Reforming ESP Teaching in Materials Science and Engineering: Current Status, Challenges, and Strategic Pathways

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Abstract: English for Specific Purposes (ESP) is vital for cultivating globally competent graduates in Materials Science and Engineering (MSE). However, current ESP teaching is limited by outdated content, rigid pedagogy, and low motivation. Using Longyan University as a case study, this paper proposes a six-dimensional reform — covering curriculum design, content renewal, pedagogy, faculty development, assessment, and motivation — based on Outcome-Based Education (OBE) principles to enhance students' professional and international communication competence.

***Keywords*:** materials science and engineering, English for specific purposes (ESP), teaching reform, engineering education, international competence

1. Introduction

English has become the dominant medium of global scientific communication, with more than 90% of indexed academic publications written in English [1]. For engineering disciplines, the integration of English for Specific Purposes (ESP) into the curriculum is not optional but essential to achieving international standards such as those outlined in the Washington Accord, which identifies communication competence as a core learning outcome [2]. In China, the "New Engineering" (Xin Gongke,) initiative further highlights the cultivation of interdisciplinary, practice-oriented engineers with both global vision and applied capability [3][4].

ESP is an approach that integrates language learning with domain-specific knowledge to meet professional communication needs. Hutchinson and Waters define ESP as "an approach rather than a product," determined by learners' purposes and contexts . Within engineering education, ESP bridges linguistic proficiency and disciplinary discourse, embedding authentic communicative genres such as technical reports, patent summaries, and research abstracts . It thereby transforms language learning from a general subject into a practical medium for professional participation.

In engineering education, accreditation frameworks such as ABET (Accreditation Board for Engineering and Technology) and the Chinese Engineering Education Accreditation (EAC) both emphasize "an ability to communicate effectively with a range of audiences" as a fundamental outcome [5]. Communication competence thus extends beyond linguistic accuracy to include technical writing, oral presentation, and intercultural collaboration skills—competencies indispensable for engineers in international environments.

Recent pedagogical trends advocate blended learning and task-based teaching, integrating online learning for knowledge input with in-person collaboration for problem-solving and project work [6][7]. These models, aligned with OBE and student-centered learning paradigms, promote simultaneous development of linguistic and professional competencies in authentic engineering contexts. However, despite their pedagogical value, implementation remains limited in many regional universities.

In many institutions, including Longyan University, ESP courses for MSE remain marginalized—offered as electives and dominated by translation-based instruction , This weakens the development of international communication competence, a key outcome in ABET and EAC standards. Accordingly, this paper analyzes the current state of ESP teaching at Longyan University and proposes an OBE-based reform model to align instruction with accreditation goals and global professional needs.

2. Current Challenges in ESP Teaching for Materials Science and Engineering

2.1 Marginalized Course Position and Misaligned Perceptions

In many universities, ESP courses in MSE are still regarded as supplementary rather than integral parts of the curriculum.

Both instructors and students often view them as peripheral to "real engineering," reflecting a misalignment between academic design and industrial expectations. Given that over 70% of corporate engineering documentation worldwide is produced in English, neglecting ESP weakens students' competitiveness and global engagement.

2.2 Outdated Teaching Content and Limited Practical Relevance

Existing ESP materials tend to emphasize traditional topics such as crystal structures and metallurgical processes while overlooking frontier areas like semiconductor materials, nanocomposites, and solid-state batteries[2][6]. Textbooks rarely incorporate authentic professional discourse from standards, technical manuals, or scientific journals, resulting in content that fails to reflect real-world communicative demands in modern materials engineering.

2.3 Rigid Teaching Methods and Low Interactivity

ESP instruction in many regional universities remains dominated by teacher-centered, translation-based pedagogy, Students passively memorize terminology rather than engage in meaningful communication. Although some pilot programs have adopted flipped or blended models, their scope remains narrow. Evidence suggests that interactive, blended approaches can improve performance and motivation by over 30% compared with traditional instruction [7].

2.4 Faculty Skill Gaps and Fragmented Expertise

High-quality ESP teaching requires dual competence in both the disciplinary field and applied linguistics. Yet, most instructors specialize in only one domain—engineering faculty often lack linguistic training, while English teachers lack disciplinary expertise [3][8]. This gap leads to fragmented instruction and inconsistent teaching quality, exacerbated by limited opportunities for cross-disciplinary collaboration or pedagogical development.

2.5 Assessment Formalism and Weak Competence Alignment

Assessment in existing ESP courses often relies on written examinations focused on translation and grammar. Such summative approaches fail to measure communicative competence or real-world application. Accreditation standards like ABET emphasize performance-based assessment focusing on written, oral, and team communication tasks. Without diversified, formative evaluation mechanisms, it is difficult to align learning outcomes with actual professional skills.

2.6 Low Student Motivation and Uneven English Foundations

Student motivation remains a persistent challenge. Engineering students often have uneven English proficiency levels, making it difficult to engage with technical content. Moreover, the perception that domestic employment rarely requires English further undermines interest. To counter this, ESP teaching must demonstrate practical relevance by linking language competence to research participation, career advancement, and international collaboration [3][6].

3. Reform Strategies and Implementation Pathways

3.1 Repositioning ESP within the Curriculum

ESP should be upgraded from an elective to a compulsory component of the professional curriculum. A 32–48-hour course integrated into the disciplinary module can ensure alignment with communication outcomes required by accreditation frameworks [5]. Embedding ESP as a core course reinforces its institutional recognition, elevates its perceived value, and ensures sustained commitment from both teachers and students.

3.2 Reconstructing Content around Frontier and Applied Knowledge

ESP content should adopt a dual-layer structure of "core disciplinary knowledge" and "dynamic frontier updates." The core layer covers foundational materials topics, while the dynamic layer introduces emerging areas such as sustainable materials, nanotechnology, and semiconductor fabrication. Authentic materials from standards (ASTM, ISO), patents, and academic sources such as Nature Materials can enrich contextual realism. Incorporating case-based learning—e.g., materials for smartphone glass or EV batteries—further enhances engagement and relevance [6][7].

3.3 Innovating Teaching Methods through Blended and Task-Based Learning

Pedagogical reform should focus on blended and task-based models. Online micro-lectures can deliver input on technical terminology and writing conventions, while classroom sessions emphasize application through discussions, simulations, and technical reporting. Task-based learning situates language in authentic engineering contexts, such as virtual experiments using ANSYS or COMSOL, or English-based project presentations. This approach fosters both linguistic competence and engineering problem-solving ability consistent with OBE principles.

3.4 Strengthening Faculty Development through Dual-Teacher Models

Establishing "dual-instructor teams" that pair engineering experts with language teachers can integrate disciplinary and linguistic expertise effectively [3][8]. Regular ESP training workshops and short-term industrial internships can help instructors contextualize teaching and innovate pedagogy. Universities should also promote collaborative research and interdisciplinary teaching design to build sustainable professional learning communities.

3.5 Diversifying Assessment toward Competence-Oriented Evaluation

Assessment should transition from exam-oriented to competence-based evaluation. A balanced model combining formative (60%) and summative (40%) components can better capture communicative performance. Formative assessment may include literature reviews, oral presentations, patent translation, or technical reports—emphasizing performance and application rather than grammar accuracy. Integrating professional identity themes such as "Made in China" innovations can enhance both language learning and professional awareness.

3.6 Enhancing Student Motivation through Tiered Instruction and Incentives

Tiered instruction tailored to proficiency levels can address learner diversity. Foundation-level students focus on core terminology and syntax, while advanced learners engage in academic debates and technical writing. Beyond pedagogy, motivation can be strengthened through competitions, publication opportunities, and scholarships supported by industry partners. Linking ESP performance to tangible academic or career benefits helps students perceive English as a professional asset rather than a burden.

4. Conclusion

ESP teaching in MSE faces multiple challenges, including marginal positioning, outdated content, rigid pedagogy, skill gaps, and low motivation. The proposed six-dimensional reform — encompassing curriculum repositioning, content innovation, blended pedagogy, faculty development, competence-oriented assessment, and motivation enhancement — offers a comprehensive pathway to transformation. Grounded in OBE and New Engineering principles, this model integrates language proficiency with professional expertise, cultivating materials engineers capable of effective global communication and collaboration.

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