

Integration of Needs Analysis in Developing E-Book Materials for English for Engineering in Road Transportation System Engineering Study Program

Dani F. Brilianti^{1*}, Nurul Fitriani², Aat Eska Fahmadi³, Brasie Pradana⁴, Abdul Rokhim⁵,
Dhiya An Najwa⁶

¹Department of Road Transportation System Engineering, Politeknik Keselamatan Transportasi Jalan, Tegal, Indonesia

²Department of Road Transportation System Engineering, Politeknik Keselamatan Transportasi Jalan, Tegal, Indonesia

³Department of Road Transportation System Engineering, Politeknik Keselamatan Transportasi Jalan, Tegal, Indonesia

⁴Department of Road Transportation System Engineering, Politeknik Keselamatan Transportasi Jalan, Tegal, Indonesia

⁵Department of Road Transportation System Engineering, Politeknik Keselamatan Transportasi Jalan, Tegal, Indonesia

d_fiabrilianti@pktj.ac.id^{1*}, nurul.fitriani@pktj.ac.id², aat@pktj.ac.id³, brasie@pktj.ac.id⁴, rokhim@pktj.ac.id⁵, dihyaannajwa@gmail.com⁶

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ABSTRACT

English for Engineering instruction in vocational education needs materials that match real industry requirements. However, current materials often fail to address the specific needs of road transportation engineering students. This study identified the English learning needs of 96 Road Transportation System Engineering students and developed an e-book to improve their technical English skills. This study used a mixed-methods research methodology, integrating quantitative and qualitative methodologies, to thoroughly analyze students' English learning demands and evaluate the efficacy of the generated e-book. Participants were 96 second-year students participating in the Road Transportation System Engineering program at Politeknik Keselamatan Transportasi Jalan in Tegal, Indonesia. Data were collected through questionnaires and interviews with students and instructors, then analyzed using descriptive statistics and thematic analysis. Results showed that students prioritized technical vocabulary (82%), struggled with report writing (69%), and needed better presentation skills (54%). While 91% recognized English as essential for their careers, 76% found existing materials inadequate. Students preferred digital, interactive materials (72%) with real-world examples (68%). The e-book includes over 200 technical terms, reading passages, writing modules, speaking exercises, and case-based activities. Evaluation results indicated that 86% of students found the e-book easy to understand, 79% felt more confident in technical communication, and 81% considered it suitable for blended learning. The developed e-book addresses these needs in a systematic manner using seven integrated components: a comprehensive technical vocabulary bank, authentic reading passages on road engineering topics, specialized writing modules, professional speaking frameworks, case-based problem-solving exercises, interactive multimedia elements, and a user-friendly digital format. This design adheres to ESP principles, which emphasize learner-centered, context-specific, and professionally focused language training.

Keywords: e-book materials; english for engineering; needs analysis; road transportation system engineering

INTRODUCTION

In an era of globalization and rapid technological advancement, English proficiency has become an essential competency for students across disciplines, particularly in engineering fields. For students in Road Transportation System Engineering (RTSE) programs, English serves as a critical gateway to international standards, technical documentation, and professional communication within the transportation sector (Hutchinson & Waters, 1987). Technology integration must be adopted so as to teach English language in an effective way, which is crucial in today's world (Başar et al., 2022). The ability to comprehend technical manuals, analyze international traffic safety reports, and communicate effectively in transportation system planning requires specialized English instruction tailored to engineering contexts.

Despite the inclusion of English for Engineering (EFE) courses in vocational curricula, a significant challenge persists: the disconnect between generic language instruction and discipline-specific needs. Existing materials often adopt a one-size-fits-all approach, failing to address the unique terminology, discourse patterns, and communicative functions specific to road transportation engineering (Changpueng & Pattanapichet, 2023). This misalignment creates a gap between academic learning and professional requirements, leaving graduates inadequately prepared for workplace communication demands.

Research in English for Specific Purposes (ESP) emphasizes that needs analysis constitutes a crucial foundational step in developing relevant, effective instructional materials (Robinett et al., 1988). By systematically identifying learners' target language use situations and learning preferences, educators can design materials that bridge academic training and professional practice (Markee, 1993). However, comprehensive needs analyses specifically targeting vocational transportation engineering students remain limited in existing literature.

Furthermore, conventional teaching methods relying on printed textbooks and face-to-face instruction present limitations in flexibility, interactivity, and content currency (Weideman, 2016). The digital transformation of education has introduced alternative delivery formats, particularly e-books, which offer advantages including enhanced accessibility, multimedia integration, content updatability, and environmental sustainability (López-Escribano et al., 2021). Research indicates that e-book-based instruction can increase student motivation and learning effectiveness, particularly among engineering students who demonstrate receptivity to digital media (Buroidah et al., 2023). Rachmawati et al. (2025) also claimed that as technology becomes more prevalent in daily life, students must cultivate the skills necessary to face the future, such as higher order thinking, cross-cultural teamwork, and change adaptation.

This study addresses three main issues in English for Engineering instruction for road transportation students. First, existing materials are too generic and do not reflect the specific technical vocabulary and communication needs of transportation engineering. Second, there has been no systematic assessment of what students actually need to succeed academically and professionally. Third, despite the advantages of digital learning, most instruction still relies on traditional printed textbooks, missing opportunities to engage students more effectively. This study aims to: (1) identify the specific English learning needs of Road Transportation System Engineering students through comprehensive needs analysis; (2) develop an interactive e-book that addresses these needs with relevant content and authentic materials; and (3) evaluate how well the e-book improves students' technical English communication skills. This research makes important contributions to both theory and practice. Theoretically, it expands ESP research into the underexplored area of road transportation engineering and demonstrates how needs analysis can be integrated with digital material development. Practically, it provides a ready-to-use e-book that meets actual student needs and offers a model that can be replicated

for other vocational engineering programs. Ultimately, this study helps prepare students for the global transportation industry by improving their technical communication competencies.

ESP represents a learner-centered approach to language instruction emphasizing purposeful, context-specific language use rather than general proficiency (Robinet et al., 1988). Unlike English for General Purposes (EGP), ESP instruction targets particular communicative competencies required within specific academic, professional, or occupational domains. Dudley-Evans and St John (1998) characterize ESP through its focus on meeting learners' needs, employing methodology and activities of relevant disciplines, and centering on language appropriate to those activities (Dudley-evans et al., 1998). Rohimajaya et al. (2021) also claimed that students are exposed to learning and developing English language skills, such as speaking, listening, reading, and writing, as well as language components like vocabulary, grammar, and pronunciation, through the use of relevant English materials.

Within ESP, English for Engineering constitutes a specialized branch addressing technical communication requirements across engineering disciplines. Engineering discourse exhibits distinctive features including specialized terminology, nominalization, passive constructions, complex noun phrases, and procedural sequencing (Allison, 2002). Effective engineering communication demands not only linguistic accuracy but also precision in technical description, logical organization, and appropriate register selection.

In addition, needs analysis serves as the cornerstone of ESP curriculum development, providing empirical foundation for instructional decisions (Sari et al., 2024). The target learner needs (what learners need to function in the target situation) and learning needs (what learners need to do to acquire language). Target needs comprise necessities (required competencies), lacks (gaps between current and required proficiency), and wants (learners' perceptions of their needs) (Robinet et al., 1988).

Contemporary needs analysis employs multiple data collection methods including questionnaires, interviews, observation, and document analysis to triangulate findings (Dudley-evans et al., 1998). For vocational engineering education, effective needs analysis must incorporate perspectives from students, instructors, and industry practitioners to ensure materials address both pedagogical objectives and workplace realities. This promotes the intellectual and social development of students; it requires them to actively participate in the process of acquiring knowledge, improves communication and interpersonal/social skills, enhances leadership skills, and increases creativity (Fini et al., 2018).

Meanwhile, the proliferation of digital technologies has transformed educational material development and delivery. Digital stuffs completely brings a new concept in ELT context since the use of digital in ELT classroom can improve EFL learners' communication skill (Lubis et al., 2020). E-books—electronic versions of texts designed for digital device access—offer multiple advantages over print materials: portability, searchability, multimedia integration, interactive features, and cost-effectiveness (López-Escribano et al., 2021). In language instruction contexts, e-books enable incorporation of audio pronunciations, embedded videos, hyperlinked glossaries, and interactive exercises that enhance comprehension and engagement. Liana et al. (2021) expressed that an e-book supported by a real-world problem-based learning model can foster critical thinking and problem-solving skills in students while stimulating their curiosity. Problem-Based Learning transforms conventional instruction into a more active learning approach. Hamidah et al. (2020) observed that real-life experiences are effective to gain knowledge by proposing the idea of “learning by doing”

Research demonstrates positive impacts of e-book-based instruction on learning outcomes. Buroidah, et al. (2023) found that project-based learning supported by e-book guides significantly improved critical thinking and metacognitive skills among undergraduate biology students. Metacognitive awareness enables control or self-regulation over thinking and

learning processes and products (Hartman, 1998). Buroidah et al. (2023) also reported that interactive e-books effectively facilitate blended learning by bridging out-of-class and in-class activities. For engineering students specifically, digital materials align with characteristics of digital-native learners who prefer technology-mediated, visually-rich, self-paced learning experiences.

Transportation engineering encompasses specialized subdomains including traffic engineering, highway design, transportation safety, and transportation systems management. Professional communication in this field requires mastery of technical vocabulary (e.g., superelevation, sight distance, level of service, crash severity index), comprehension of standards and specifications (AASHTO, FHWA guidelines), and ability to produce technical documents including design reports, safety audits, traffic impact analyses, and incident investigations.

Despite transportation engineering's linguistic specificity, ESP research in this domain remains limited. Existing studies predominantly examine general engineering contexts or other specializations (mechanical, electrical, computer engineering), leaving road transportation engineering's unique communicative requirements underexplored. This gap underscores the need for targeted research identifying and addressing transportation engineering students' English learning needs.

METHODOLOGY

RESEARCH DESIGN

This study employed a mixed-methods research design combining quantitative and qualitative approaches to comprehensively investigate students' English learning needs and evaluate the developed e-book's effectiveness. The research proceeded through three phases: (1) needs analysis, (2) e-book development, and (3) preliminary evaluation.

PARTICIPANTS AND SETTING

Participants comprised 96 second-year students enrolled in the Road Transportation System Engineering program at Politeknik Keselamatan Transportasi Jalan, Tegal, Indonesia. Purposive sampling was employed to select participants who had completed introductory English coursework and were concurrently enrolled in English for Engineering courses, ensuring they possessed both foundational language competence and exposure to discipline-specific content.

Sample size determination followed Siyoto and Sodik's (2015) formula:
$$n = (Z^2\alpha \times \sigma^2) / e^2$$

Where:

- $Z\alpha = 1.96$ (95% confidence level)
- $\sigma^2 = 0.25$ (standard deviation approximation)
- $e = 0.05$ (margin of error)

This calculation yielded $n = 96.04$, rounded to 96 participants.

Additionally, 15 students participated in in-depth interviews, and one English instructor provided expert perspective on current materials and teaching challenges.

DATA COLLECTION INSTRUMENTS

QUESTIONNAIRE

A structured needs analysis questionnaire was developed adapting Khan's (2007) framework and Dudley-Evans and St John's (1998) ESP parameters. The instrument comprised 50 items across ten dimensions:

1. Current and target language use domains
2. Attitudes toward English's role in engineering
3. Language skills priorities
4. Importance of specific skills
5. Preferred learning strategies
6. Classroom interaction patterns
7. Student-instructor relationships
8. Strategy preferences
9. Learning environment conditions
10. Specific course material needs

Items employed a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The questionnaire underwent expert validation and pilot testing to ensure content validity and reliability.

INTERVIEW PROTOCOL

Semi-structured interviews explored students' experiences with existing materials, specific linguistic challenges, and preferences for content presentation. Interview questions addressed:

- Difficulties encountered in technical reading, writing, speaking, and listening
- Perceptions of material relevance and adequacy
- Preferred learning activities and formats
- Specific content areas requiring emphasis

DOCUMENT ANALYSIS

Existing course materials, textbooks, and syllabi were reviewed to identify gaps between current instruction and professional communication requirements.

DATA COLLECTION PROCEDURE

Data collection occurred during the 2025 academic year following ethical approval. Questionnaires were administered via Google Forms, with completion requiring approximately 20 minutes. Subsequently, interviews were conducted with selected participants, each lasting 30-45 minutes. All interviews were audio-recorded with participants' consent and transcribed verbatim for analysis.

DATA ANALYSIS

1. Quantitative data from questionnaires were analyzed using descriptive statistics, calculating frequency distributions and percentages for each item and dimension. Results were interpreted to identify priority needs and preferences.
2. Qualitative data from interviews underwent thematic analysis following Braun and Clarke's (2006) six-phase process:
 - a) Familiarization with data
 - b) Generating initial codes

- c) Searching for themes
- d) Reviewing themes
- e) Defining and naming themes
- f) Producing the report

Interview findings were triangulated with questionnaire results to enhance validity and provide nuanced understanding of students' needs.

E-BOOK DEVELOPMENT PROCESS

Based on needs analysis findings, e-book development followed a systematic process:

1. Content selection: Identifying priority topics based on frequency and importance ratings in needs analysis
2. Material compilation: Gathering authentic texts, technical documents, and visual resources relevant to road transportation engineering
3. Pedagogical design: Structuring content into modules with learning objectives, explanatory sections, examples, and practice activities
4. Digital formatting: Converting content into interactive PDF format with embedded hyperlinks, multimedia elements, and navigation features
5. Expert review: Soliciting feedback from ESP specialists and transportation engineering faculty
6. Revision: Refining content based on expert recommendations

PRELIMINARY EVALUATION

A preliminary evaluation of the e-book involved distributing it to 15 students for two-week trial use. Post-trial questionnaires assessed perceived comprehensibility, relevance, usability, and effectiveness. Feedback informed final revisions before broader implementation.

RESULT AND DISCUSSION

NEEDS ANALYSIS RESULTS

DOMAIN OF LANGUAGE USE

Analysis revealed that English usage among RTSE students primarily occurs in academic contexts, particularly receptive skills. Results indicated:

- 1) Reading: 82% of respondents reported frequent engagement with technical texts including equipment manuals, safety guidelines, operational standards, and engineering articles used as course references
- 2) Writing: 69% experienced significant difficulties composing technical reports in English, including accident analyses, laboratory reports, and technical documentation
- 3) Speaking: 54% identified need for enhanced presentation skills to support academic seminars, project presentations, innovation competitions, and professional simulations
- 4) Listening: While less frequently prioritized, listening skills remained relevant for online training, instructional videos, and equipment demonstrations.

These findings demonstrate that while receptive skills dominate current language use, productive skills represent critical development areas for professional readiness.

ATTITUDES TOWARDS ENGLISH

Students demonstrated overwhelmingly positive attitudes toward English's role in transportation engineering:

- 1) 91% agreed English constitutes essential professional competency for transportation sector careers
- 2) Students recognized English as necessary for accessing international journals, global safety standards (AASHTO, IRC, FHWA, PIARC), and technical guidelines predominantly available in English
- 3) Awareness extended to English's role facilitating participation in international seminars, cross-institutional technical discussions, and collaborative research with foreign institutions

However, significant gaps existed between recognized importance and material adequacy:

- a) 76% reported current EFE materials inadequately reflected professional needs
- b) Students characterized materials as excessively generic, insufficiently contextualized to road transportation engineering, and poorly connected to practical engineering activities (field testing, safety analysis, technical mapping, project documentation)

This disconnect indicates substantial curriculum misalignment requiring intervention.

LANGUAGE SKILLS PRIORITIES

Students' skill priority rankings revealed:

- 1) Priority 1 - Technical Vocabulary (Highest):
Students consistently identified terminology mastery as most critical. Essential vocabulary domains included:
 - Infrastructure terms (pavement distress, slope stability, road geometry)
 - Traffic engineering (traffic volume, level of service, crash analysis)
 - Safety standards (safety barrier specification, sight distance, superelevation)Vocabulary mastery serves as linguistic foundation enabling comprehension of maintenance manuals, international safety standards, laboratory testing procedures, and project documents.
- 2) Priority 2 - Reading Skills:
Critical for understanding technical documents including road specifications, planning maps, safety diagrams, geometric standards, and accident analysis reports. These texts employ complex sentence structures and advanced technical terminology requiring strong reading comprehension.
- 3) Priority 3 - Writing Skills:
Essential for producing standardized technical documentation including accident analysis reports, pavement quality testing reports, road safety inspection records, and traffic survey documentation. Professional writing competency represents highly valued industry skill.
- 4) Priority 4 - Speaking Skills:
Required for project presentations, technical analysis communication, and problem-solving discussions. Professional activities necessitate clear, logical, accurate technical communication.
- 5) Priority 5 - Listening Skills:
Relevant for online technical training, procedural instructions via video, and engineering equipment demonstrations in digital learning contexts.

PREFERRED LEARNING STRATEGY

Students demonstrated strong preferences for technology-enhanced, visually-supported learning:

- 1) Digital formats: 72% preferred digital, interactive materials over conventional print textbooks, valuing accessibility, visual enhancement capabilities, simulation viewing, and flexible, self-paced review
- 2) Case-based learning: 68% reported enhanced comprehension through authentic examples including road hazard analysis, road geometric diagrams, accident flow charts, crash blackspot mapping, and road inspection reports
- 3) Scenario-based tasks: 59% required exercises reflecting professional situations demanding technical decision-making, accident data analysis, pavement condition evaluation, and safety recommendation formulation based on applicable standards

These preferences align with ESP principles emphasizing authentic, context-relevant materials and active learning approaches.

LEARNING ENVIRONMENT CONDITIONS

Current learning materials exhibited significant limitations:

- 1) Students characterized available media as monotonous, text-heavy, and visually insufficient
- 2) Difficulty comprehending content requiring visual interpretation (pavement structures, accident analysis workflows, road equipment components, traffic graphs) when presented solely through verbal narration
- 3) 86% expressed urgent need for digital learning media featuring:
 - a. High-resolution technical images
 - b. Field equipment illustrations
 - c. Safety flow charts depicting hazard identification processes
 - d. Work procedure visualizations
 - e. Integrated technical terminology glossary
 - f. Interactive exercises
 - g. Self-directed learning spaces

INTERVIEW FINDINGS

In-depth interviews with 15 students and one instructor provided qualitative depth supporting quantitative findings:

INSTRUCTOR PERSPECTIVE

The English instructor identified critical gaps in available materials:

- a. Absence of technical vocabulary central to transportation engineering communication
- b. Lack of terminology such as superelevation, road gradient, traffic flow capacity, crash severity, pavement condition index
- c. Students demonstrate cognitive understanding of technical concepts but cannot articulate them accurately in English
- d. This linguistic disconnect impairs technical report writing, project presentations, and academic discourse participation
- e. Students exhibit unpreparedness for national competitions, internship programs, and academic activities requiring English communication

STUDENT PERSPECTIVE

Students identified five essential content areas requiring emphasis:

- a. Road Geometry: Terminology for gradient, horizontal/vertical curves, lane width, shoulders, and geometric parameters
- b. Traffic Engineering: Vocabulary for traffic volume, speed, capacity, traffic management, and intersection analysis
- c. Road Safety Audits: Safety terminology, hazard identification, risk factors, treatment recommendations
- d. Road Signs: Understanding and explanation of signs, markings, traffic signals, regulatory and warning terminology
- e. Basic Engineering Documentation: Technical reports, inspection notes, incident reports, and various technical documentation forms

Students emphasized these areas as essential but inadequately covered in current instruction, creating gaps between language competency and technical competency.

E-BOOK DESIGN INTEGRATION

Needs analysis findings directly informed e-book design comprising seven integrated components:

TECHNICAL VOCABULARY BANK (200+TERMS)

Thematically organized glossary covering road geometry, traffic planning, road safety, pavement engineering, and basic technical documentation. Each entry includes definition, example sentence in technical context, and relevant visual representation where applicable

READING PASSAGES ON ROAD ENGINEERING

Authentic texts addressing topics including:

- Road geometric analysis
- Safety standards and guidelines
- Traffic management principles
- Pavement design and maintenance
- Transportation system planning

Each passage accompanied by comprehension questions and critical thinking prompts encouraging interpretation and analysis.

WRITING MODULES

Three specialized modules:

- Safety Report Writing: Structure, language, and content for road safety inspection reports
- Technical Incident Reporting: Format and language for documenting traffic incidents and abnormal conditions
- Engineering Proposal Outlines: Components and organization of technical proposals for transportation projects

Modules include templates, annotated examples, and guided writing tasks.

SPEAKING MODULES

Two focused modules:

- Presenting Road Design: Language and structure for describing road geometry, space requirements, and technical justifications
- Explaining Accident Analysis: Frameworks for presenting accident data, interpreting causal factors, and articulating safety recommendations

Modules provide sentence frames, technical vocabulary lists, and professional presentation examples.

CASE-BASED EXERCISES

Authentic scenario exercises including:

- Road Safety Problem Scenarios: Requiring safety issue analysis and recommendation formulation
- Traffic Congestion Analysis: Involving traffic data interpretation and technical solution proposals

Exercises develop analytical thinking, problem-solving, and technical language application in professional contexts.

INTERACTIVE ELEMENTS

Authentic scenario exercises including:

- Road Safety Problem Scenarios: Requiring safety issue analysis and recommendation formulation
- Traffic Congestion Analysis: Involving traffic data interpretation and technical solution proposals

Exercises develop analytical thinking, problem-solving, and technical language application in professional contexts.

FORMAT AND NAVIGATION

Interactive PDF format with:

- Hyperlinked table of contents
- Internal cross-references
- Clickable glossary terms
- Bookmarking capability
- Device-responsive design

This structure facilitates self-paced, non-linear learning adapting to individual needs.

PRELIMINARY EVALUATION RESULTS

Trial implementation with 15 students over two weeks yielded positive feedback:

- Comprehensibility: 86% found materials clear and understandable, particularly appreciating visual support and technical examples
- Confidence: 79% reported increased confidence using technical terminology and explaining engineering concepts in English
- Reading Skills: 74% perceived improvement in technical text comprehension, especially equipment manuals, technical diagrams, and safety reports
- Blended Learning Suitability: 81% deemed the e-book appropriate for blended learning implementation

Qualitative feedback highlighted strengths including contextual relevance, practical applicability, visual clarity, and self-directed learning support. Suggested improvements included expanding vocabulary coverage, adding more practice exercises, and incorporating audio pronunciations for technical terms.

DISCUSSION

ALIGNMENT WITH ESP PRINCIPLES

Findings demonstrate that RTSE students possess highly specific linguistic needs consistent with ESP theoretical frameworks. Students require English instruction focused on technical communication rather than general proficiency, evidenced by prioritization of transportation-specific terminology, technical document comprehension and production, and professional communication scenarios (Hutchinson & Waters, 1987). This specificity validates ESP pedagogy's core premise that effective language instruction for specialized domains must be purpose-driven, context-embedded, and aligned with target discourse communities.

The identified needs mastering technical vocabulary, reading specifications and standards, writing technical reports, presenting engineering analyses—directly reflect authentic professional practices in road transportation engineering. This alignment between learning needs and workplace requirements underscores the importance of systematic needs analysis as foundational to relevant curriculum development (Dudley-Evans & St John, 1998).

MATERIAL-NEEDS DISCONNECT

Despite students' positive attitudes toward English's professional importance (91% recognition), the substantial dissatisfaction with current materials (76% inadequacy rating) reveals critical curriculum shortcomings. This disconnect suggests existing materials adopt generic EGP approaches incompatible with vocational engineering contexts. Materials lacking domain-specific vocabulary, authentic technical documents, and engineering-focused communicative tasks cannot adequately prepare students for professional English use.

This finding aligns with broader ESP research indicating that one-size-fits-all language instruction fails to meet specialized learners' needs (Robinson, 1991). The gap between material content and professional requirements likely contributes to students' reported difficulties 69% struggling with technical writing, 54% needing presentation skill development highlighting the real-world consequences of misaligned instruction.

DIGITAL MEDIA AS SOLUTION

Students' strong preference for digital, interactive learning materials (72%) reflects both generational characteristics and pedagogical effectiveness considerations. Digital-native engineering students demonstrate receptivity to technology-mediated learning offering visual richness, interactivity, and flexibility absent from conventional print materials (Escribano et al., 2021).

Beyond preference, digital formats possess inherent advantages for technical content delivery. Engineering concepts often require visual representation—diagrams, flowcharts, equipment illustrations, geometric drawings—difficult to reproduce adequately in print. E-books enable high-quality image integration, scalable graphics, embedded multimedia, and dynamic content updates reflecting evolving industry standards and practices.

The 68% preference for case-based learning and 59% demand for scenario-based tasks further supports interactive digital media adoption. E-books can incorporate simulations, interactive problem-solving exercises, and linked video demonstrations impossible in static

print formats. This multimedia integration supports constructivist learning approaches where students actively engage with authentic problems rather than passively receiving information.

FORMAT AND NAVIGATION

The developed e-book's structure directly responds to identified needs through systematic integration of:

1. Linguistic foundations (200+ term glossary) addressing vocabulary mastery priority
2. Receptive skill development (reading passages) supporting comprehension of technical documents
3. Productive skill development (writing and speaking modules) targeting professional communication competencies
4. Applied practice (case-based exercises) connecting language use to engineering problem-solving
5. Technological affordances (interactive elements) leveraging digital media's pedagogical potential

This integrated design reflects Weideman's (2016) model of responsible applied linguistics emphasizing relevance, contextuality, and sustainability in material development. The e-book provides not merely a language learning resource but a bridge between academic instruction and professional practice.

Preliminary evaluation results validate this design approach. High comprehensibility ratings (86%) suggest materials successfully balance technical accuracy with pedagogical accessibility. Increased confidence in technical communication (79%) indicates materials effectively build linguistic self-efficacy crucial for professional English use. Improved reading comprehension (74%) demonstrates tangible skill development. Strong suitability ratings for blended learning (81%) confirm materials' flexibility for diverse instructional contexts.

IMPLICATIONS FOR VOCATIONAL ESP INSTRUCTION

Findings carry several implications for ESP instruction in vocational engineering education:

1. Systematic needs analysis is essential: Effective ESP materials cannot be developed without comprehensive understanding of learners' target language use situations, current proficiency, and learning preferences. Needs analysis must be ongoing, incorporating student, instructor, and industry perspectives.
2. Contextualization is non-negotiable: Generic materials inadequately serve specialized learners. Effective ESP instruction requires discipline-specific vocabulary, authentic documents from target professional contexts, and communicative tasks reflecting real workplace demands.
3. Digital media offers pedagogical advantages: Interactive e-books enable content presentation, practice activities, and learning experiences impossible with conventional materials. Digital media's flexibility, multimedia integration, and self-paced access align with vocational students' learning characteristics and professional preparation needs.
4. Integration of skills and content: Effective ESP instruction should not isolate language skills but integrate them within meaningful content and authentic tasks. The e-book's case-based approach combining reading, writing, speaking, and vocabulary within engineering problem-solving scenarios exemplifies this integration.
5. Continuous evaluation and revision: Materials must be regularly evaluated and updated to maintain relevance as industry practices, technologies, and standards evolve. Digital formats facilitate updates more readily than print materials.

LIMITATIONS

This study acknowledges several limitations:

1. Single-institution focus: Research conducted at one polytechnic may limit generalizability to other transportation engineering programs with different curricula, student populations, or resource contexts.
2. Limited implementation scope: Preliminary evaluation involved only 15 students over two weeks. Longer-term, larger-scale implementation studies are needed to assess sustained effectiveness.
3. Self-reported data: Questionnaires and interviews rely on self-perceptions rather than objective performance measures. Future research should include pre-post assessments of actual language proficiency.
4. Lack of comparative analysis: This study did not compare e-book effectiveness against conventional materials or alternative approaches.

CONCLUSION AND RECOMMENDATION

CONCLUSION

This research successfully identified English learning needs of Road Transportation System Engineering students and integrated findings into a contextually-relevant e-book addressing critical gaps in existing materials. Needs analysis revealed that students prioritize technical vocabulary mastery, technical document reading and writing competencies, and professional presentation skills requirements inadequately met by current generic EFE materials.

The developed e-book systematically addresses these needs through seven integrated components: comprehensive technical vocabulary bank, authentic reading passages on road engineering topics, specialized writing modules, professional speaking frameworks, case-based problem-solving exercises, interactive multimedia elements, and user-friendly digital format. This design reflects ESP principles emphasizing learner-centered, context-specific, and professionally-oriented language instruction.

Preliminary evaluation demonstrates the e-book's effectiveness in enhancing technical comprehension, building communication confidence, and supporting blended learning implementation. Students' positive responses validate the needs-based development approach and confirm digital interactive media's pedagogical value for vocational engineering education.

Beyond producing a functional learning resource, this study contributes methodologically by demonstrating systematic integration of needs analysis, ESP principles, and digital technology in material development. The research provides a replicable model for developing discipline-specific English materials in vocational contexts, addressing the ongoing challenge of aligning language instruction with professional communication requirements.

As transportation industries continue globalizing and English remains the lingua franca of international technical communication, effective ESP instruction becomes increasingly critical for vocational engineering graduates' professional success. This research represents one step toward closing the gap between academic language learning and workplace communication demands, ultimately enhancing graduates' readiness to navigate complex, multilingual professional environments in the global transportation sector.

RECOMMENDATIONS FOR FUTURE RESEARCH

Building on this study's findings, future research should:

1. Conduct longitudinal studies tracking e-book users' language development and professional English use over extended periods
2. Compare learning outcomes between e-book-based and conventional instruction through experimental or quasi-experimental designs
3. Investigate transferability of the needs analysis and e-book development model to other engineering specializations
4. Explore integration of emerging technologies (augmented reality, artificial intelligence) in ESP e-book development
5. Examine industry professionals' perspectives on graduates' English communication competencies to validate needs analysis findings

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