

TEACHING ENGLISH FOR SCIENCE AND TECHNOLOGY IN ENGINEERING EDUCATION: UNDERSTANDING INNOVATIONS IN SUSTAINABLE MOBILITY

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Abstract

The rapid development of emerging technologies has significantly transformed modern transportation systems and infrastructure, placing sustainable mobility at the centre of global development strategies. As scientific communication and technological innovation increasingly take place in international settings, English has become the dominant language for accessing and disseminating technical knowledge. Consequently, students of engineering and technical sciences have to develop the linguistic competence necessary to understand and communicate complex technological concepts in English. This paper examines the role of English for Science and Technology (EST) in preparing engineering students to understand innovations related to sustainable mobility and emerging technologies. Particular attention is given to the development of reading skills and terminological competence required to analyse professional and scientific texts on smart transportation systems, green infrastructure, and environmentally responsible technological solutions. The study presents results from a questionnaire administered to engineering students to explore their perceptions of the importance of English for understanding contemporary technological developments. The findings indicate that students recognise the importance of English for accessing scientific literature and following global technological trends, and they support integrating technological topics and authentic materials into EST courses. By connecting language instruction with contemporary technological challenges, EST teaching can contribute to the development of both linguistic competence and professional awareness among future engineers.

Keywords: English for Science and Technology; engineering education; sustainable mobility; ESP; technical terminology; technological innovation

JEL classification: I23, I21, O33

INTRODUCTION

In an era characterised by rapid technological change and the growing global imperative to develop sustainable transportation systems, engineering education faces a dual challenge: preparing students in their technical disciplines while simultaneously equipping them with the linguistic tools required to access and communicate cutting-edge knowledge. The majority of scientific publications, technical standards, and international research initiatives are produced in English, and this trend shows no sign of abating (Crystal, 2003; Phillipson, 2009). For students enrolled in engineering and technical programmes in non-Anglophone countries, the capacity to read and interpret English-language scientific discourse has become as professionally significant as mastery of subject-specific content.

Sustainable mobility, broadly understood as the design and implementation of transportation systems that minimise environmental impact while maximising efficiency, safety, and social inclusion, has emerged as one of the most dynamic and interdisciplinary fields in contemporary engineering (Banister, 2008). Concepts such as electric vehicles, smart transportation networks, green urban infrastructure, and low-emission logistics require not only advanced technical understanding but also the ability to engage with a rapidly expanding, predominantly Englishlanguage body of literature. Engineering students who lack the necessary language skills risk being excluded from the very knowledge communities that are shaping their professional futures.

English for Science and Technology (EST), a well-established strand of English for Specific Purposes (ESP), provides a principled framework for addressing this challenge. By focusing on the language patterns, text types, and communicative conventions characteristic of scientific and technical discourse, EST courses can develop the reading, comprehension, and vocabulary skills that engineering students require to function effectively in international academic and professional environments (Hutchinson & Waters, 1987; Dudley-Evans & St. John, 1998).

This paper investigates the role of EST in helping engineering students understand innovations in sustainable mobility. In addition to the theoretical analysis, it reports findings from a smallscale survey exploring students' perceptions of the importance of English in their professional development and their attitudes toward integrating technology-related themes into EST instruction. The primary objective is to demonstrate how well-designed EST curricula can bridge linguistic education and the requirements of contemporary engineering practice.

1. THEORETICAL FRAMEWORK

1.1. ENGLISH FOR SCIENCE AND TECHNOLOGY WITHIN THE ESP TRADITION

EST occupies a well-defined position within the broader field of English for Specific Purposes, which emerged in the 1960s in response to the recognition that general-purpose language instruction did not adequately serve learners with clearly identifiable professional or academic objectives (Hutchinson & Waters, 1987). The foundational principle of ESP that language teaching should be shaped by the specific needs of the learner has generated a rich body of pedagogical theory and practice over the past six decades (Anthony, 2018; Belcher, 2009; Brown, 2016).

Within this tradition, EST focuses on the communicative practices of the scientific and technical community. Dudley-Evans and St. John (1998) argue that effective EST instruction must cultivate students' ability to read and comprehend disciplinary texts as well as produce them, attending closely to the genre conventions, rhetorical structures, and terminological registers that characterise scientific writing.

Hyland's (2006) influential work on academic discourse further emphasises the importance of genre awareness: competent students must be able to navigate a range of text types, from research articles and technical reports to grant proposals and conference proceedings, each governed by distinct communicative norms.

Richards and Rodgers (2014) observe that methodological approaches in language education have evolved considerably in response to changing societal demands, with particular implications for EST. As engineering curricula shift to incorporate emerging technologies and sustainability concerns, EST pedagogy must evolve in parallel to ensure that language instruction remains anchored in the professional realities students will encounter upon graduation.

1.2. AUTHENTIC MATERIALS AND PROBLEM-BASED LEARNING IN EST

A growing consensus in the applied linguistics literature holds that the use of authentic materials, texts drawn from real disciplinary practice rather than purpose-written pedagogical simplifications, substantially enhances both language acquisition and the development of professional competence (Flowerdew & Peacock, 2001). When students engage with genuine scientific articles, technical manuals, or industry reports, they are exposed to the full range of linguistic features characteristic of disciplinary discourse: complex nominalisations, passive constructions, hedging devices, and the dense terminological networks that define specialised fields. Project-based and problem-based learning approaches are particularly well suited to the EST context because they require students to engage with authentic technological problems while practising the language skills, namely reading, summarising, presenting, and discussing, that professional engineers routinely employ. Flowerdew and Peacock (2001) demonstrate that such integrative approaches strengthen the connection between linguistic ability and technical expertise, enabling students to participate more effectively in international research environments. The pedagogical literature consistently reports that learners who perceive language instruction as directly relevant to their professional aspirations demonstrate higher motivation and deeper processing of target-language input (Dörnyei & Ushioda, 2011).

1.3. SUSTAINABLE MOBILITY AS A CONTENT DOMAIN FOR EST INSTRUCTION

Sustainable mobility encompasses the planning, design, and operation of transportation systems that balance economic efficiency, environmental responsibility, and social equity (Banister, 2008; Litman, 2020). The field has expanded dramatically in recent years, driven by concerns about climate change, urban air quality, and the depletion of fossil fuels. Technological innovations at the heart of this transformation, including battery-electric and hydrogen fuel cell vehicles, autonomous driving systems, intelligent traffic management platforms, and multimodal urban mobility networks, are generating a prolific scientific literature, almost entirely in English.

From an EST perspective, sustainable mobility offers an exceptionally rich content domain. Its texts exhibit the full range of scientific and technical discourse features that students need to master: precise quantitative language, discipline-specific terminology, complex causal and comparative structures, and a diversity of text types ranging from peer-reviewed research articles to policy documents and engineering standards. Integrating this content into EST instruction thus serves a dual purpose: it equips students with practical, relevant language skills while simultaneously developing their awareness of and engagement with the global sustainability challenges they will face as professional engineers.

2. METHODOLOGY

2.1. RESEARCH CONTEXT AND PARTICIPANTS

The study was conducted with forty undergraduate students enrolled in engineering and technical study programmes who attended an English course during the 2024/2025 academic year. All participants had an intermediate level of English proficiency (roughly B1- B2 on the Common European Framework of Reference for Languages) and had a foundational familiarity with technical terminology in their respective engineering disciplines. The sample, while modest in size, is considered sufficient for the exploratory, descriptive purposes of the present investigation, consistent with the conventions of small-scale pedagogical research in the ESP field (Dörnyei, 2007).

2.2. RESEARCH INSTRUMENT

Data were collected using a structured questionnaire comprising six statements, each rated on a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The instrument was designed to examine three interrelated dimensions: students' perceptions of the importance of English in understanding technological innovations; their self-assessed difficulties with specialised technical terminology; and their attitudes towards integrating technology-related content and authentic materials into EST courses. The questionnaire was administered in class during a regular teaching session to maximise the response rate and to allow for any procedural clarifications.

2.3. RESEARCH QUESTIONS

The study was guided by the following research questions:

RQ1: To what extent do engineering students perceive English as important for understanding technological innovations and accessing scientific literature?

RQ2: How do students assess the difficulty of specialised technological terminology encountered in English-language professional texts?

RQ3: What are students' attitudes towards integrating technology-related topics and authentic materials into EST instruction?

3. RESULTS

The survey results reveal consistently high recognition among participating engineering students of the role English plays in their professional and academic development. Table 1 presents the percentage of respondents who agreed or strongly agreed with each of the six survey statements.

Table 1. Students' Perceptions of the Role of English in Understanding Technological Innovations (N=40) - Source: Authors' own research (2025)

Survey Statement	% Agree / Strongly Agree
English is essential for understanding new technologies and their applications.	100%
The majority of research on sustainable mobility is published in English.	87.5%
Technical terminology related to emerging technologies is difficult to comprehend.	67.5%
English enables students to follow global technological developments in real time.	100%

Technology-related topics should be incorporated into English language courses.	100%
Survey Statement	% Agree / Strongly Agree
Authentic technological texts make English classes more engaging and relevant.	100%

The data reveal a number of noteworthy patterns. Universal agreement (100%) was recorded for four of the six statements: the importance of English for understanding new technologies; the role of English in following global technological developments; the inclusion of technology-related topics in English courses; and the value of authentic technological texts in the classroom. A high but not unanimous proportion of respondents (87.5%) agreed that most research on sustainable mobility is published in English, suggesting that a small number of students may be less aware of the predominantly Anglophone character of the scientific literature in this field. The statement concerning the difficulty of technical terminology attracted 67.5% agreement, indicating that while most students perceive terminological comprehension as a challenge, a substantial minority do not. This finding may reflect variation in students' prior exposure to English-medium technical content or differences in subject-specific background knowledge.

Taken together, these results confirm that the student cohort is strongly cognisant of the professional and academic value of English, perceives technology-related content as motivating, and identifies specialised terminology as the primary linguistic obstacle in their engagement with English-language scientific texts.

4. DISCUSSION

The findings of this study align closely with the broader literature on EST and ESP, which consistently identifies English proficiency as a critical competence for students in scientific and technical disciplines (Hutchinson & Waters, 1987; Anthony, 2018). The unanimous recognition of English as important for accessing technological knowledge reinforces Crystal's (2003) argument that English functions as the *de facto* lingua franca of global scientific communication, a reality that EST practitioners must address head-on in curriculum design.

The observation that 67.5% of students report difficulty with specialised technical terminology is particularly significant from a pedagogical standpoint. Terminological competence, the ability to recognise, understand, and use the specialised vocabulary of a discourse community, is widely regarded as one of the central challenges in disciplinary language learning (Nation, 2001). Students who struggle with technical vocabulary are likely to encounter comprehension difficulties even when their general English proficiency is adequate, because scientific texts are characterised by high concentrations of low-frequency, domain-specific terms whose meanings cannot be inferred from context alone. This finding underscores the need for systematic, corpusinformed vocabulary instruction within EST courses, supplemented by extensive reading practice with authentic scientific materials.

The strong student support for integrating technological topics and authentic materials into EST instruction aligns with the motivational theory of situated learning, which holds that learners are most productive when instructional content is perceived as directly relevant to their future professional identities (Lave & Wenger, 1991).

When EST courses employ texts drawn from current scientific and technical debates, such as those surrounding electric-vehicle battery technology, smart-city logistics, or low-carbon urban planning, students simultaneously develop language skills and build the domain knowledge that will serve them in their careers. This dual benefit represents a compelling argument for content-integrated approaches to EST instruction (Coyle, Hood & Marsh, 2010).

It is worth noting certain limitations of the present study. The sample of forty students drawn from a single institutional context limits the generalisability of the findings. Future research should employ larger and more geographically and institutionally diverse samples, explore the specific vocabulary and text types that pose the greatest challenges for engineering students, and examine the longitudinal effects of technology-integrated EST instruction on students' reading proficiency and professional preparedness.

5. PEDAGOGICAL IMPLICATIONS

The theoretical and empirical evidence reviewed in this paper points to several concrete recommendations for EST practitioners in engineering education contexts.

First, EST curricula should be systematically built around authentic materials drawn from current scientific and professional discourse on sustainable mobility and related technological fields. Research articles from peer-reviewed journals such as *Transportation Research Part D: Transport and Environment*, *Sustainable Cities and Society*, and the *International Journal of Hydrogen Energy* provide rich linguistic input while simultaneously expanding students' technological horizons. Technical reports from organisations such as the International Energy Agency (IEA) and the European Environment Agency (EEA) offer additional genre diversity and exposure to the policy-oriented dimensions of sustainable mobility discourse.

Second, explicit and systematic attention to the development of disciplinary vocabulary is essential. Drawing on the principles of corpus linguistics, instructors should identify high-frequency technical terms that recur across key text types in the sustainable mobility field and build vocabulary instruction around these lexical targets. Nation's (2001) tiered vocabulary learning framework, distinguishing between high-frequency general academic vocabulary and low-frequency discipline-specific terminology, provides a useful organising principle for this task. Third, project-based learning approaches should be incorporated into EST instruction to provide students with opportunities to engage with authentic technological problems while practising reading, summarising, and presenting skills in English. Projects might include the critical review of a recent research article on smart transportation systems, the preparation of a structured summary of an IEA report on electric vehicle adoption, or the development of a short technical presentation on a sustainable mobility innovation of the student's choosing. Such tasks mirror the communicative demands that engineers routinely encounter in international professional settings, thereby strengthening the perceived relevance of EST instruction.

Fourth, instructors should devote explicit attention to the genre conventions of scientific writing, including the rhetorical organisation of research articles (introduction–methods– results–discussion), the use of hedging language, and the conventions for citing and referencing sources. Genre awareness of this kind equips students not only to read scientific texts more efficiently but also to produce them, a skill of increasing importance as engineering education increasingly expects students to engage in undergraduate research and to communicate their findings to international audiences.

CONCLUSION

The accelerating pace of technological innovation in sustainable mobility, combined with the continued dominance of English as the language of global scientific communication, has created an urgent need for EST courses that equip engineering students with the linguistic competence to engage meaningfully in contemporary professional discourse. This paper has argued that EST instruction centred on the themes and text types of sustainable mobility and emerging technologies represents a powerful response to this need. The survey data reported here indicate that engineering students are highly aware of the professional importance of English, broadly supportive of technology-integrated EST instruction, and primarily challenged by the terminological complexity of disciplinary texts. These findings provide empirical grounding for a set of pedagogical recommendations, centred on authentic materials, systematic vocabulary instruction, project-based learning, and genre awareness, that can guide the design and delivery of EST courses in engineering education contexts. Ultimately, the goal of EST instruction in this context is not merely to teach language but to develop the kind of integrated professional competence, linguistic, disciplinary, and intercultural, that future engineers will need to participate effectively in the international scientific communities addressing the most pressing sustainability challenges of our time. When language learning is connected to authentic professional purposes, it becomes not a peripheral add-on to technical education but an indispensable component of engineering formation.

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