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Bridging the gap: A critical needs analysis of ESP for industrial engineering students' professional communication competence in Indonesian higher education

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ABSTRACT

This research investigates the English for Specific Purposes (ESP) requirements of industrial engineering students through a systematic needs analysis framework examining necessities, lacks, and wants dimensions. Employing a mixed-methods approach, the study encompassed 120 industrial engineering students across three Indonesian universities. Data collection utilized validated questionnaires incorporating seven primary dimensions, with findings analyzed through descriptive statistical methods. The results demonstrated that comprehending technical literature in English represented the most critical necessity (M=4.29), closely followed by competency in negotiating with international clients (M=4.27). The lacks dimension revealed substantial challenges in interpreting technical documentation and instructional materials (M=2.91), alongside difficulties in composing technical reports (M=3.12). Analysis of the wants dimension indicated strong motivation for enhancing technical reading proficiency (M=4.56), while demonstrating minimal emphasis on oral communication development (M=2.86). Findings reveal a pronounced disparity between existing conventional ESP curricula and students' authentic professional requirements, highlighting the necessity for curriculum restructuring centered on technical communication competencies. The systematic gap identified suggests inadequate alignment between academic instruction and industry demands in globalized professional contexts. This study provides empirical evidence supporting the development of responsive ESP curricula tailored to industrial engineering students' professional communication needs in contemporary international business environments, contributing valuable insights for educational policy formulation and pedagogical practice enhancement.

Contribution/ Originality: This study is original and provides the first empirical tri-dimensional needs analysis framework for ESP curriculum development in industrial engineering contexts. By systematically quantifying the gap between conventional ESP instruction and authentic professional communication demands, this research establishes evidence-based foundations for technical communication competency integration, directly informing pedagogical restructuring in globalized engineering education.

1. INTRODUCTION

Recently, in the midst of a tremendous technological onslaught, English for Specific Purposes (ESP) has become an integral component in engineering higher education, especially in the face of the increasingly complex challenges of industrial globalization. The need for specific English communication skills in the context of industrial engineering can no longer be ignored, given the dynamics of modern industry that demand professionals to be able to interact in a multinational environment with international communication standards. This phenomenon becomes increasingly relevant when Industry 4.0 presents a new paradigm that integrates digital technology with sophisticated professional communication practices (Day & Krzanowsk, 2010).

Nevertheless, in the context of industrial engineering education in Indonesia, the implementation of ESP faces fundamental challenges related to the gap between the available curriculum and the authentic needs of students, as stated by Rahayu, Sudarsono, and Nurlaelawati (2018). Empirical observations indicate that the majority of ESP programs in technical colleges still rely on a general English approach that is not aligned with the demands of specific technical communication, as noted by (Caciora & Sturza, 2025). This misalignment creates a significant gap between the competencies developed in learning and the competencies required in professional practice in the field, as highlighted by (Rohmah, 2019).

Industrial engineering students have distinct communication requirements that set them apart from students in other fields (Qiu, Zhang, & Dong, 2024). They must be able to read and understand international technical documents, communicate with people from other countries, and produce technical reports and presentations that meet international industry standards (Bekteshi & Xhaferi, 2020). Communication in industrial engineering is complex because it requires knowledge of ISO standards, industrial equipment manuals, technical specifications, and the ability to negotiate business deals in an international setting. The needs analysis theory formulated by Waters within the grand theory (Paltridge & Starfield, 2016) provides a comprehensive theoretical framework for understanding the learning demands of English for Specific Purposes (ESP). This paradigm categorizes target needs into three groups: necessities (what students need to operate effectively in a target setting), lacks (the gap between current abilities and target abilities), and wants (what students wish to learn). A thorough understanding of these three elements is essential for designing a successful and relevant ESP curriculum (Woodrow, 2018).

Prior studies in the domain of English for Specific Purposes in industrial engineering reveal considerable discrepancies in methodologies and results. A study by Arnó-Macià, Aguilar-Pérez, and Tatzl (2020) highlights the necessity of aligning industry requirements with academic curricula, whereas research by Rus (2020) underscores the significance of realistic learning materials. Nonetheless, a void persists in the literature regarding requirements analysis tailored to the context of industrial engineering in Indonesia, which possesses distinct cultural and industrial attributes. Consequently, Indonesia's economic landscape, increasingly interconnected with the global value chain, necessitates industrial engineering graduates possessing proficient international communication skills (Abdullah et al., 2022). The influx of foreign investment and global collaboration in the manufacturing sector and automotive industry require personnel proficient in technical English communication. This phenomenon necessitates educational institutions to modify curricula in accordance with thorough and empirical needs assessments (Athanasiou, Constantinou, & Burston, 2024).

However, the constraints of prior studies in comprehensively assessing the ESP requirements of industrial engineering students served as the primary impetus for this research Đurović and Bauk (2022). Most prior studies concentrated on narrow facets or employed a restricted sample, therefore failing to deliver a holistic understanding of the particular ESP requirements for industrial engineering students. This research aims to address this deficiency using a stringent methodological framework and a representative sample.

The urgency of this research is further strengthened by the fact that mistakes in designing the ESP curriculum can have a long-term impact on the readiness of graduates to face professional challenges. Investments in English education that are not on target not only have an impact on resource efficiency but also on the quality of graduates produced.

Therefore, this research aims to provide a solid empirical foundation for the development of an ESP curriculum that is more effective and relevant to the needs of modern industry.

1.1. Research Questions

Based on the background that has been described, this study seeks to answer the following questions:

1. What is the profile of the target needs of industrial engineering students in ESP learning, which includes the dimensions of necessities, lacks, and wants?
2. What is the gap between the current ESP curriculum and industrial engineering students' authentic technical communication needs?
3. What are the characteristics of the learning needs of industrial engineering students related to learning style preferences, learning activities, ICT literacy, and the desired learning setting?

1.2. Research Objectives

In line with the research questions that have been formulated, this study has the following objectives:

1. Identify and analyze the profile of the needs of the target industrial engineering students in ESP learning through a comprehensive study of the dimensions of necessities, lacks, and wants to understand the necessary technical communication competencies.
2. Evaluate the gap between the conventional ESP curriculum and the authentic needs of industrial engineering students to identify areas that require curriculum reformulation.
3. Analyze the characteristics of industrial engineering students' learning needs to provide recommendations in designing ESP learning strategies that are in accordance with students' preferences and learning styles.

2. LITERATURE REVIEW

As we all know, English for Specific Purposes (ESP), as a branch of English language teaching, has evolved significantly since its emergence in the 1960s. Hutchinson and Waters (1987), in Mushthoza and Ma'rufah (2018) define ESP as "a language teaching approach in which all decisions regarding content and methods are based on the learner's reasons for learning the language." This definition emphasizes the importance of needs analysis as a foundation in designing an effective ESP curriculum. The development of ESP is inseparable from the demands of globalization, which require professionals from various fields to master English for specific purposes in their professional domain (Udu, 2021).

Needs analysis theory in the context of ESP has become the dominant paradigm in the development of English curricula for specific purposes. Mushthoza and Ma'rufah (2018) developed a framework that distinguishes between target needs and learning needs, where target needs consist of necessities (objective needs based on the demands of the target situation), lacks (the gap between current abilities and required abilities), and wants (subjective needs based on learners' perceptions) (Kim, 2013). The framework has become a solid theoretical foundation for various ESP research around the world and has proven effective in identifying authentic learning needs (Kohnke, 2021).

The setting of industrial engineering possesses distinct and intricate communication qualities that set it apart from other engineering disciplines. Alsamadani (2017) asserts that ESPs in industrial engineering must prioritize communication in professional contexts that involve engagement with a variety of stakeholders, from technicians to senior management. Communication in industrial engineering encompasses technical, administrative, economic, and strategic factors that necessitate several linguistic registers. This complexity necessitates a thorough and cohesive ESP strategy (Khamis, Rahim, & Hussin, 2019).

Previous research in the field of ESP for industrial engineering shows a variety of interesting findings. A study conducted by Iswati (2021) on engineering students at international universities revealed that the ability to read technical literature and presentation skills are students' top priorities. Meanwhile, Fitria (2020) conducted research in the Eastern European context and found that the ability to write technical reports and interpersonal communication are the main focus of the needs of industrial engineering students. These differences in findings indicate the importance of local context in the analysis of ESP needs.

If we look at the necessities dimension in the needs analysis, ESP industrial engineering reflects the objective demands of the increasingly global and technology-intensive world of work. Misgana (2024), in their research on industrial engineering graduates in Asia found that understanding international technical documentation, ISO standards, and industrial equipment specifications is a non-negotiable competency in the modern world of work. These findings are reinforced by a longitudinal study conducted by Azmuddin, Abdul Rahim, Ali, and Khamis (2022) that showed a positive correlation between technical English proficiency and the professional performance of industrial engineering graduates.

Analysis of the dimensions of lacks in the context of industrial engineering ESP reveals a systematic gap between students' competencies and the professional demands. Research conducted by Agustina (2014) shows that industrial engineering students have significant difficulties understanding the formal register of technical English, using specific terminology, and the conventions of writing technical documentation. The challenges are not solely linguistic but also pertain to the comprehension of particular genres and discourse patterns in industrial engineering communication (Lasagabaster, 2022).

The desire factor in industrial engineering ESP reflects students' inner objectives and motivation for learning English. A study by Kalkayeva, Golovchun, Irgatoglu, Turlybekova, and Ferens (2025) indicated that industrial engineering students exhibit a strong ambition to acquire technical communication skills, although they often possess a distorted understanding of the importance of the requisite competencies. The findings underscore the necessity of instructing students on the realities of professional communication within the field of industrial engineering (Fenton-Smith, Stillwell, & Dupuy, 2017). In the realm of industrial engineering English for Specific Purposes, learning requirements encompass learning preferences, learning styles, and variables influencing learning efficacy. Research conducted by Alsamadani (2017) indicates that industrial engineering students prefer experiential learning and simulations that replicate real-world scenarios. This desire aligns with the attributes of the industrial engineering field, which prioritizes practical application and problem-solving in complex industrial environments (Saienko & Nazarenko, 2021).

The incorporation of technology in industrial engineering ESP education has emerged as a notably important trend. A research by Pitarch (2024) indicated that industrial engineering students exhibited a favorable reaction to English for Specific Purposes (ESP) instruction that incorporated digital platforms and multimedia resources. This study also identifies deficiencies in technological literacy that may impede the application of technology-based ESP learning. These findings underscore the necessity of a thorough learning needs analysis in the formulation of effective ESP learning strategies.

3. METHODOLOGY

3.1. Research Design

This research employs a mixed-methods design utilizing a sequential explanatory technique. Quantitative data is initially gathered via surveys and subsequently enriched with qualitative data through interviews and observations. This design was chosen to achieve a thorough comprehension of the multifaceted and intricate English for Specific Purposes requirements of industrial engineering students. Quantitative procedures are employed to discern patterns and trends widely, whereas qualitative tactics are utilized to understand context and subtleties more profoundly.

3.2. Participants

The research participants were 120 industrial engineering students at Pamulang University, Tangerang, Indonesia, selected by purposive sampling from three authorized universities in Indonesia offering industrial engineering programs. The eligibility criteria for participation are: (1) active students enrolled in the industrial engineering program during semesters 3-8, (2) completion of general English courses, and (3) possession of a career plan in the industrial sector. The allocation of participation per university consists of 40 students from each institution to guarantee geographical representativeness and institutional variety. The participants exhibited a gender balance, comprising 52% males and 48% females, within an age range of 19 to 23 years.

3.3. Instrumentation

The primary tool for research is a structured questionnaire designed according to the requirements analysis framework established by Hutchinson and Waters (1987), tailored for the field of industrial engineering. The questionnaire comprises 72 items categorized into seven primary aspects: (1) Necessities (10 items), (2) Lacks (10 items), (3) Wants (10 items), (4) Learning Styles/Preferences (10 items), (5) Learning Activities (10 items), (6) ICT Literacy (11 items), and (7) Preferred Learning Setting (11 items). Each item uses a 5-point Likert scale (1=strongly disagree to 5=strongly agree). The validity of the instrument's content was verified by three expert judges with ESP expertise and industrial engineering, while the internal reliability was tested using Cronbach's Alpha with a value of 0.84–0.89 for all dimensions.

3.4. Data Collection Procedure

Data collection was carried out in three systematic stages over a four-month period. The first stage involved the distribution of online questionnaires through the Google Forms platform to all participants with the help of study program coordinators at each university. Each participant was provided with informed consent and a detailed explanation of the research objectives before filling out the questionnaire. The second stage involved semi-structured interviews with 30 randomly selected participants to gain in-depth insights into their ESP needs. The third stage consisted of observation of ESP classes at the three universities to understand the actual learning conditions and identify the gap between the existing curriculum and the needs of students.

3.5. Data Analysis

Quantitative data analysis was carried out using the Statistical Package for Social Sciences (SPSS) version 26, with descriptive statistical techniques including the calculation of mean, standard deviation, and frequency distribution for each dimension of needs analysis. Further analysis used crosstabulation to identify patterns of relationships between variables and Analysis of Variance (ANOVA) to test differences in needs based on participants' demographic characteristics. Qualitative data from interviews and observations were analyzed using thematic analysis techniques with the Miles and Huberman approach, including the stages of data reduction, data display, and conclusion drawing. Data triangulation was carried out to ensure the validity and reliability of the research findings.

4. RESULTS AND DISCUSSION

4.1. Profile of Target Needs of Industrial Engineering Students

4.1.1. Target Needs Analysis

The target needs analysis is carried out to understand specifically what is needed by Industrial Engineering students in the context of ESP learning. Table 1 presents the indicator of target needs.

Table 1. Target needs.

No.	Question	Indicator	Dimension
1	How important is the ability to read technical literature in English to you?	Necessities	Target needs
2	How important is the ability to write technical reports in English for you?	Necessities	Target needs
3	How important is understanding technical instructions and manuals in English to you?	Necessities	Target needs
4	How important is the ability to communicate verbally in English in the workplace or in the place of study?	Necessities	Target needs
5	How important is the ability to translate technical texts from English to Indonesian to you?	Necessities	Target needs
6	How important is the ability to negotiate in English with an international client or partner?	Necessities	Target needs

No.	Question	Indicator	Dimension
7	How important is the ability to comprehend presentations in technical areas in English to you?	Necessities	Target needs
8	How important is the ability to participate in technical discussions in English to you?	Necessities	Target needs
9	How important is the ability to write professional emails in English to you?	Necessities	Target needs
10	How important is the ability to attend a seminar or workshop that uses English in engineering?	Necessities	Target needs
11	How difficult is it for you to understand technical literature in English?	Lacks	Target needs
12	How difficult is it for you to write a technical report in English?	Lacks	Target needs
13	How difficult is it for you to communicate verbally in English at work or study?	Lacks	Target needs
14	How difficult is it for you to understand the instructions and technical manuals in English?	Lacks	Target needs
15	How difficult is it for you to translate technical texts from English to Indonesian?	Lacks	Target needs
16	How difficult is it for you to understand technical presentations in English?	Lacks	Target needs
17	How difficult is it for you to actively participate in English-speaking technical discussions?	Lacks	Target needs
18	How difficult is it for you to write professional emails in English?	Lacks	Target needs
19	How difficult is it for you to negotiate in English with an international client or partner?	Lacks	Target needs
20	How difficult is it for you to attend a seminar or workshop in English in the field of industrial engineering?	Lacks	Target needs
21	How much do you want to improve your reading ability in technical literature in English?	Wants	Target needs
22	How much do you want to improve your ability to write technical reports in English?	Wants	Target needs
23	How much do you want to improve your oral communication skills in English at work or study?	Wants	Target needs
24	How much do you want to improve your ability to understand instructions and technical manuals in English?	Wants	Target needs
25	How much do you want to improve your ability to translate technical texts from English to Indonesian?	Wants	Target needs
26	How much do you want to improve your ability to understand technical presentations in English?	Wants	Target needs
27	How much do you want to improve your ability to participate in technical discussions in English?	Wants	Target needs
28	How much do you want to improve your professional email writing skills in English?	Wants	Target needs
29	How much do you want to improve your negotiating skills in English with an international client or partner?	Wants	Target needs
30	How much would you like to attend a seminar or workshop in English in the field of industrial engineering?	Wants	Target needs

Table 2 presents the information of necessities. indicator.

Table 2. Necessities.

Indicator	Mean	Std. Deviation
Ability to read technical literature in English	4.29	0.936
Ability to write technical reports in English.	3.96	0.927
Understand technical instructions and manuals in English.	4.16	0.951
Verbal communication skills in engineering English	4.11	0.996
Ability to translate technical texts from English to Indonesian.	4.16	1.008
Ability to negotiate in English with international clients	4.27	0.982
Understand technical presentations in English	4.15	0.935
Participate in English-speaking technical discussions.	4.05	0.9
Write professional emails in English.	4.04	0.983
Attend seminars/Workshops that use English in engineering	3.99	0.941

The Necessities dimension shows that the ability to read technical literature in English has the highest average (4.29) with a fairly low standard deviation (0.936). This indicates that this ability is indispensable for students to support their professional or academic activities. In addition, the ability to negotiate in English with international clients is also considered very important, with an average score of 4.27. Overall, these competencies are considered essential in the target situation.

The average scores for writing professional emails in English and attending seminars/workshops were lower, at 4.04 and 3.99, respectively. The minimal standard deviation in both indicators signifies the uniformity of student perspectives, suggesting that this domain necessitates increased focus on skill enhancement. It is essential to guarantee that training includes rigorous practice in formal written communication and fosters confidence in participating in international activities.

The Necessities dimension indicates that proficiency in reading technical literature in English has the highest mean score (4.29) with a relatively low standard deviation (0.936). This indicates that this skill is essential for pupils to facilitate their career or academic endeavors. The capacity to negotiate in English with multinational clientele is seen as highly significant, reflected by an average score of 4.27. These competencies are deemed indispensable in the specified context.

The average scores for writing professional emails in English and attending seminars/workshops were 4.04 and 3.99, respectively. The minimal standard deviation in both indicators signifies the uniformity of student perspectives, suggesting that this domain necessitates greater focus on skill enhancement. It is essential to guarantee that training includes rigorous practice in formal written communication and fosters confidence in participating in international activities.

The standard deviation on most indicators is below 1.0, which indicates that there is uniformity in students' perceptions of the importance of each competency. As such, training programs can prioritize technical reading and writing skills as well as oral communication that support success in the target situation. Table 3 presents the information of Lacks.Indicator

Table 3. Lacks.

Indicator	Mean	Std. Deviation
Ability to understand technical literature in English	2.91	0.781
Ability to write technical reports in English.	3.12	0.802
Ability to communicate verbally in English at work/study	3.06	0.769
Ability to understand technical instructions and manuals	2.91	0.785
Ability to translate technical texts from English to Indonesian.	3.04	0.789
Understand technical presentations in English	3.02	0.78
Participate in English-speaking technical discussions.	3.05	0.776
Write professional emails in English.	3.08	0.783
Negotiate in English with international clients.	3.07	0.775
Attend seminars/workshops in English in engineering.	3.09	0.79

The Lacks dimension shows that understanding technical literature and instructions/manuals in English is the most difficult area for students, with an average of 2.91 and low standard deviations (0.781 and 0.785), respectively. This indicates that students face significant challenges in reading technical materials and following technical instructions in English. This challenge may arise from insufficient experience in interpreting intricate technical texts within a global framework.

Composing technical reports and professional emails is seen as challenging, with average scores of 3.12 and 3.08, respectively. These problems underscore the necessity for the enhancement of advanced technical writing skills. A low standard deviation signifies uniformity in the challenges encountered by students.

These results underscore the significance of training aimed at enhancing the comprehension of technical publications and refining writing abilities. Practice-oriented methodologies, such as simulations or practical projects, might mitigate perceived challenges in these domains. Table 4 presents the indicator of Wants.

Table 4. Wants.

Indicator	Mean	Std. Deviation
Improve reading ability in technical literature in English.	4.56	0.731
Improve the ability to write technical reports in English.	4.47	0.799
Improve oral communication skills in English at work/Study	2.86	0.389
Improve the ability to understand technical instructions and manuals.	4.52	0.758
Improve the ability to translate technical texts from English to Indonesian.	4.51	0.762
Improve the ability to understand technical presentations in English.	4.46	0.798
Improve the ability to participate in technical discussions in English.	4.44	0.82
Improve professional email writing skills in English.	4.42	0.865
Improve the ability to negotiate in English with international clients.	4.44	0.864
Attend seminars/Workshops that use English in engineering	4.34	0.912

The aspiration to enhance proficiency in reading English technical literature is significantly elevated, with a mean of 4.56 and a standard deviation of 0.731. This signifies a substantial need for improved reading instruction. Furthermore, the aspiration to enhance the comprehension of technical instructions and the translation of technical materials also had elevated average scores of 4.52 and 4.51, respectively. This underscores the necessity for training relevant to the technological context.

Oral communication skills have a much lower average (2.86), which suggests that students do not consider them a top priority compared to reading and writing. Nonetheless, these abilities remain important in professional collaboration situations and can be incorporated as part of a gradual training program.

The standard deviation in the want's indicator is relatively low, indicating uniformity in student needs. These results guide focusing training on technical skills such as reading and writing, while still preparing students for broader communication skills in the future.

1) Learning Needs Analysis

Learning needs analysis describes some questions based on the indicators and the dimensions of each question, such as learning styles, learning activities, ICT literacy, and preferred learning styles. Table 5 illustrates the learning needs.

Table 5. Learning needs.

No.	Question	Indicator	Dimension
31	Would you rather learn English independently than in a formal class?	Learning styles/Preferences	Learning needs
32	Do you prefer to learn English using multimedia materials (video, audio)?	Learning styles/Preferences	Learning needs
33	Do you prefer to learn English by participating in group discussions?	Learning styles/Preferences	Learning needs
34	Do you prefer to learn English through hands-on practice?	Learning styles/Preferences	Learning needs
35	Do you prefer to learn English using technology (learning apps, e-learning)?	Learning styles/Preferences	Learning needs
36	Do you prefer to learn English by reading and writing?	Learning styles/Preferences	Learning needs
37	Do you prefer to learn English by listening and speaking?	Learning styles/Preferences	Learning needs
38	Do you prefer to learn English by listening to presentations or lectures?	Learning styles/Preferences	Learning needs
39	Do you prefer to learn English using authentic materials (journal articles, technical reports)?	Learning styles/Preferences	Learning needs
40	Do you prefer to learn English by role-playing or simulating?	Learning styles/Preferences	Learning needs
41	Is learning effective enough today to support engineering English?	Learning activities	Learning needs
42	Is self-study effective enough with online resources to learn English?	Learning activities	Learning needs
43	Are group discussions effective enough for learning English?	Learning activities	Learning needs
44	Is hands-on practice effective enough to learn English?	Learning activities	Learning needs

No.	Question	Indicator	Dimension
45	Is the use of technology (e-learning) effective enough to learn English?	Learning activities	Learning needs
46	Is listening and speaking learning effective enough to learn English?	Learning activities	Learning needs
47	Is learning machinery and equipment effective enough?	Learning activities	Learning needs
48	Is it effective enough to have technical term vocabulary skills in presentations?	Learning activities	Learning needs
49	Is it effective enough to use authentic material (journal articles, technical reports) to learn English?	Learning activities	Learning needs
50	Is role-play learning or simulation effective enough to learn English?	Learning activities	Learning needs
51	I feel comfortable using online learning apps.	ICT literacy	Learning needs
52	I often use the internet for industrial engineering learning.	ICT literacy	Learning needs
53	I feel comfortable using learning software.	ICT literacy	Learning needs
54	I feel that technology helps to learn English.	ICT literacy	Learning needs
55	I often use e-learning to learn English.	ICT literacy	Learning needs
56	I agree that online materials are more effective than printed materials.	ICT literacy	Learning needs
57	I feel comfortable taking an English course online.	ICT literacy	Learning needs
58	I often use digital devices (tablets, computers) to learn English.	ICT literacy	Learning needs
59	I feel comfortable using social media to learn English.	ICT literacy	Learning needs
60	I often use translation apps to understand English texts.	ICT literacy	Learning needs
61	I feel that there is a need for an ICT-based learning model for industrial engineering ESP.	ICT literacy	Learning needs
62	Do you prefer to learn English in a classroom with a face-to-face teacher?	Preferred learning setting	Learning needs
63	Do you prefer to learn English in small groups?	Preferred learning setting	Learning needs
64	Do you prefer to learn English independently at home?	Preferred learning setting	Learning needs
65	Do you prefer to learn English in a formal setting (such as in a classroom)?	Preferred learning setting	Learning needs
66	Do you prefer to learn English in an on-the-job environment?	Preferred learning setting	Learning needs
67	Would you rather learn English in a language lab?	Preferred learning setting	Learning needs
68	Would you rather learn English at a library or a learning resource center?	Preferred learning setting	Learning needs
69	Would you rather learn English through online courses?	Preferred learning setting	Learning needs
70	Would you rather learn English with the assistance of a live tutor?	Preferred learning setting	Learning needs
71	Would you rather learn English through short-term intensive training?	Preferred learning setting	Learning needs
72	What do you think about an ICT-based ESP learning model in industrial engineering?	Preferred learning setting	Learning needs

Table 6 presents the Learning Styles/Preferences indicator.

Table 6. Learning Styles/Preferences (2.a).

Indicator	Mean	Std. Deviation
Independent learning from formal classes	3.57	0.89
Using multimedia materials (audio, videos)	3.6	0.92
Participate in group discussions.	3.61	0.9
Through hands-on practice	3.88	0.91
Using technology (e-learning learning application)	3.74	0.93
Through reading and writing	3.58	0.88
Listening and speaking	3.65	0.92
Listen to presentations or lectures.	3.63	0.9
Using authentic material (journal articles, technical books).	3.67	0.88
Through role-playing or simulation	3.54	0.91

The results of the analysis showed that students preferred hands-on practice, with the highest average of 3.88 and a standard deviation of 0.91. This indicates that learning approaches involving physical activity or real simulations are very interesting and effective. Group discussions and the use of technology, such as e-learning, also scored quite high (3.61 and 3.74, respectively), indicating a preference for interactive and technology-based methods.

In contrast, learning through role-playing or simulation received the lowest average score (3.54), although the standard deviation remained consistent (0.91). This indicates that students are less interested in simulation methods or may be less familiar with this approach. Reading and writing also tend to be less in demand than other interactive methods, with an average score of 3.58. Based on these results, the learning program can focus on developing hands-on practice activities while improving simulation elements and text-based methods to increase student interest. Table 7 presents the learning activities indicator.

Table 7. Learning activities.

Indicator	Mean	Std. Deviation
Quite effective learning at the moment for English engineering.	3.57	0.88
Quite effective self-study with online resources	3.32	1.01
Quite effective group discussions for learning.	3.59	0.89
Quite effective hands-on practice.	3.9	0.93
Quite effective learning technology (e-learning)	3.41	1.04
Quite effective learning: Listening and Speaking	3.84	0.91
Quite effective machine learning and equipment	3.66	0.83
Quite effective technical terms in presentation	3.81	0.86
Quite effective authentic material (technical report article).	3.54	0.87
Quite effective role-play or simulation.	3.84	0.94

Hands-on practice is again the most effective activity according to students, with an average of 3.90 and a standard deviation of 0.93. In addition, listening and speaking learning are also considered quite effective (average 3.84). This signifies that students tend to prefer audio-lingual and hands-on experience-based activities to improve their skills.

In contrast, technology-based learning such as e-learning has a lower average score (3.41), with a fairly high standard deviation (1.04). This indicates that the effectiveness of e-learning needs to be improved through a more interactive and engaging approach. Independent learning with online resources is also considered less effective (3.32), highlighting the need for guidance or assistance during the independent learning process.

The recommendation from these results is to improve the quality of e-learning and to integrate more Listening and Speaking activities into the learning program. Table 8 presents the Wants indicator.

Table 8. Wants.

Indicator	Mean	Std. Deviation
Improve reading ability in technical literature in English.	4.56	0.731
Improve the ability to write technical reports in English.	4.47	0.799
Improve oral communication skills in English at work/Study	2.86	0.389
Improve the ability to understand technical instructions and manuals.	4.52	0.758
Improve the ability to translate technical texts from English to Indonesian.	4.51	0.762
Improve the ability to understand technical presentations in English.	4.46	0.798
Improve the ability to participate in technical discussions in English	4.44	0.82
Improve professional email writing skills in English.	4.42	0.865
Improve the ability to negotiate in English with international clients.	4.44	0.864
Attend seminars/Workshops that use English in engineering	4.34	0.912

The desire to improve the reading ability of English technical literature is very high, with an average of 4.56 and a standard deviation of 0.731. This indicates a great need for more intensive reading training. In addition, the desire to improve the ability to understand technical instructions and translate technical texts also has high average scores, 4.52 and 4.51, respectively. This reflects the need for training that is relevant to the technical context.

Oral communication skills have a much lower average (2.86), which suggests that students do not consider them a top priority compared to reading and writing. Nonetheless, these abilities remain important in professional collaboration situations and can be incorporated as part of a gradual training program.

The standard deviation in the want's indicator is relatively low, indicating uniformity in student needs. These results guide focusing training on technical skills such as reading and writing, while still preparing students for broader communication skills in the future.

The results of the analysis showed that students preferred hands-on practice, with the highest average of 3.88 and a standard deviation of 0.91. This indicates that learning approaches involving physical activity or real simulations are very interesting and effective. Group discussions and the use of technology, such as e-learning, also scored quite high (3.61 and 3.74, respectively), indicating a preference for interactive and technology-based methods.

In contrast, learning through role-playing or simulation received the lowest average score (3.54), although the standard deviation remained consistent (0.91). This indicates that students are less interested in simulation methods or may be less familiar with this approach. Reading and writing also tend to be less in demand than other interactive methods, with an average score of 3.58. Based on these results, the learning program should focus on developing hands-on practice activities, while also improving simulation elements and text-based methods to increase student interest.

Hands-on practice is again the most effective activity according to students, with an average of 3.90 and a standard deviation of 0.93. In addition, listening and speaking learning are also considered quite effective (average 3.84). This signifies that students tend to prefer audio-lingual and hands-on experience-based activities to improve their skills.

In contrast, technology-based learning such as e-learning has a lower average score (3.41), with a fairly high standard deviation (1.04). This indicates that the effectiveness of e-learning needs to be improved through a more interactive and engaging approach. Independent learning with online resources is also considered less effective (3.32), highlighting the need for guidance or assistance during the independent learning process.

The recommendation from these results is to improve the quality of e-learning and to integrate more Listening and Speaking activities into the learning program. Table 9 learning activities.

Table 9. Learning activities.

Indicator	Mean	Std. Deviation
Convenient to use online learning apps	3.3	1.09
Often use the internet for industrial engineering learning	3.79	0.91
Comfortable using learning software	2.58	0.51
Technology helps learn English	4.09	0.93
Often use e-learning to learn	3.5	1.04
Online materials are more effective than printed materials.	3.29	1.05
Convenient to take online English courses	3.23	1.06
Frequent use of digital devices (Tablet computers)	3.68	0.93
Convenient use of social media to learn	3.91	0.93
Often use a translator app to understand text	4.1	0.88
ICT-based learning models are needed for industrial engineering ESP.	3.81	0.91

Students feel that technology is very helpful in learning English, with a highest average of 4.09 and a standard deviation of 0.93. The use of a translator app to understand the text is also considered very useful (average 4.10). In addition, social media for learning received a high average score (3.91), indicating that digital technology is an important part of supporting learning.

However, the convenience of using the learning software has the lowest average (2.58) with a standard deviation of 0.51. This indicates that there are obstacles in mastering more specific learning tools or applications. The effectiveness of online materials compared to print materials is also questionable, with an average of 3.29.

To improve students' ICT literacy, it is necessary to conduct training on the use of learning software and the introduction of digital tools that are broader and more focused. Table 10 ICT literacy.

Table 10. ICT literacy.

Indicator	Mean	Std. Deviation
Learn in class with a face-to-face teacher	4.1	0.984
Study in small groups	3.67	0.986
Study independently at home	3.38	1.1
Learn in a formal setting (Such as in a classroom)	3.72	0.938
Learning in the work environment (On-the-job training)	3.6	0.957
Study in a language lab	3.54	0.981
Study in a library or learning resource center.	3.64	0.921
Learning through online	3.28	1.036
Learn with direct tutoring	4.06	0.918
Learning through short-term intensive training	3.49	0.937
ESP learning model in the context of industrial engineering	3.98	0.894

Learning in a classroom with a face-to-face instructor is the most preferred method for students, with an average score of 4.10 and a standard deviation of 0.984. Direct tutoring also received high scores (4.06), indicating that direct interaction is highly valued by students. Learning in a formal setting (3.72) and in libraries or learning centers (3.64) are also quite preferred.

In contrast, learning through online courses has the lowest average (3.28) with a standard deviation of 1.036, indicating that this method is considered less attractive to college students. Self-study at home is also less popular (3.38 on average), signaling the need for intervention in creating a more engaging self-paced learning experience.

These results indicate the need to improve technology-based learning methods while still maintaining a face-to-face approach as the core of the learning program. Table 11, present preferred learning setting.

Table 11. Preferred learning setting.

Dimension	Strong indicators	Weak indicators	Average score (Strong)	Average score (Weak)
Necessities	Reading technical literature, understanding manuals, negotiating in English.	Writing emails, attending workshops (Moderate scores)	4.3	3.8
Lacks	Lower difficulty in translating texts and general communication.	Difficulty in understanding instructions/manuals, writing emails, discussions.	3.5	2.9
Wants	High desire to improve reading, writing, and attending workshops.	Lower priority for spoken communication	4.5	3.2
Learning styles/Preferences	Multimedia-based learning, hands-on practice, group discussions	Independent study, traditional text-based learning	4.0	3.4
Learning activities	Hands-on practice, group discussions	Learning via online resources and lectures.	4.1	3.3
ICT literacy	Technology usage for English learning (e.g., e-learning)	Familiarity with specific software and applications (e.g., technical tools)	4.2	3.1
Preferred learning settings	Face-to-face learning, direct tutor assistance, ESP model for industrial English.	Self-study, online courses	4.1	3.28

a. Necessities Dimension This dimension highlights the need for students to understand technical literature, manuals, and negotiations in English. With an average score of 4.3 for a strong indicator, it shows that students understand the importance of these abilities to support their professional or academic activities. However, the average score on the weak indicator, which is 3.8, indicates that the ability to write professional emails and attend workshops in English still needs improvement. The challenges in these weak indicators may be due to a lack of exposure or intensive training in more specific and formal writing skills.

b. Lack of Dimension This dimension includes the difficulties experienced by students in a variety of technical English activities. The average score on the weak indicator, which is 2.9, indicates that understanding technical instructions/manuals, writing emails, and discussing in English are areas of challenge. On the other hand, translating technical texts is rated easier with a score of 3.5 on a strong indicator. This indicates the need for increased training geared towards oral communication and a more complex technical understanding to meet the needs of students.

c. The Wants Dimension The desire to improve reading, writing, and attending technical English workshops is very high, with an average score of 4.5 on strong indicators. However, oral communication skills have a lower priority, with an average score of 3.2. This shows that students are more focused on academic or professional needs compared to day-to-day communication. Going forward, the curriculum can be designed to accommodate the needs of more in-depth technical reading and writing, while still paying attention to oral communication for collaboration purposes.

d. Learning Styles/Preferences Dimension Learning preferences show that multimedia, hands-on practice, and group discussions have an average score of 4.0 as strong indicators. However, self-paced learning and text-based methods tend to be less in demand, with an average score of 3.4. This indicates that an interactive and practical learning approach is more effective than traditional learning methods. Learning programs can be designed by utilizing multimedia and simulation technology to improve the student learning experience.

e. Learning Activities Dimension Learning activities such as hands-on practice and group discussions have an average score of 4.1 on strong indicators, indicating that practice-based approaches are more in demand. However, learning through online resources and lectures had a lower score, which was 3.3 on a weak indicator. This shows that although technology is used frequently, its effectiveness is still below direct interaction-based methods. Therefore, a blended learning approach that combines technology with hands-on practice can improve learning efficiency.

f. ICT Literacy Dimension This dimension shows that the use of technology for English language learning, such as e-learning, scores an average of 4.2 for a strong indicator. This indicates that students feel comfortable using technology to support their learning. However, the average score on the weak indicator, which is 3.1, indicates that familiarity with specific software and applications is still a challenge. More specific technology-based training programs can be designed to improve students' digital literacy.

g. Preferred Learning Settings Dimension Face-to-face learning settings such as face-to-face with teachers or tutors received high scores, 4.10 and 4.06, respectively. However, self-study at home (3.38) and online courses (3.28) are the settings with the lowest scores. These results emphasize the importance of direct interaction in the learning process, which can increase student motivation and understanding. Learning programs can be optimized by increasing face-to-face sessions, both physically and through interactive online sessions.

The resulting diagram will show a visualization of each dimension with the average score of strong and weak indicators, so that areas that need attention can be identified directly. This diagram will help in designing a learning program that is more aligned with the needs of students. Figure 1 illustrates the Indicator Weakness Diagram.

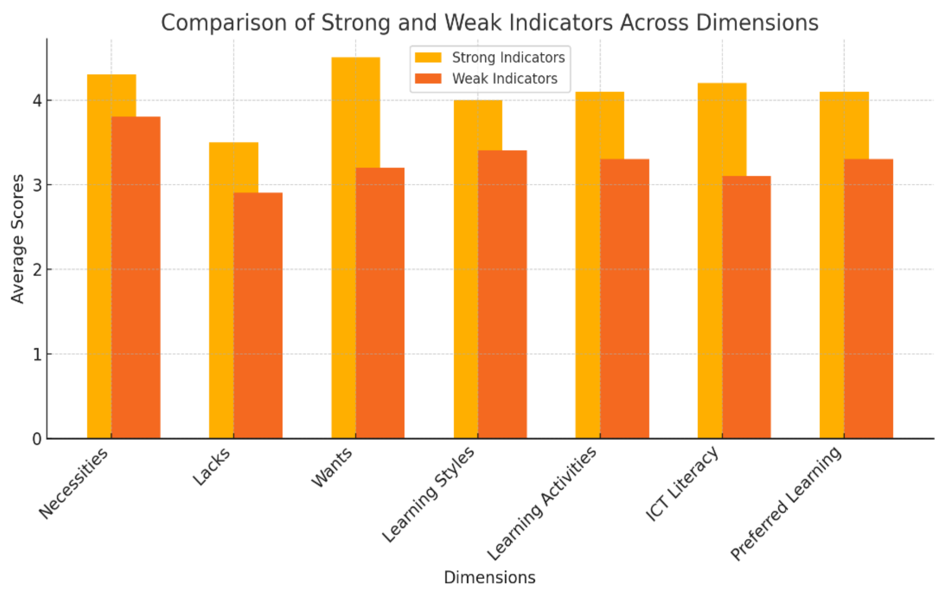

Figure 1. Indicator weakness diagram.

The diagram compares the average scores of strong and weak indicators for each dimension related to English learning in the industrial engineering study program. The dimension with the highest strong score is Wants, which indicates the desire of students to improve their reading and writing skills and attend technical workshops in English. On the other hand, the Lacks dimension has the lowest weak indicator score, indicating that students are having difficulty understanding technical manuals, writing professional emails, and discussing technical contexts. The ICT Literacy dimension shows a striking difference between strong and weak indicators, highlighting the importance of improving technological literacy, especially in using specialized software and applications.

The weaknesses that can be seen, especially in the Lacks and ICT Literacy dimensions, suggest that the current learning program does not fully meet the needs of students in understanding technical manuals in depth and utilizing technology effectively. The Preferred Learning dimension also indicates that self-paced learning and online courses are less in demand, confirming the need for more interactive and technology-based interventions.

4.2. Discussions

4.2.1. Characteristics of Learning Needs

Learning needs analysis reveals very specific and practical learning preferences. Students show a strong preference for hands-on practice (mean 3.88, SD: 0.91), which aligns with the characteristics of the industrial engineering discipline that emphasizes practical application and problem-solving. Preference for multimedia and learning technology (mean 3.74, SD: 0.93) indicates the readiness of the digital generation to adopt a technology-enhanced learning approach, although it is noted that the convenience of using learning software remains low (mean 2.58, SD: 0.51).

Paradoxically, students highly value face-to-face learning (mean 4.10, SD: 0.984) but assign lower scores to online learning (mean 3.28, SD: 1.036). This suggests the need for a blended learning approach that combines the advantages of both modalities. Additionally, learning with the assistance of a direct tutor received high appreciation (mean 4.06, SD: 0.918), emphasizing the importance of personal interaction in the ESP learning process.

The ICT literacy analysis revealed a significant gap between the perception of the benefits of technology (mean 4.09, SD: 0.93) and the convenience of using specific learning applications (mean 2.58, SD: 0.51). This gap indicates the need for a more comprehensive technology scaffolding in the implementation of technology-based ESP learning. The high use of translator applications (mean 4.10, SD: 0.88) indicates a dependency that needs to be directed towards more autonomous and sustainable learning strategies.

4.2.2. Implications for ESP Curriculum Development

The findings of this study reveal a systematic gap between the conventional ESP curriculum and the authentic needs of industrial engineering students. The dominance of the general English approach in the current curriculum has proven ineffective in preparing students for specific professional communication demands. The high priority given by students to the ability to read technical literature and understand industry documentation requires a reformulation of the curriculum based on genre analysis and authentic materials.

The gap between necessities and lacks in critical areas such as technical reading and technical writing indicates the need for a more intensive and target-specific approach to learning. The ESP curriculum needs to be designed with a systematic progression from general technical vocabulary to domain-specific terminology, from basic comprehension to critical analysis, and from guided writing to autonomous technical documentation. The integration of project-based learning that simulates real work situations is imperative to bridge the gap between academic learning and professional application.

High hands-on learning preferences demand an ESP curriculum that integrates experiential learning with authentic tasks. Industrial communication simulations, case study analysis, and collaborative projects with industry partners can be effective strategies to increase learning engagement and relevance. The development of assessment rubrics that reflect industry communication standards is also an urgent need to ensure alignment between learning outcomes and professional requirements.

5. CONCLUSION

Based on the result and discussion above, the author believes that this study successfully identified a comprehensive and multidimensional profile of industrial engineering students' ESP needs, with the main finding being a high priority on the ability to read technical literature and international professional communication. Analysis of 120 students from three universities revealed remarkable consistency in the perception of needs, which indicates the high external validity of the findings. The necessities dimension shows students' high awareness of the demands of global communication in modern industries, while the lacks dimension reveals significant gaps in technical reading and writing competencies that require serious curriculum intervention.

The systematic gap between the conventional ESP curriculum and the authentic needs of students is a critical finding that demands a fundamental reformulation of the ESP approach in engineering higher education. The predominance of the prevailing general English approach has proven to be ineffective in preparing students to face the complexity of industrial engineering professional communication. The gap between high needs and low current competence in critical areas such as understanding technical documentation and writing professional reports indicates the urgency of curriculum development based on rigorous and evidence-based needs analysis.

The characteristics of students' learning needs that show a strong preference for practical and interactive learning provide valuable insights for the design of effective pedagogical approaches. Student readiness for learning technology, even though accompanied by gaps in application-specific literacy, opens up opportunities for the implementation of blended learning that optimizes the advantages of technology by maintaining the value of personal interaction that is highly valued by students. These findings provide an empirical foundation for the development of culturally appropriate and contextually relevant learning strategies.

The theoretical implications of this research lie in the validation and contextualization of the Hutchinson and Waters (1987) in the Indonesian industrial engineering setting, which demonstrates the robustness and adaptability of the framework across cultural and disciplinary contexts. Empirical contributions in the form of detailed and evidence-based needs profiles enrich the ESP body of knowledge with context-specific data that has been underexplored. The findings regarding the paradox between awareness and competence in technical communication provide new insights into the complexity of needs analysis, which involves not only the identification of needs but also the understanding gap between perception and reality.

Finally, practical recommendations emerging from this study include the development of a modular and adaptive ESP curriculum, emphasising authentic materials and task-based learning that simulate real professional communication situations. Integrating systematic technology training to improve students' ICT literacy is a prerequisite for implementing technology-enhanced ESP learning. Cooperation with industry practitioners in curriculum development and assessment design is also a strategic need to ensure the curriculum's relevance and currency with the industry's demands that continue to grow. Further research is needed to explore the effectiveness of the implementation of the curriculum developed based on the findings of this needs analysis, as well as longitudinal investigations on the impact of the improved ESP curriculum on the work readiness and professional performance of industrial engineering graduates.

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