communication is treated as a general skill transferrable across contexts, a module requirement in a programme, or a situated practice embedded in the work of an engineer. While each model attempts to address the persistent need for communication instruction in engineering programmes, each model also carries limitations and affordances. We believe, however, that ECP's model provides a unique, measurably effective, and replicable structure for teaching engineering students vital communication skills.

Siloed technical writing modules

Historically and currently, many engineering students in USA universities take technical communication modules, typically taught by English department educators (Connors, 1983; Yeats & Thompson, 2010). These siloed modules focus on professional genres such as reports, proposals, and presentations. While they prioritise awareness of rhetorical principles, they are often distanced from authentic engineering practice. Such modules may be less effective in convincing students that communication is central to engineering work.

Communication-intensive modules in engineering majors

Communication-intensive modules in the engineering majors embed writing and speaking tasks directly into disciplinary classes. This model helps students experience communication as integral to technical problem solving. Studies suggest that students are more engaged when assignments are tied to authentic engineering tasks (Paretti et al., 2014). This approach's success depends significantly on module design and sustained collaboration between engineering and communication staff.

Integrated curricula across multiple years

Integrated communicative instruction across multiple years of an engineering programme allows disciplinary genres to be addressed repeatedly in varied contexts, which supports long-term development and adaptability. This approach rests on the premise that communication cannot be mastered in a single module but must be reinforced and refined through the undergraduate experience. While integrated curricula have clear advantages, they also require substantial institutional coordination and staff commitment, which can make implementation difficult.

Supplemental approaches

A final category embeds supplemental engineering communication instruction via workshops, peer review programmes, process writing assignments, and communication modules in technical modules. These approaches offer scalable ways to introduce communication practice, particularly in large-enrolment contexts, and can strengthen students' abilities in revision, reflection, and collaborative feedback. While pragmatic, supplemental approaches nevertheless often provide limited and fragmented exposure to authentic engineering communication and may fail to cultivate the deeper rhetorical awareness necessary for professional practice.

1.2 Relationship between context and programme

These engineering communication pedagogy models take shape within larger regulatory and accreditation structures that influence how engineering curricula are designed and what learning outcomes must be demonstrated. In the USA, each university or college degree programme is allowed to create a path towards undergraduate degree completion with guidelines set by each state, and in many cases, national rules or guidelines also apply. For most engineering degrees, ABET sets the criteria for accreditation — an important benchmark that signals the quality of the degree. ABET approvals are mandatory for programmes that want their graduates to be eligible for professional licensure and to be competitive in the job market.

Cornell's Engineering Communications Program model

Across undergraduate engineering contexts internationally, communication is seldom "*authentically integrated*" in the engineering curriculum (Hutchison et al., 2021; Reave, 2004). Evans and Gabriel (2007) identified Cornell's Engineering Communications Program (ECP) as offering a new paradigm for teaching communication. Unlike skills-based or supplemental approaches, this model frames communication as social action inseparable from engineering practice. Communication genres are treated not as static templates to be mastered but as recurring forms of action through which engineers participate in professional communities; this practice, in turn, contributes to awareness of their ability to act as and be recognised as engineers. In practice, students work in teams on real engineering tasks for real clients when possible. In doing so, students' learning is situated by communicating in context and understanding communicative knowledge as part of their engineering problem-solving mindset.

1.3 Cornell's Engineering Communications Program history

We offer this brief review of our programme's context for you to see how we implement this approach. To graduate, all Duffield Engineering undergraduates must fulfil the Engineering Communications Requirement (ECR) (Cornell Duffield Engineering, 2025). Students may fulfil this requirement through multiple approved pathways, and ECP's core mission is to provide students with opportunities to develop communication skills that prepare them to contribute effectively in team-based environments across industry, academia, or other professional settings. Understanding ECP's positioning in Cornell's curricular structure (Fig. 4.11.1) may help you envision similar structures or engage actively in addressing your own university's allowances for programmatic positioning.

The ECR addresses ABET Criterion 3, which requires engineering programmes to develop in undergraduates "*an ability to communicate effectively with a range of audiences*" (ABET, n.d.). Steven Youra, the first director of ECP at Cornell, championed the ECR's creation, and the requirement went into effect in 1986/87. The second ECP director, Rick Evans, curated some unofficial but sustained relationships in the majors.

However, as enrolment and demand for communication instruction increased, educator workload became a pressing concern.

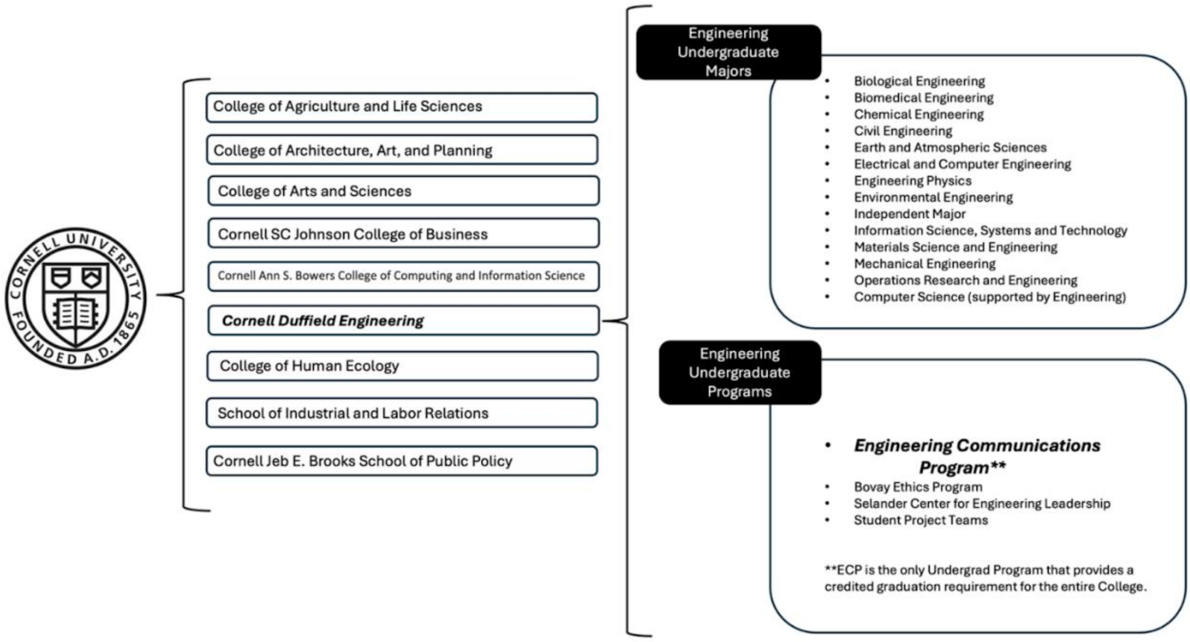

Figure 4.11.1: Cornell University's undergraduate structure (Own Work). Inside Cornell Duffield Engineering, the Engineering Communications Program is classified as an Engineering Undergraduate Program, reporting directly to the Engineering Associate Dean. Programmes can serve all majors.

With the models that we have outlined above in mind, you may be deciding which best fits your institutional context and is most feasible. Initially, ECP made ad-hoc instructional arrangements with engineering staff rather than creating official credit-bearing modules, which raised a few concerns. First, attaching credit to ECP modules made their importance clearer to students, ensured that modules appeared on transcripts and in graduation plans, and allowed staff labour to be counted in budgeting and staffing decisions. Second, ECP modules were added to administrative systems, like enrolment rosters, helping to account for instruction workloads in ways that both the institution and students recognised. In other words, you may find that formalising communication as credit-bearing work is essential for sustaining it. Therefore, after negotiating and mapping partnerships, ECP began attaching 1-credit (2 ECTS) modules to partnered engineering modules. Naturally, our first partnerships continued those already established relationships. While the entity responsible for approving the college curriculum was supportive of our efforts from the beginning, we advocate for finding allies within your own institution who are willing to do the same.

In the following sections, we outline the four *core communicative competencies* (CCC; see Conference on college composition and communication, 2018), which we suggest implementing when building the foundation of any engineering communication modules. Next, we describe ECP's programmatic model, logistics, benefits, and potential complications, which you may also encounter in adapting a similar programmatic structure. Lastly, we provide a method for measuring students' communicative self-efficacy that, stemming from the CCC and supported by years' worth of results, we believe can assist you in similar programmatic or module-level assessment of communication instruction.

2 Core communicative competencies (CCC)

As a multidisciplinary field, communication can be approached from many theoretical frameworks, but ECP grounds its curricular and pedagogical approaches in four competencies: context, social action, design, and identity (Evans & Gabriel, 2007). Table 4.11.1 shows a brief definition of each competency as well as an approachable resource for you to introduce these competencies to your students.

Table 4.11.1: Core communicative competencies

Competency	*Definition*	*Resource*
Context	Communication is always context-bound. Context refers to the specific nexus of activities, means, and identities that makes communication as mediated social action possible.	'Rhetorical situation' one-page poster (Conference on college composition and communication, 2018)
Social action	When we communicate, we engage with others in communicative events, perform specific activities, and use any number of signs or symbols in order to get something done.	'Genre' one-page poster (Conference on college composition and communication, 2018)
Design	All communication reveals design, or structure and organisation, and the enactment of that design in performance. Multimodality has impacts on design.	'An introduction to and strategies for multimodal composing' (Gagich, 2020)
Identity	Communication as mediated social action is how we show ourselves to be legitimate members of a community, creating a credible and situated identity. It is how people engage in the legitimate performances of that community.	'Gee: What is discourse' YouTube video (Scott, 2014)

The theories we suggest expanding your familiarity with include:

- Situated learning and communities of practice (Lave & Wenger, 1991);
- Cultural-historical activity theory (Engeström, 1987; Vygotsky, 1986);

- Actor-network theory (Latour, 1987);
- Discourse analysis (Gee, 1990).

However, this theoretical and research-rich body of literature is quite time-consuming to read and comprehend, so at the absolute minimum, Paretti et al.'s (2014) work is a must-read to effectively and appropriately teach engineering students communication. Paretti et al. (2014, p. 606) succinctly summarise these theories.

Context. Communication occurs within a specific rhetorical situation comprised of 1) events for writing, labelled exigences ("*an imperfection marked by an urgency"* (Bitzer, 1968, p. 6) that prompts the need for coordinated action; 2) people (speakers, audiences, and their existing knowledge and beliefs); 3) media constraints and affordances; 4) cultural, social, and disciplinary conventions; and 5) audience expectations (Bitzer, 1968). Students analyse context features, adapting them to best shape their communication. Our understanding of communication practices draws heavily upon Bitzer's foundational article, which we recommend that you read as a starting point.

Social action. Within these rhetorical contexts, actors use strategic communication in order to cooperate towards goals. Bitzer (1968) argues for an understanding of rhetoric as a practice that promotes change in the world through organising the actions of collaborators. Building on Bitzer's foundation, Miller (1984) theorises genres of language use as "*typified rhetorical action in recurring situations"* (p. 159). Genres of language use are often thought of as written but also include spoken, such as "*the letter of recommendation, the user manual, the progress report, the ransom note, the lecture, and the white paper"* (Miller, 1984, p. 155). We also draw from the tradition of North American Rhetorical Genre Theory, which teaches students to analyse genres based upon their socio-historical contexts and ideology (Schryer, 2002). Importantly, we help students learn that genres are not fixed templates waiting for specific content; rather, they are socially constructed practices that change over time and must be adapted in each specific instance, and they are 'tools of cognition' central to the specific actions and goals of disciplines (Bazerman, 2009). We show students that analysing genres can help them better understand what social actions each genre accomplishes and how to deploy genres and specific rhetorical moves to accomplish their own ends.

Design. Communication can be strategically designed, and we present rhetorically based design principles for students to adapt and apply. Communicators almost always work within the affordances and constraints of specific genres, media, and their corresponding audience expectations, so we teach students to consider the trade-offs between conventions and innovations. Introducing students to communication design principles such as hierarchy, amplification, alignment, proximity, contrast, and repetition (Kress, 1990; Kress & van Leeuwen, 2001), which are relevant across modes and media, allows them to illustrate and explore organisational hierarchies in technical documents via headings and subheadings as well as in the design of graphs, figures, tables, slides, or posters. When students are taught to understand that communication occurs through multiple modes, such as visual, aural, spatial, gestural, and linguistic, known as multimodality (Kress & van Leeuwen, 2001), they can identify and manoeuvre modes to complement their engineering goals and purposes.

Identity. The identity of the communicator both shapes and is shaped by design choices towards social action in a context. The abovementioned theories of situated learning in communities of practice highlight how novices in a field need to actively develop their disciplinary identity and they do this at least partly through developing their communication abilities across relevant engineering contexts, not only through gaining technical skills (Lave & Wenger, 1991; Vygotsky, 1986). Particular language patterns known as discourses are used to shape and perform identities in specific social contexts (Gee, 1990, 1999).

Several rhetorical theories explain how engineers develop their identities through communication (Agha, 2006; Anderson et al., 2010; Pare, 2002). First, engineers possess disciplinary knowledge that builds their 'situated ethos', referring to their reputation or credibility as an engineer situated within professional and personal communities, but they can also design their communication to develop their 'invented ethos' by performing specific language patterns and adapting their language appropriately according to their audience. Second, that performance of specific actions through language builds an engineer's identity. In other words, engineers make rhetorical choices depending upon the engineering context or situation that they are in. Successful identity building, therefore, depends on their ability to understand the needs of a context and the social actions that an engineer would perform within that context. As an example, if you are a structural engineer who designs bridges, you need disciplinary expertise to know what you're talking about, but you also need to sound like you know what you're talking about, not only to other structural engineers but also to other people who rely upon you to know and trust that you can design bridges.

Because communication is always tied to activities and purposes within specific contexts, it follows that for engineering students to truly learn to communicate as engineers, they need to practise communication within authentic disciplinary engineering contexts while using authentic genres to achieve authentic goals. Consequently, providing communication instruction within those authentic contexts is preferable, such as embedded in design projects or experimental research labs, rather than teaching communication separately, isolated from the activities of engineering.

While we teach communication both in embedded 'partner' relationships with engineering modules and in stand-alone communication modules, our goal is to promote and develop partner modules. In the stand-alone modules, we concentrate on teaching students the analytical skills (genre analysis, discourse analysis, design analysis) and strategic practices (identifying models, peer review) that will aid their continuing communication development in authentic contexts. In 'partner' modules we teach them these skills and practices and also scaffold their application in the context of their engineering work.

3 Curriculum design at Cornell Duffield Engineering

The robustness of ECP relies not only on the theoretical foundations of the CCC but also on the practical curricular structure and logistics that we also must contend with to offer communication instruction to engineering students. Accordingly, we shift our focus to how undergraduate students fulfil their engineering communications requirement (ECR). Enrolment data shows that most Duffield Engineering undergraduates (ca. 70% of students) fulfil the ECR by enrolling in and passing a module offered by ECP. To meet this need, ECP employs five full-time and one half-time teaching staff members.

In order for an authentically integrated engineering communication curriculum to work effectively, engineering and communication administrators and staff must be willing to cooperate and collaborate, respecting one another's areas of expertise. We believe you can establish fruitful partnerships between communication and technical modules, steps for which we describe in Section 3.3. We do not yet offer specialized training for this model, but we recommend that you hire staff with specific degrees and experience (see Section 5). We have found that experience teaching technical writing or communication modules is often insufficient; rather, candidates who are familiar with engineering curricula make a better match for this kind of engineering education.

Currently, students can fulfil the ECR via three methods:

- *Category A1:* stand-alone modules offered by the ECP (1-credit/2 ECTS or 3 credit/6 ECTS); includes independent studies.
- *Category A2:* partner modules, where the ECP attaches a 1-credit or 3-credit communications module to an engineering module.
- *Category B:* engineering modules designated as communication-intensive; these reside inside some engineering majors.

Because ECP does not control or assess modules in Category B, we will address Categories A1 and A2 in Section 3.2 and 3.3.

3.1 Student and staff workloads by module type

ECP's agile offerings provide traditional and specialised modules alike, all of which use the CCC, comparable credit workloads for students (see Table 4.11.2), and situated learning outcomes aligned with ABET.

ECP's stand-alone modules offer flexibility in curricular planning. At Cornell, a full-time teaching load is typically two 3-credit modules in both the Autumn and Spring semesters (referred to as a '2/2 load'). In semesters with a high number of graduating students, we can assign an educator who would normally teach two 3-credit modules to instead teach two sections of a 1-credit module in place of one 3-credit module (see Fig. 4.11.2). This adjustment keeps the educator's workload roughly equivalent while expanding capacity by providing approximately 24 additional seats in a given semester.

Table 4.11.2: ECP's 15-week standardised semester student workload. ECP student workload expectations are applied across all module types. Note the inclusion of multimodal communication elements, along with oral and visual communication, teamwork, research, and ethics form the core of each ECP module.

1-credit/2 ECTS modules	*3-credit/6 ECTS modules*
Write at least four significant assignments with a cumulative total of at least 1000 polished words by the end of the term (may include revisions, formal presentation notes, and traditional writing assignments).	Write, cumulatively, at least 3000 polished words by the end of the term. This word count can be spread over several assignments, and it assumes revision processes have been enacted.
Present at least two formal presentations (individual or team). One presentation may be a major technical presentation (recorded or live) for an interdisciplinary/varied relevant audience.	Present at least twice for review by the educator and/or peers. Presentations can be recorded or live, but they presume practice sessions and a final polished presentation.
Complete at least one assignment involving issues of professional ethics.	Complete at least one assignment involving issues of professional ethics.
	Research and provide information in ethically aware ways, including incorporating outside research with proper citations and dealing with AI impacts. Necessarily, this means that projects will require library database skills, at a minimum.
	Create multimodal, technically-focused artifacts that communicate information to audiences. This can include, but is not limited to, figures, tables, video, or other multimodal artifacts (such as 3D elements). These artifacts may or may not include generative AI.
	Participate constructively in a team project, where the essential skills of teamwork, communication, cross-cultural communication, and accessibility are enacted.

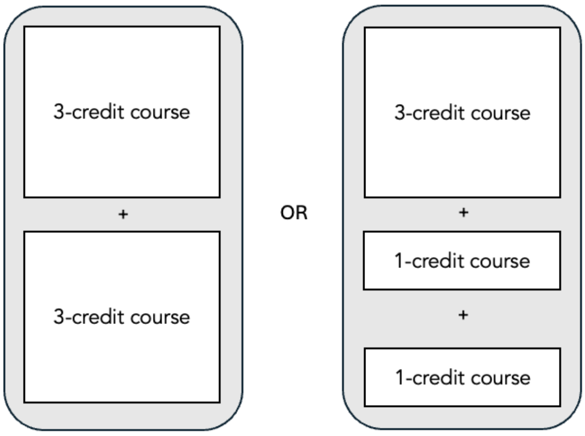

Figure 4.11.2: Workload for ECP staff by semester (Own Work). ECP deploys two flexible patterns of semester-based teaching workload. Seat demand influences which pattern is used for teaching assignments.

3.2 Stand-alone modules

Traditional stand-alone modules provide students flexible ways to fulfil the Cornell's ECR. Regardless of their credit load, all stand-alone modules incorporate the CCC in the work of drafting, revising, research, editing, presenting, creating visuals, and authoring multimodal communication artifacts. Students in all modules work both individually and in teams. Furthermore, workloads for staff and students are aligned across the programme and meet New York State Education Department requirements.

Stand-alone 3-credit modules

The story of our programme started with 3-credit modules, and for many years, ECP offered just two variants at the 3-credit level. We now have four 3-credit modules. We will concentrate here on ECP's foundational module, Engineering Communications, which had its inception in the late 1980s, continuing to the present. Engineering Communications is designed to help students think clearly about how daily work can be done effectively, efficiently, and professionally in the engineering, technical, and business sectors. It focuses on engineering communication skills that help boost students' career development in strategic communication, rhetorical skills, technical writing techniques, presentations, and collaboration.

Stand-alone 1-credit modules

At the time of writing, ECP offers three 1-credit (2 ECTS) stand-alone modules. Each module reflects the expertise of the respective staff who developed them and concentrates on specialised genres and theories.

3.3 Partnered modules

Our programme also offers partnered modules that are guided by Reave's (2004) term 'authentic integration', defined as "*the collaboration between instructors, in which at least one has technical expertise and another has communication expertise, to engage engineering students in a meaningfully unified course or project*" (Hutchison et al., 2021, p. 923). Here, an engineering communication module is partnered with a specific engineering module within a major. The partnership structure can be envisioned as similar to a lecture paired with a lab section, where the engineering communication module functions as the applied component. Partner modules require coordination and are therefore complex in multiple dimensions.

If you are considering a similar model, developing or consulting a formal partnership guide may support implementation in your institutional context. To support the creation, maintenance, and dissolution of these partnerships, ECP has an in-house partnership guide that states: "*These partnered courses [modules] are close collaborations between dedicated ECP and engineering instructors. ECP faculty bring a wealth of knowledge, expertise, and experience about communication practices; they work closely with engineering faculty to understand field-specific expectations for students in the majors.*" Hutchison's (2025) workshop paper on building and sustaining these partnerships may offer additional practical guidance.

While the impetus for these collaborations can vary, our experience has shown that you should lay a solid foundation by identifying required modules in your department's curriculum that either have communication deliverables assigned or in which staff wish to incorporate communication. When offering partnered modules, we strongly recommend requiring students to enrol in both the engineering module and the communication module so that students' and educators' effort and workloads alike remain fair and predictable.

Successful collaborations rely upon an initial meeting between communication and engineering staff to recognise the learning outcomes of the engineering module and how those can be met with relevant communication deliverables, which may already exist in the engineering module. During those early meetings, we recommend that you take advantage of the time to review the syllabus and/or a module calendar to get a sense of the learning outcomes and conceptual arc of the module. Good partnerships create learning paths in tandem. For instance, if the engineering staff assigns a final design report, then the engineering communication module will include activities and assignments that structure and scaffold that report in advance of the final due date, such as instruction in researching the literature or gathering primary insights, as well as a shorter design justification assignment in which students synthesise primary and secondary research and identify appropriate materials for prototyping their proposed design. ECP academic staff then offer focused written and/or verbal feedback on that written assignment to prepare students for the heavier lift of a more comprehensive technical document.

Accounting for instructional effort in partnered modules

Most ECP partner modules are offered at the 1-credit level. The addition of partnerships solidifies and documents the learning and teaching labour for students and involved staff alike. For staff, making the workload both documented and visible within the university system is of the utmost importance for reasons such as identified field expertise, curricular visibility and positioning, service models, and promotion considerations.

Partner model pros and cons

When creating a partnered module, there are many common goals on the engineering side and the communication side. Briefly, partnering engineering and communication modules provides students with 1) situated learning via authentic projects (Artemeva et al., 1999; Poe et al., 2010); 2) structured teamwork via guided practices and agreements; 3) detailed iterative feedback cycles from peers and educators; and 4) situated engineering communication activities.

ECP holds these expectations for positive partnerships, where all parties in the partnership aim to

- Introduce students to and encourage their development of the ability to use the disciplinary variety of language for participating in their discipline;
- Offer students a theoretical framework for understanding communication that will allow continued lifelong communicative agility.

We also hold that partnered modules must be

- Rich, complex, and complimentary teaching and learning environments where students are exposed to situated communication experiences;
- Created with instructional partners whose good intentions are responsive to the demands and tenets of their fields and expertise;
- Balanced efforts to raise the impacts of module content and learning outcomes;
- Prime opportunities for pedagogical research.

For the most part, ECP has found wonderful working partnerships across Cornell Duffield Engineering. ECP has also experienced partnerships that needed to be dissolved due to shifts in module offerings in the majors, budgets, misaligned expectations, and differing pedagogical approaches.

3.4 Developing assignments and rubrics with the CCC

To see how the CCC framework operates at the module level, ECP staff develops rubrics to evaluate students' work for various assignments. We invite you to adapt Example 1, which provides high-level assignment criteria from a 1-credit (2 ECTS) professional portfolio website module. In this module, students write a final report to comprehensively explain their rationale for their website design and functionality. Each of the four CCC concepts intersects with module learning outcomes.

Example 1. Assignment criteria for rubric development

Multiple ECP staff members teach sections of Creating and Communicating Your Digital Professionalism. While our teaching styles differ, we mainly use the same set of assignments and rubrics to evaluate students' performance and assess their progress toward a fixed set of module learning outcomes. The rubric criteria below are each assigned a point value, but since you operate within a different teaching *context, we share just those criteria and leave grading methods up to you. Note that communicative concepts are in all caps.*

Social action. *Your website and multimodal content perform a credible social action or actions within the context (rhetorical situation) that you are responding to. Describe sequentially how you expect your primary audience to engage with this portfolio website. Explain how your chosen design promotes this engagement and potentially realises your desired outcome.*

Context. *Your website and multimodal content show thoughtful consideration of your professional context (rhetorical situation). Describe the premises/assumptions underlying your portfolio website and provide an evidence-based rationale that supports those premises/assumptions. Draw upon what you learned about genre conventions and any other relevant research.*

Design. *You create an intentional design that is responsive to context (rhetorical situation) and enables responsive action on the part of your primary (and, if applicable, secondary) audience. Explain how you designed your website and multimodal content to engage your intended audience. Cite what you learned from coursework as evidence.*

Identity. *You demonstrate a professional identity that enables the audience to ascribe appropriate abilities and attributes to you.*

Multimodality: *Your website showcases an awareness of multiple modes (visual, aural, gestural, spatial, and linguistic) and strategically implements these modes to complement one another, such that those modes are responsive to your rhetorical situation.*

4 Assessing core communicative competencies

Since 2019, ECP has programmatically collected communicative self-efficacy (CSE) surveys to gauge students' confidence across multiple dimensions that map onto the CCC. Self-efficacy explains a person's agency to take action and achieve a positive behaviour or outcome (Bandura, 1997) and is measured in confidence levels which signify behaviours like goal setting, persistence, resilience in the face of failure, and more. Confidence generally shows how individuals represent those behaviours to themselves and others. Bandura's research method has influenced assessment of engineering students, as is shown by its use in engineering education: the American Society for Engineering Education conference proceedings show over 5,300 references to Bandura's work to date.

ECP's current director and the director emeritus created a 23-item survey with the goal of measuring students' confidence in their abilities to perform a variety of communication activities (Nathans-Kelly & Evans, 2017a). Each question maps onto the CCC. Following Bandura's (2006) pivotal research, each question prompts students to select their percentage of confidence on a scale of 1 to 100 (Nathans-Kelly & Evans, 2017b).

Like many educators, you might be subject to student evaluations of teaching. You may also be aware of research that shows their flaws, including bias towards educators of colour, women, and those who identify as 2SLGBTQIA+[i] (Shorter, 2023). Furthermore, such surveys are not able to offer a reliable metric of module quality or learning outcomes being met (Uttl et al., 2017). If you're looking for a more powerful statistical window into the effectiveness of engineering communication instruction, we offer our CSE survey protocol, which asks students to gauge their confidence in performing specifically identified communication skills.

4.1 How to replicate the survey and analyse results

Should you decide to implement a similar programme, we encourage you to replicate our survey methods described below in Example 2. We are also happy to provide a how-to guide on using an Excel spreadsheet with macros that assists with steps 2 and 3 below by contacting our lead author.

Example 2. Process for replicating the communicative self-efficacy survey

1. *Send students the same survey at the beginning of the semester (pre-survey) and again at the end (post-survey). See Table 4.11.3 below for survey questions or our website (Nathans-Kelly & Evans, 2017b) for the full questionnaire. Collect student IDs or some other information that allows you to identify which students completed both surveys and match up their responses.*
2. *The same students need to complete both the pre- and post-survey to conduct paired t-tests to see whether their confidence in their communicative self-efficacy produces statistically significant increases.*
3. *Calculate effect size (Cohen's d) to measure the extent to which your communication instruction works. The difference between the same group of students — once at the beginning and again at the end of the semester — takes more than sample size and statistical significance (p-values) into account to see if there is practical significance, also known as real-world applications, of your study (Sullivan & Feinn, 2012). Large effect sizes ($d \geq 0.8$) mean that your instruction likely has real-world applications for students, indicating their confidence when communicating in future situations.*

4.2 Increased communicative self-efficacy

Our survey results across all module types indicate that students consistently demonstrate statistically significant increases in communicative self-efficacy. We have narrowed down these results to focus on average increases from two module types described above. Over the past six years (2019 to 2025[ii]), students in our signature 3-credit module Engineering Communications reported increases in the same seven questions, six of which showed large average effect sizes ($d \geq 0.8$) or real-world application. For the past four years (2022 to 2025), students in a 1-credit partner module, Communications for Practical Tools for Operations Research, Machine Learning and Data Science, showed significant gains in nine questions, seven of which also showed large or extremely large real-world applications.

While our full survey includes 23 questions, we concentrate on the 13 that are statistically significant year after year in either a 3-credit module, 1-credit module, or both. Overall, as Table 4.11.3 indicates, students from both module types succeed in giving presentations (Q8), slide design (Q9), and handling Q&A sessions. We suspect these results are owed to assigning students multiple presentations in a semester, regardless of their module selection, accompanied by readings from our director's coauthored book (Nathans-Kelly & Nicometo, 2014). In the engineering module that is partnered with our 1-credit module, students participate in a team project where they analyse a large dataset using operations research and machine learning tools and then write two reports. Therefore, the repeated appearance of Q11, Q13, and Q14 under the design competence offers evidence that students recognise learning outcomes focused on analysing and visualising data. Students in the 3-credit module persistently reflect self-efficacy in the design (Q2 and Q3) and context (Q5 and Q6) areas of communicative competence, perhaps owed to the robust semester-long projects that they typically complete in Engineering Communications.

Offering results from students in our modules alone may not paint a fully convincing picture that, in addition to giving engineering students communication assignments, communication instruction is also required in order to bolster this competence. To address this question, in the Spring 2025 semester, we collected surveys from students who took the 1-credit partner communication module; for comparison, we also surveyed students who *only* took the engineering module as a control group. The students who took both the engineering and the partnered communication modules more than doubled the number of significant questions (total of 16) compared to the control group. All questions had medium effect sizes or higher, with six questions showing very large effect sizes ($d = 1.0+$). By contrast, students in the control group had only seven questions with statistically significant increases, although all effect sizes were small to medium.

We tested for discrepancies between both sets of students' beginning-of-semester averages, but statistical testing yielded no significant differences between the two. In other words, there does not seem to be any proof that a self-selection bias exists among students who enrolled in both partner modules. These results give further credence to our authentically integrated communication curriculum: if we hope for engineering students to learn to communicate effectively, they must receive explicit instruction, preferably in the form of dedicated modules rather than the supplemental approaches mentioned in Section 1.1.

Table 4.11.3: CCC and survey questions with consistent increases by module type. Average increase was calculated by subtracting students' collective beginning average from the ending average. Only those questions are shown here that show statistically significant increases ($p \leq 0.05$) and large real-world applications (effect sizes or Cohen's $d \geq 0.8$).

Communicative competence	*Survey question I am ___% confident that I can:*	*Module type*	*Average increase*
Identity	Q1. express and represent my expertise in technical and professional contexts	1cr	13.9%
	Q23. be perceived as a knowledgeable and capable communicator	1cr	9.8%
Design	Q2. choose words and sentence structures	3cr	14.2%
	Q3. construct well-organised communication	3cr	12.6%
	Q11. design data visuals	1cr	13.3%
	Q13. create captions that interpret data and non-data visuals	1cr	15.1%
	Q14. integrate data and non-data visuals	1cr	16.1%
Context	Q5. write a first draft	3cr	14.1%
	Q6. revise beyond simple editing	3cr	12.5%
	Q8. give technical and professional talks and presentations	both	17.1% (1cr) 17.1% (3cr)
	Q9. use slide design strategically	both	13.8% (1cr) 17.1% (3cr)
	Q10. close presentations and answer questions	both	18.0% (1cr) 17.0% (3cr)
Social action	Q18. present technical information for multiple audiences	1cr	14.7%

5 Future outlook

ECP's authentic integration model where engineering and communication academic staff collaborate to design and revise modules is a practise that is not necessarily widespread within engineering colleges and programmes worldwide. Each academic year, ECP can teach up to 600 students in a wide variety of modules. With staff planning, ECP's curricular agility, and integrated CCC, we manage to meet increasing curricular demands. We strongly believe that if our small team can educate engineering students in communicative context, design, identity, and social action, so, too, can other engineering programmes. To do so, we recommend that you hire staff whose expertise includes rhetorical genre theory, technical and scientific communication, linguistics, rhetoric of science, and related fields, who have studied the complex integration of communication in technical settings. Perhaps most importantly for curricular agility, ECP hires staff who exhibit deep collaboration practices, investigate and comprehensively understand engineering module learning outcomes, and research how CCC complements and strengthens those outcomes. When hiring, we give preference to candidates who have a PhD in technical communication, professional communication, science communication, applied linguistics with a specialization in professional and academic discourse or related sector, or a related degree with a focus on communication, with competencies in teaching oral presentations and multimodal artifacts.

ECP academic staff teach modules where students develop and apply the CCC in team-based projects that enhance, highlight, and articulate their technical skills. Furthermore, we fully endorse Leydens' (2012) assertion that the technical cannot be extricated from the social, and communication is an integral part of any engineer's sociotechnical growth to gain professional and personal success.

References

ABET. (n.d.). Criteria for accrediting engineering programs, 2024-2025. https://www.abet.org/wp-content/uploads/2023/05/2024-2025_EAC_Criteria.pdf

Agha, A. (2006). Language and social relations. Cambridge University Press.

Anderson, K. J. B., Courter, S. S., McGlamery, T., Nathans-Kelly, T. M., & Nicometo, C. G. (2010). Understanding engineering work and identity: A cross-case analysis of engineers within six firms. Engineering Studies, 2(3), 153–174. https://doi.org/10.1080/19378629.2010.519772

Artemeva, N., Logie, S., & St-Martin, J. (1999). From page to stage: How theories of genre and situated learning help introduce engineering students to discipline-specific communication. Technical Communication Quarterly, 8(3), 301–316. https://doi.org/10.1080/10572259909364670

Bandura, A. (1997). Self-efficacy: The exercise of control. Worth Publishers.

Bandura, A. (2006). Guide for constructing self-efficacy scales. In T. Urdan & F. Pajares (Eds.), Self-efficacy beliefs of adolescents (pp. 307–337). Information Age Publishing.

Bazerman, C. (2009). Genre and cognitive development: Beyond writing to learn. Pratiques. Linguistique, Littérature, Didactique, 143/144, 127–138. https://doi.org/10.4000/pratiques.1419

Bitzer, L. F. (1968). The rhetorical situation. Philosophy & Rhetoric, 1(1), 1–14.

Brumberger, E. R., & Ellsworth, A. J. T. (2025). From academy to workplace: Perceptions of engineering communication skills. IEEE Transactions on Professional Communication, 68(4), 451–466. https://doi.org/10.1109/TPC.2025.3607170

Buswell, N. T., Jesiek, B. K., Troy, C. D., Essig, R. R., & Boyd, J. (2019). Engineering instructors on writing: Perceptions, practices, and needs. IEEE Transactions on Professional Communication, 62(1), 55–74. https://doi.org/10.1109/TPC.2019.2893392

Conference on college composition and communication. (2018). CCC Poster Pages. https://cccc.ncte.org/cccc/ccc/posterpages/

Connors, R. J. (1983). The rise of technical writing instruction in America. Journal of Technical Writing and Communication, 12(4), 3–19. https://doi.org/10.1177/004728168201200406

Cornell Duffield Engineering. (2025). Engineering communications requirement. https://www.engineering.cornell.edu/courses-requirements/bachelor-science-requirements/engineering-communications-requirement/

Cunningham, D., & Stewart, J. (2012). Perceptions and practices: A survey of professional engineers and architects. International Scholarly Research Network Education, 1–10. https://doi.org/10.5402/2012/617137

Darling, A. L., & Dannels, D. P. (2003). Practicing engineers talk about the importance of talk: A report on the role of oral communication in the workplace. Communication Education, 52(1), 1–16. https://doi.org/10.1080/03634520302457

Engeström, Y. (1987). Learning by expanding: An activity-theoretical approach to developmental research. Cambridge University Press.

Europass. (n.d.) Description of the eight EQF levels. https://europass.europa.eu/en/description-eight-eqf-levels

Evans, R., & Gabriel, J. (2007). A new paradigm for understanding communication that can transform engineering communications learning and teaching. In The moving frontiers of engineering. International Conference on Engineering Education, Coimbra, Portugal. http://icee2007.dei.uc.pt/proceedings/papers/427.pdf

Gagich, M. (2020). An introduction to and strategies for multimodal composing. In D. Driscoll, M. Stewart, & M. Vetter (Eds.), Writing spaces: Readings on writing (Vol. 3). WritingSpaces.org; Parlor Press; The WAC Clearinghouse. https://wacclearinghouse.org/books/writingspaces/writingspaces3/

Gee, J. P. (1990). Social linguistics and literacies: Ideology in discourses. Routledge.

Gee, J. P. (1999). Critical issues: Reading and the new literacy studies: Reframing the national academy of sciences report on reading. Journal of Literacy Research, 31(3), 355–374.

Hirudayaraj, M., Baker, R., Baker, F., & Eastman, M. (2021). Soft skills for entry-level engineers: What employers want. Education Sciences, 11(10), Article 10. https://doi.org/10.3390/educsci11100641

Hutchison, A. (2025). Workshop: Putting up the bat signal to partner technical and communication curricula. In 2025 IEEE International Professional Communication Conference, 117–119. https://ieeexplore.ieee.org/abstract/document/11114996/

Hutchison, A., Evans, R., & Malepati, N. (2021). A preliminary review of communication instruction in an international undergraduate engineering context. SEFI Conference, Blended learning in engineering education: Challenging, enlightening — and lasting, 923–935. https://doi.org/10.5281/zenodo.14650327

Khoo, E., Zegwaard, K., & Adam, A. (2020). Employer and academic staff perceptions of science and engineering graduate competencies. Australasian Journal of Engineering Education, 25(1), 103–118. https://doi.org/10.1080/22054952.2020.1801238

Kress, G. (1990). Critical discourse analysis. Annual Review of Applied Linguistics, 11, 84–99. https://doi.org/10.1017/S0267190500001975

Kress, G., & Van Leeuwen, T. (2001). Multimodal discourse. Bloomsbury.

Kreth, M. L. (2000). A survey of the co-op writing experiences of recent engineering graduates. IEEE Transactions on Professional Communication, 43(2), 137–152. https://doi.org/10.1109/47.843642

Latour, B. (1987). Science in action: How to follow scientists and engineers through society. Harvard University Press.

Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. Cambridge University Press.

Leydens, J. A. (2012). Sociotechnical communication in engineering: An exploration and unveiling of common myths. Engineering Studies, 4(1), 1–9. https://doi.org/10.1080/19378629.2012.662851

Miller, C. R. (1984). Genre as social action. Quarterly Journal of Speech, 70, 151–167.

Nathans-Kelly, T., & Evans, R. (2017a). Creating communicative self-efficacy through integrating and innovating engineering communication instruction. In Proceedings of the 2017 ASEE Annual Conference. https://doi.org/10.18260/1-2--28082

Nathans-Kelly, T., & Evans, R. (2017b). ECP Research. CHEC: Cornell help for engineering communication. https://chec.engineering.cornell.edu/ecp-research/

Nathans-Kelly, T., & Nicometo, C. G. (2014). Slide rules: Design, build, and archive presentations in the engineering and technical fields. John Wiley & Sons.

Pare, A. (2002). Genre and identity: Individuals, institutions, and ideology. In R. M. Coe, L. Lingard, & T. Teslenko (Eds.), The rhetoric and ideology of genre. Strategies for stability and change (pp. 57–71). Hampton Press.

Paretti, M. C., McNair, L. D., & Leydens, J. A. (2014). Engineering communication. In A. Johri & B. M. Olds (Eds.), Cambridge handbook of engineering education research (pp. 601–632). Cambridge University Press.

Poe, M., Lerner, N., & Craig, J. (2010). Learning to communicate in science and engineering: Case studies from MIT. MIT Press.

Ramadi, E., Ramadi, S., & Nasr, K. (2016). Engineering graduates' skill sets in the MENA region: A gap analysis of industry expectations and satisfaction. European Journal of Engineering Education, 41(1), 34–52. https://doi.org/10.1080/03043797.2015.1012707

Reave, L. (2004). Technical communication instruction in engineering schools: A survey of top-ranked U.S. and Canadian programs. Journal of Business and Technical Communication, 18(4), 452–490. https://doi.org/10.1177/1050651904267068

Sageev, P., & Romanowski, C. J. (2001). A message from recent engineering graduates in the workplace: Results of a survey on technical communication skills. Journal of Engineering Education, 90(4), 685–693. https://doi.org/10.1002/j.2168-9830.2001.tb00660.x

Schryer, C. F. (2002). Genre and power: A chronotopic analysis. In R. M. Coe, L. Lingard, &. T. Teslenko (Eds.), The rhetoric and ideology of genre: Strategies for stability and change (pp. 73–102). Hampton Press.

Scott, J. (2014). Gee: What is discourse [Video recording]. https://www.youtube.com/watch?v=qEB4rAZanpM

Sullivan, G. M., & Feinn, R. (2012). Using effect size — or why the p value is not enough. Journal of Graduate Medical Education, 4(3), 279–282. https://doi.org/10.4300/JGME-D-12-00156.1

Uttl, B., White, C. A., & Gonzalez, D. W. (2017). Meta-analysis of faculty's teaching effectiveness: Student evaluation of teaching ratings and student learning are not related. Studies in Educational Evaluation, 54, 22–42. https://doi.org/10.1016/j.stueduc.2016.08.007

Vygotsky, L. S. (1986). Thought and language (rev. ed.). MIT Press.

Yeats, D., & Thompson, I. (2010). Mapping technical and professional communication: A summary and survey of academic locations for programs. Technical Communication Quarterly, 19(3), 225–261. https://doi.org/10.1080/10572252.2010.481538

AI statement

The authors have not implemented generative AI in any way in the writing or creation of figures and tables in this chapter. An Atlas.ti summary of all the reviewers' feedback was generated to help the lead author completely address points during revision. The authors take full responsibility for the content of the publication.

Contributor statement

Conceptualisation	Rick Evans, Traci Nathans-Kelly, Allison Hutchison
Data curation	Allison Hutchison
Formal analysis	Allison Hutchison
Investigation	Rick Evans, Traci Nathans-Kelly, Allison Hutchison
Methodology	Rick Evans, Traci Nathans-Kelly
Visualisation	Allison Hutchison, Traci Nathans-Kelly
Writing - original draft	Allison Hutchison, Traci Nathans-Kelly, Suzanne Lane, Cameron Mozafari, Hua Wang
Writing - reviewing and editing	Allison Hutchison, Traci Nathans-Kelly, Suzanne Lane, Cameron Mozafari, Hua Wang

[i] In the USA, the term 2SLGBTQIA+ refers to Two-Spirit, Lesbian, Gay, Bisexual, Transgender, Queer or Questioning, Intersex, Asexual, and other identities under the + symbol. The addition of 'Two-Spirit' (2S) at the beginning of the acronym specifically recognises and honours the distinct, pre-colonial gender and sexual identities of Indigenous peoples, placing them before Western-defined concepts.

[ii] Exceptions from this analysis include 2020 when we did not collect data, as well as Spring 2024 when a data collection error occurred.