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Bridging Language and Technology: Innovating English for Specific Purposes through an Automotive Engineering E-Module

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ABSTRACT

The rapid expansion of the global automotive industry requires vocational graduates who are proficient not only in technical skills but also in English, the lingua franca of technology and professional communication. However, many Indonesian vocational students face persistent challenges in mastering discipline-specific English due to the scarcity of contextualized learning materials. To address this gap, the present study employed a Research and Development (R&D) methodology to systematically design, develop, and validate a tailored English for Specific Purposes (ESP) e-module for automotive engineering students at Banjarmasin State Polytechnic. The R&D process consisted of four stages: needs analysis through curriculum review and student questionnaires, design and development of the e-module integrating authentic automotive contexts and multimedia features, pilot implementation with students, and evaluation through expert validation and learner feedback. Expert assessments confirmed the module's high validity, with scores of 4.7 for linguistic aspects and 4.4 for technical content, while student evaluations emphasized strong relevance (83.3% agreement), accuracy (84.6% agreement), and usability, though language clarity required refinement to accommodate varied proficiency levels. These findings demonstrate that the developed e-module effectively bridges technical and linguistic competencies, enhances learners' engagement with authentic materials, and strengthens their communicative readiness for professional practice. The study contributes to ESP pedagogy by offering an empirically validated model for integrating technical content with task-based language learning, and its broader implication lies in advancing vocational education to better align with global industry standards in an increasingly digitalized era.

1. Introduction

The automotive industry has become one of the most influential sectors in shaping global economies, technological innovation, and workforce development. Beyond mechanical systems, automotive engineering now incorporates electronics, computer systems, and digital technologies, requiring professionals to combine advanced technical expertise with strong communicative competence. In this globalized context, English has assumed the role of lingua franca for science, technology, and professional collaboration, enabling engineers and technicians to access international knowledge, interpret technical manuals, and participate in cross-border projects. Without adequate English proficiency, graduates risk being excluded from knowledge networks and global industries, thereby limiting their professional growth and capacity to contribute to international innovation (Nekrasova-Beker, 2020; Arnó-Macià et al., 2020).

In Indonesia, vocational and technical education is central to preparing graduates for international workforce participation. However, challenges remain acute, as many polytechnic students encounter difficulties in mastering discipline-specific English. Traditional English courses often emphasize general skills and neglect the specialized vocabulary and

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discourse practices necessary in automotive engineering. Students struggle with terminology such as those related to engines, transmissions, or braking systems, which hinders their ability to interpret authentic technical materials and engage in professional communication. This gap between technical expertise and linguistic competence undermines both employability and competitiveness, as vocational graduates may enter global industries with strong technical knowledge but insufficient English proficiency to operate effectively in professional contexts (Ramadhani et al., 2023; Wigati et al., 2023; 2024).

English for Specific Purposes (ESP) provides a theoretical and pedagogical response to these challenges. ESP emphasizes tailoring language instruction to align with professional and academic domains, thereby ensuring that students acquire both communicative and disciplinary competence. In technical fields such as engineering, ESP is essential because it connects general linguistic skills with domain-specific discourses and communicative practices (Nekrasova-Beker, 2020; Azalmad, 2023). Research highlights the importance of focusing on vocabulary, discourse structures, and communicative strategies that reflect professional realities (Arnó-Macià et al., 2020). Vocabulary-oriented studies confirm that mastery of technical terms, lexical bundles, and phrase-level features strongly predicts reading comprehension and communication performance in engineering contexts (Azalmad, 2023; Wigati et al., 2023; 2024). These findings underscore the centrality of vocabulary-focused ESP instruction, while also indicating that subfields such as automotive engineering remain underrepresented in available resources, leaving a significant gap in contextualized instruction.

Parallel to vocabulary-based approaches, ESP scholarship has increasingly investigated digital innovations that transform language learning in technical domains. Research shows that e-modules, online platforms, and multimedia tools enhance interactivity, foster learner autonomy, and provide authentic practice in specialized contexts (Đurović, 2023; Borucinsky & Pritchard, 2022; Surani et al., 2023). Profession-based vocabulary acquisition has been successfully supported through digital innovations such as 3D animation (Chaikovska et al., 2023), while digital storytelling connects language instruction with real-world employability and workplace communication (Yu et al., 2024). Flipped classroom approaches integrating Quizlet and Edpuzzle have proven effective in improving ESP learning outcomes in engineering courses (Ningsih, Nasrullah, & Rosalina, 2024; Amelia et al., 2024). Needs analyses emphasize the importance of grounding ESP in authentic workplace tasks (Septiyani et al., 2022; Dewi et al., 2024), and digital literacy studies confirm that multimodal tools increase learner engagement and accessibility (Farahsani & Harmanto, 2022; Humeniuk et al., 2021). While these studies confirm the potential of digital ESP, most initiatives have been developed in broader fields such as business, law, and accounting (Kholis & Iryanti, 2021; Iswati & Hastuti, 2021; Kusumawati, 2018; Lestari & Putra, 2023). The absence of empirically validated ESP resources for automotive engineering illustrates a major gap in current scholarship.

Collectively, current scholarship demonstrates a growing recognition of the importance of ESP materials in technical education. Studies highlight vocabulary demands in engineering contexts (Nekrasova-Beker, 2020; Azalmad, 2023), the value of stakeholder-informed module design (Wigati et al., 2023; 2024), and the potential of digital platforms to enhance contextual learning (Đurović, 2023; Surani et al., 2023). Innovations such as modular design (Ningsih & Nikmah, 2023), collaborative tools (Farahsani & Harmanto, 2022), and digital storytelling (Yu et al., 2024) illustrate how ESP instruction has evolved toward interactive and practice-oriented learning. However, most of these studies are situated in domains such as law, business, and accounting (Septiyani et al., 2022; Kholis & Iryanti, 2021; Amelia et al., 2024), with limited application in automotive engineering. The distinct discourse practices, vocabulary demands, and technical genres of automotive engineering are rarely addressed in existing ESP resources, creating a state of the art that is well developed in general technical domains but lacking in depth for discipline-specific contexts such as automotive. This gap positions automotive engineering as a critical area for innovation in ESP research and practice.

This study addresses the identified gap by designing and validating a tailored ESP e-module for automotive engineering students at Banjarmasin State Polytechnic. Unlike general ESP resources or broadly conceived engineering modules, the present e-module integrates technical vocabulary, authentic automotive contexts, and task-based activities that mirror workplace practices. Its novelty lies in combining linguistic preparation with technical accuracy while embedding digital and interactive features that support learner engagement and accessibility. The contribution of the study is both theoretical and practical. Theoretically, it advances ESP pedagogy by demonstrating how language instruction can be adapted to a highly specialized technical field. Practically, it provides a validated resource that vocational institutions can use to strengthen workforce readiness in alignment with global industry demands (Amelia et al., 2024; Asmianto et al., 2022; Nova, 2024).

The significance of this research is reflected in its capacity to prepare students for both academic achievement and professional success. For learners, the e-module improves comprehension of technical

resources and develops communicative competence for international contexts. For educators and institutions, it offers a replicable model for integrating language and technical curricula. The study aims to design, develop, and evaluate the ESP e-module through a Research and Development methodology. The process includes needs analysis, design and development, pilot implementation, and evaluation. Curriculum review, student surveys, and expert validation by language and automotive specialists ensure that the e-module is contextually relevant, pedagogically robust, and technically accurate (Lestari & Putra, 2023; Ningsih & Nikmah, 2023).

2. Methods

This study employed a Research and Development (R&D) methodology, which is widely recognized as an effective approach for designing and validating instructional products in education (Lestari & Putra, 2023). The choice of R&D was based on the need to systematically create, refine, and evaluate a pedagogical tool that meets both linguistic and technical demands of automotive engineering students. The methodology followed four sequential stages: needs analysis, design and development, implementation, and evaluation. This structured process ensured that the resulting e-module was not only theoretically sound but also pedagogically robust and practically applicable within a vocational context.

2.1 Participants and Context

The study was conducted at Banjarmasin State Polytechnic with a cohort of automotive engineering students who were directly involved in the piloting of the e-module. The participants were selected because they represent the target group most in need of specialized English for Specific Purposes instruction. In addition to student participants, two expert validators were engaged. One was a specialist in English language teaching who assessed content and linguistic aspects, while the other was an automotive engineering practitioner who evaluated technical accuracy, terminology, and multimedia design. The inclusion of both language and technical experts was crucial to ensure that the module addressed the dual requirements of linguistic relevance and disciplinary precision (Asmianto et al., 2022).

2.2 Instruments and Data Collection

Multiple instruments were employed to collect comprehensive data. First, curriculum analysis was conducted to identify core English needs for automotive engineering students, particularly in relation to technical vocabulary and comprehension of discipline-specific materials. Second, a student questionnaire was administered to capture learners' feedback on content relevance, accuracy, and usability. Third, expert validation forms were used to obtain quantitative and qualitative assessments of the e-module. This triangulated data collection strategy enhanced the validity and reliability of the study by incorporating perspectives from institutional documents, learners, and subject specialists (Ningsih & Nikmah, 2023; Lestari & Putra, 2023).

2.3 Design and Development

The design of the e-module drew insights from the needs analysis and was structured to integrate authentic automotive contexts, technical vocabulary, and multimedia features. The learning design emphasized task-based activities, enabling students to practice communicative skills through activities such as interpreting technical manuals, describing automotive processes, and simulating diagnostic tasks in English. The development also incorporated principles of cognitive load theory to manage the complexity of technical information while maintaining accessibility for students at different proficiency levels (Asmianto et al., 2022)

2.4 Implementation

The implementation phase involved pilot testing of the e-module in classroom settings. Students engaged with the module individually and collaboratively, allowing them to experience both autonomous learning and peer interaction. Observations and questionnaires were used to document students' learning progress and responses to the module. This stage was essential for assessing the practical usability of the e-module in real learning environments and identifying areas for refinement.

2.5 Evaluation and Data Analysis

The evaluation stage combined expert validation and student feedback to assess the effectiveness of the e-module. Quantitative data from expert validators were analyzed to determine content validity and technical reliability. The English language expert rated the e-module at 4.7 out of 5 for linguistic aspects, while the automotive expert rated it at 4.4 out of 5 for technical accuracy, indicating strong validity across both domains. Student questionnaires were analyzed descriptively, focusing on the percentage of agreement regarding relevance, accuracy, and clarity. Qualitative feedback from experts and learners was used to refine language clarity and adapt technical content for broader accessibility.

By combining quantitative and qualitative approaches, the study ensured a rigorous analysis of both the strengths and limitations of the instructional product (Lestari & Putra, 2023; Asmianto et al., 2022).

3. Results

This study applied the Research and Development methodology, consisting of four systematic stages: needs analysis, design and development, implementation, and evaluation. Each stage generated findings that guided the refinement of the ESP e-module for automotive engineering

students. The following subsections present the results in sequence, highlighting not only the data but also their meaning and implications for ESP instruction in vocational contexts.

3.1 Needs Analysis

The needs analysis revealed that students faced persistent challenges in learning discipline-specific English. They struggled with technical vocabulary, comprehension of authentic materials such as manuals and diagnostic reports, and application of English in communicative tasks related to automotive engineering. Curriculum review confirmed that English instruction at the polytechnic level remained general and detached from the linguistic demands of automotive contexts. Student questionnaires further showed that 72 percent of respondents believed existing materials lacked relevance to their field of study.

Table 3.1 Summary of Needs Analysis Findings

Focus Area	Findings
Vocabulary	Students lacked mastery of technical terms (engine, brake, transmission).
Authentic Materials	Difficulty interpreting manuals, diagnostic reports, and technical texts.
Curriculum Review	English instruction was general with limited technical alignment.
Student Perceptions	72% reported the need for English materials integrated with technical content.

These findings demonstrate a clear mismatch between students' academic preparation and the linguistic competencies required for professional practice. Students were aware of the limitations of existing resources, as indicated by their expressed demand for more contextualized materials. This awareness suggests readiness for innovation and receptiveness to discipline-specific learning. Importantly, the results emphasize that a generic approach to English instruction is insufficient in preparing students for technical communication. The needs analysis therefore justified the development of a targeted e-module that could bridge this gap by embedding authentic contexts and technical discourse into ESP learning.

3.2 Design and Development

Based on the needs analysis, the e-module was designed to incorporate technical vocabulary lists, authentic automotive contexts, and multimedia features to enhance interactivity. Task-based learning principles were embedded, with activities such as interpreting manuals, describing vehicle components, and simulating professional scenarios. Cognitive load considerations were applied to balance technical detail with accessible language. The result was a modular structure containing units that integrated linguistic objectives with automotive content, providing a coherent progression of learning tasks. R&D Cycle and E-Module Design Focus below:

1) Needs Analysis → Identifying linguistic and technical gaps
2) Design → Integrating authentic contexts, vocabulary, and tasks
3) Development → Embedding multimedia features and modular units
4) Evaluation → Expert validation and student feedback

The design results show how linguistic and technical domains can be systematically integrated. By embedding authentic texts and real-world tasks, the e-module transformed English from a general subject into a tool for technical communication. The inclusion of multimedia elements not only supported learner motivation but also mirrored professional practices where visual and technical data often accompany text. The design process demonstrates that effective ESP instruction must combine authenticity, interactivity, and scaffolding, ensuring that learners at varied proficiency levels can engage with complex content.

3.3. Implementation

The e-module was tested with automotive engineering students in classroom sessions. Learners engaged individually and in groups, combining self-paced exploration with guided instruction. They showed active participation in vocabulary tasks and simulations, applying new terminology to technical processes and collaborating in task-based activities.

Table 3.2 Student Feedback on Implementation

Indicator	Strongly Agree	Agree	Neutral	Disagree
Relevance	23%	61%	16%	0%
Accuracy	31%	54%	11%	4%
Usability	27%	58%	12%	3%
Language Clarity	19%	30%	46%	5%

The feedback shows that students perceived the module as relevant, accurate, and user-friendly. High percentages in agreement categories confirm that the content aligned well with their needs, validating the design decisions. However, nearly half of the students responded neutrally regarding language clarity, indicating that while tasks were contextually relevant, some linguistic explanations remained complex. This finding suggests the necessity of additional scaffolding, glossaries, or simplified language to ensure inclusivity for learners of lower proficiency. The pilot also highlighted the role of group work in promoting confidence, as collaborative engagement appeared to mitigate difficulties faced by individual learners.

3.4 Evaluation

The evaluation stage combined expert validation and student feedback to determine the overall quality of the e-module. The English language expert awarded a validity score of 4.7 out of 5 for linguistic aspects, while the automotive expert awarded 4.4 for technical content. Multimedia design received 4.5, indicating that interactive features were pedagogically valuable and technically appropriate.

Table 3.3 Expert Validation Results

Aspect	Score (out of 5)
Linguistic Quality	4.7
Technical Content	4.4
Multimedia Design	4.5

Expert scores validate the high quality of the module, confirming that it successfully balanced linguistic and technical elements. The slightly lower score for technical content suggests that while the module covered essential vocabulary and contexts, there may be opportunities to expand technical detail in future iterations. Student questionnaire results further reinforced this evaluation, as over 80 percent confirmed that the module was relevant and accurate to their field. Nevertheless, the recurring issue of language clarity highlights a nuanced challenge: while authenticity is crucial, linguistic accessibility must be carefully calibrated to the proficiency range of the learners.

3.5 Comprehensive Interpretation of Findings

Across all stages, the results confirm that the R&D process produced a valid and effective ESP e-module. The needs analysis established the urgency of addressing gaps between existing English instruction and the specific requirements of automotive engineering. The design and development stage translated these needs into a digital resource that combined authenticity with interactivity. The implementation stage demonstrated strong learner engagement, validating the contextual relevance of the content. The evaluation stage provided quantitative evidence of validity and qualitative insights into areas for refinement.

The results reveal three important insights. First, vocational students are highly responsive to contextualized and interactive resources, showing improved engagement when language tasks are directly tied to their field. Second, expert validation underscores the feasibility of integrating linguistic and technical domains within one instructional product. Third, the challenge of balancing authenticity with clarity indicates that future ESP materials must adopt adaptive scaffolding strategies, such as tiered tasks or bilingual glossaries, to accommodate diverse learner proficiency levels. Collectively, these findings suggest that ESP e-modules, when systematically developed through R&D, can bridge the gap between technical knowledge and language proficiency, thereby supporting both academic achievement and workforce readiness.

4. Discussion

This study set out to investigate the linguistic needs of vocational students in automotive engineering and to design an ESP e-module that integrates authenticity, digital innovation, and disciplinary specificity. Using a research and development (R&D) approach, the study not only identified gaps in English preparation but also systematically addressed them through design, expert validation, and pilot implementation. By situating the research in automotive engineering, an underexplored

area within ESP, the study contributes to both theoretical debates and practical innovations in vocational education.

The needs analysis revealed a significant gap between students' English proficiency and the communicative demands of their field. Learners struggled with technical vocabulary, authentic texts such as manuals, and communicative tasks required in workplace settings. These results echo previous research showing that general English instruction is insufficient for specialized disciplines (Nekrasova-Beker, 2020; Arnó-Macià et al., 2020; Ramadhani et al., 2023). Prior studies confirm that success in technical education depends heavily on mastery of domain-specific language (Azalmad, 2023; Wigati et al., 2023; 2024). The present findings reinforce this position, with more than seventy percent of students reporting the limited relevance of current materials.

What distinguishes this study is its focus on the automotive field, a sub-discipline often overlooked in ESP research. While earlier studies have concentrated on general engineering, business, law, or accounting (Kholis & Iryanti, 2021; Iswati & Hastuti, 2021; Kusumawati, 2018; Lestari & Putra, 2023), this research highlights the unique linguistic challenges faced in automotive contexts, including highly technical vocabulary and specialized genres such as diagnostic reports or repair manuals. The implication is that ESP scholarship must broaden its scope to include more specialized areas where professional and linguistic demands intersect in distinctive ways.

The design of the e-module was guided by authenticity, task-based learning, and cognitive accessibility. Integrating authentic contexts and vocabulary into structured learning modules reflects established findings that vocabulary and genre-based instruction are essential in ESP (Azalmad, 2023; Wigati et al., 2023; 2024). The contribution of this study lies in demonstrating how technical authenticity and linguistic scaffolding can be effectively combined in digital learning environments. The modular structure supported a progression from basic vocabulary to applied professional communication tasks, creating a coherent and practical learning pathway.

Digital innovation also played a central role. Multimedia features such as visuals and interactive activities reflect the growing emphasis on technology-enhanced ESP pedagogy (Đurović, 2023; Surani et al., 2023). However, findings revealed a nuanced challenge: while multimedia enhanced student engagement, some learners still found language explanations difficult to follow. This suggests that the value of digital design depends on how well it is aligned with linguistic accessibility. Future ESP research should therefore examine not only the adoption of digital tools but also their optimization for students with diverse proficiency levels in technical programs.

Pilot implementation provided strong evidence of the module's practical effectiveness. More than eighty percent of students reported satisfaction with its relevance, accuracy, and usability. These findings are consistent with prior studies that highlight the benefits of authentic task-based ESP resources in boosting engagement and perceived usefulness (Septiyani et al., 2022; Dewi et al., 2024). Observations also confirmed that learners applied new vocabulary in collaborative contexts, supporting the argument that task-based approaches foster both competence and confidence (Arnó-Macià et al., 2020).

Yet, neutral responses regarding clarity underscore the persistent tension between authenticity and accessibility. While authentic texts prepare students for workplace communication, they can be overwhelming without appropriate scaffolding. This challenge resonates with broader ESP discussions on balancing relevance with cognitive load (Farahsani & Harmanto, 2022; Humeniuk et al., 2021). The present study adds new evidence to this debate, showing that while students valued authenticity, they simultaneously required additional linguistic support. This highlights the need for adaptive scaffolding in ESP materials for vocational contexts.

Expert validation further strengthened the results. The module received high ratings in both linguistic accuracy (4.7) and technical content (4.4), demonstrating the value of involving dual expertise in material design. Previous research has emphasized that ESP resources often lack disciplinary depth if they are designed solely by language specialists (Iswati & Hastuti, 2021; Kholis & Iryanti, 2021). By integrating both language and subject-matter experts, this study ensured that the materials were simultaneously accurate and relevant.

Further, student feedback complemented expert validation, confirming the module's relevance and usefulness. These findings are consistent with research that emphasizes learner perceptions as critical indicators of ESP effectiveness (Amelia et al., 2024; Ningsih, Nasrullah, & Rosalina, 2024). At the same time, concerns about language clarity highlight that accessibility remains an area for improvement. The dual need for disciplinary precision and linguistic scaffolding is therefore evident, reinforcing the argument that ESP pedagogy must address both dimensions equally.

The study extends ESP scholarship in three key ways. First, it fills a gap by focusing on automotive engineering, a neglected area that requires domain-specific ESP resources (Lestari & Priyana, 2020; Armawan, 2024). Second, it demonstrates the use of R&D methodology in systematically designing, developing, and validating materials. This structured process offers a replicable framework for future

research and aligns with innovative pedagogical strategies, such as 3D engineering animations, that enhance technical learning (Chaikovska et al., 2023). Third, it provides empirical evidence on the balance between authenticity and accessibility, an issue often discussed but less frequently examined with data from vocational settings. Studies on multimodal composing (Kohnke et al., 2021) and authentic material integration (Trang, 2022) support this line of inquiry, and the present research contributes further insights by focusing on automotive contexts.

These contributions confirm existing theories on the importance of authenticity, vocabulary, and digital innovation while extending them into new disciplinary territory. The originality of the study lies in bridging linguistic and technical needs in ways validated by both experts and learners, ensuring pedagogical soundness and professional relevance.

The implications for ESP pedagogy and vocational education are substantial. Contextualized e-modules can effectively prepare students for the linguistic demands of their fields, supporting academic achievement and workforce readiness (Amelia et al., 2024). Digital innovation, particularly multimedia and interactive features, enhances motivation and engagement (Asmianto et al., 2022). Moreover, dual expert validation remains essential to guarantee both linguistic accuracy and technical precision in highly specialized fields (Nova, 2024). By aligning language instruction with disciplinary practice, vocational institutions can prepare students for global employability and international professional environments (Amelia et al., 2024; Asmianto et al., 2022; Nova, 2024; Ningsih & Nikmah, 2023).

Nonetheless, limitations must be acknowledged. Neutral student responses indicate that complex explanations reduced accessibility (Ningsih & Nikmah, 2023). Future research should explore adaptive scaffolding strategies, including bilingual glossaries, tiered activities, or step-by-step guidance. The scope of technical content was also limited. Although validated by experts, the material could be expanded to cover more advanced automotive contexts. Further research should also examine its transferability to related fields such as industrial engineering, maritime studies, and computing. Comparative and longitudinal approaches would provide valuable insights into the adaptability and long-term impact of ESP resources.

In conclusion, this study demonstrates that the systematic application of R&D methodology can produce an empirically validated ESP e-module that integrates linguistic and technical competencies for vocational students. By embedding authentic contexts, technical vocabulary, and interactive features, the findings affirm key ESP principles such as authenticity and vocabulary focus while extending them to the neglected domain of automotive engineering. At the same time, the study highlights the ongoing challenge of balancing authenticity with accessibility. More broadly, ESP pedagogy must evolve to meet the demands of vocational education and global industry. As digitalization and globalization continue to reshape professional practice, students require not only technical expertise but also communicative competence in English. This study contributes to that goal by offering both theoretical insights and practical innovations.

5. Conclusion

This study confirmed that a tailored ESP e-module for automotive engineering students can effectively address the long-standing gap between general English instruction and the specialized communicative demands of technical education. The findings revealed high levels of expert validation in linguistic accuracy (4.7) and technical content (4.4), as well as strong student agreement on relevance and accuracy, highlighting the module's capacity to bridge technical and linguistic competencies while enhancing engagement with authentic professional materials. The key contribution lies in its novelty of integrating automotive-specific vocabulary, authentic contexts, and task-based learning supported by digital features, offering both a theoretical advancement in ESP pedagogy and a practical tool for workforce readiness. The broader implication of this study extends to the global challenge of aligning vocational curricula with industry standards in an era where English proficiency is central to professional mobility, innovation, and cross-border collaboration. As such, this study strengthens Indonesian vocational students' preparation and shows how digital ESP resources support graduates' participation in global knowledge economies. Future research should refine language scaffolding, adapt the module across technical fields, and assess long-term effects on workplace performance and intercultural communication.

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