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Exploring Translation Challenges in English-to-Indonesian Physics Terminology: An ESP Context

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ABSTRACT

This study aims to identify and analyse the difficulties encountered by physics education students in translating physics terminology from English to Indonesian. Using a mixed-methods approach, data were collected through questionnaires and interviews involving 147 students from various universities in Indonesia. The obtained results show that the difficulty of scientific translation is expressed mainly in terminology with the least difficulty in the general understandability of sentences written in a scientific text – with the results below terminology (mean 4.17), grammatical structure (mean 4.15), understanding scientific concepts (mean 4.15), and the lack of experience and exposure to English-language physics sources (mean 4.15), with the overall level of difficulty categorized as very high (mean 4.22). One of the most significant indicators influencing scientific translation's difficulty level is insufficient mastery of conceptual issues and poor study of the practice of transience. From the above, it can be recommended that when preparing a future translation, it is necessary to provide training in situational translation in the scientific field and provide him with greater access to foreign-language scientific literature in the field to streamline scientific translation's end in the student's physics education. Future studies can test the effectiveness of context-based scientific translation training and examine other factors (e.g., English proficiency and translation strategies) in a broader population.

Keywords: *Translation problems, physics terms, English to Indonesian, students' difficulties, language barriers.*

INTRODUCTION

Difficulties in translating English physics terms into Indonesian continue to pose serious challenges to students' understanding of scientific concepts. Language remains a major barrier in science learning, as the language of instruction plays a fundamental role in shaping how students construct meaning and comprehend scientific ideas (Ouchaib, 2021). Physics concepts are often expressed using unfamiliar vocabulary and complex sentence structures in English, which can obscure meaning and hinder comprehension. Limited proficiency in scientific language has been shown to cause students to misinterpret concepts or form inappropriate connections between ideas (Hamnell-Pamment, 2024). In addition, the use of discipline-specific metaphors and specialized modes of expression in physics may further complicate students' understanding when ideas are translated or explained in another language (Bøe et al.,

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2023). These conditions highlight the importance of scientific literacy that is closely integrated with mastery of scientific language.

Accordingly, translation skills have become increasingly important for enabling students to engage more effectively with English-language physics materials. Contextual and bilingual translation training has been shown to strengthen students' understanding by helping them connect English terminology with the physical principles it represents (McEwin et al., 2025; Mulyaningsih, 2024). Similarly, translation activities conducted within familiar learning contexts support students in interpreting abstract scientific concepts more effectively (Qomar & Yuliani, 2021; Lumbantoruan, 2024). In this sense, translation is not merely a process of word-for-word substitution, but a meaning-oriented activity that supports conceptual understanding rather than rote memorization.

Translation difficulties also affect students' academic writing accuracy. Vocabulary limitations and weak grammatical competence are frequently identified as major sources of mistranslation (Agustina, 2019). Literal translation and the misuse of so-called "false friends" further threaten the clarity and coherence of scientific texts (Fitriati & Rukmini, 2021). Such problems disrupt not only linguistic form but also conceptual accuracy, indicating that linguistic competence and conceptual mastery must develop simultaneously.

From a theoretical standpoint, these issues can be examined through the lens of Translation Studies. Translation Studies is understood as an interdisciplinary field that draws on linguistics, psychology, communication, and related disciplines to analysed how meaning is transferred across languages and cultures (Akbulut, 2022). Translation itself is grounded in cross-cultural communication and involves linguistic, cultural, situational, and cognitive dimensions (House, 2016). Within this framework, equivalence plays a central role. Equivalence refers to maintaining the intended meaning and communicative value between source and target texts, although achieving such equivalence is often challenging due to linguistic and cultural differences (Ciocoi-Pop & Al-Bayati, 2023; Verkhovtsova, 2023). Translation is therefore not concerned with producing identical reproductions of texts, but with conveying intention in a way that is appropriate to the target context (Panou, 2013).

To address these challenges, translators commonly employ strategies such as localization, adaptation, cultural equivalents, annotations, and the use of cultural informants. These strategies can enhance clarity and relevance while preserving the conceptual accuracy of scientific terms (Le, 2024; Uzakova, 2024). Nevertheless, translation problems may still arise when scientific texts involve lexical ambiguity, structural differences, or complex syntactic patterns (Suhono et al., 2020).

Physics terminology presents additional challenges in translation. The language of physics is characterized by precision, context-independence, and dense meaning, whereas everyday language is more flexible and context-dependent (Harlow & Otero, 2006). As a result, students must reinterpret common words such as *force* and *energy*, whose scientific meanings differ substantially from their everyday usage. Precision in the relationships among physics terms is therefore essential to prevent misconceptions (Khudaybergenova & Pimenova, 2025).

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In the Indonesian context, inconsistencies in term translation have been shown to contribute to persistent misconceptions in physics learning (Kilichova, 2023; Nurulwati & Rahmadani, 2014).

Previous studies indicate that translation errors stem from both linguistic limitations and conceptual misunderstandings. Constraints in vocabulary and grammar have been widely reported as contributing factors (Ramadhani & Sari, 2021). At the same time, conceptual misunderstandings can lead students to mistranslate physics terms when they rely on literal translation without grasping the underlying physical principles (Zeidan et al., 2023). While many studies have examined general translation issues, relatively few have focused specifically on physics terminology (Sari & Yuliasri, 2017). Although bilingual materials and contextual translation practices have been proposed as potential solutions (McEwin et al., 2025; Mulyaningsih, 2024; Lumbantoruan, 2024), the interaction between linguistic competence and conceptual understanding in physics translation remains insufficiently explored.

This gap is particularly relevant in the Indonesian educational context, where the implementation of English for Specific Purposes (ESP) and English for Science and Technology (EST) continues to face challenges (Manurung et al., 2023; Prayogo, 2016). Students frequently rely on digital translation tools to cope with English-language physics texts; however, such tools often introduce inaccuracies in terminology choice and contextual meaning despite their efficiency (Farahsani et al., 2021; Al-Shloul, 2023). Given the breadth and technical complexity of physics literature, accurate translation of physics terminology from English into Indonesian is crucial for supporting students' conceptual understanding and meaningful learning.

METHODOLOGY

Research Design

This study employed a mixed-method research design by integrating descriptive quantitative and qualitative approaches. The mixed-method design was selected to obtain a comprehensive understanding of students' difficulties in translating physics terms from English into Indonesian. Quantitative data were used to identify general patterns and tendencies in students' translation difficulties, while qualitative data were utilized to explore students' experiences and reasoning processes in greater depth. The integration of numerical and narrative data enabled a more holistic interpretation of the phenomenon under investigation, as suggested in mixed-method research frameworks (Creswell, 2014; Sugiyono, 2017).

Participants

The participants of this study consisted of 150 undergraduate students enrolled in physics education programs at several universities in Indonesia. The participants were selected using purposive sampling. The main criterion for participant selection was that the students had completed courses that required the use of English-language physics learning materials. This

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criterion was applied to ensure that the participants had direct experience with English physics terminology and translation activities. Therefore, the selected participants were considered appropriate for representing physics education students who encounter translation challenges in academic contexts.

Instruments

Data were collected using two main instruments: a questionnaire and semi-structured interviews. The questionnaire consisted of 50 items designed to measure students' difficulties in translating physics terms. The items covered three main aspects: (1) linguistic difficulties, including vocabulary, grammar, and false friends; (2) conceptual difficulties related to understanding physics terms within a scientific context; and (3) translation strategies, such as the use of contextual clues, reference sources, and learning habits. Each item was rated on a five-point Likert scale ranging from 1 (Never) to 5 (Always).

Prior to data collection, the questionnaire underwent validity and reliability testing. Item validity was examined using the Pearson Product–Moment correlation. The results showed that 38 items had correlation coefficients higher than the critical value ($r = 0.162$) at the 5% significance level, indicating that the items were valid. Reliability analysis using Cronbach's Alpha yielded a coefficient of $\alpha = 0.953$, which indicates very high internal consistency. These results suggest that the questionnaire was reliable and suitable for measuring students' translation difficulties.

To complement the questionnaire data, semi-structured interviews were conducted with several selected participants. The interview questions focused on students' experiences in translating physics terms, the strategies they used, and the linguistic and conceptual factors influencing their translation processes.

Data Collection

Data collection was conducted directly by the researcher through questionnaire distribution and interviews. The questionnaire was administered both online and offline to 150 physics education students who participated voluntarily. Before data collection, the researcher explained the purpose of the study and obtained informed consent from all participants.

The interviews were conducted either face-to-face or online via Microsoft Teams, depending on participants' availability. Each interview session lasted approximately 20 minutes and was audio-recorded with the participants' permission. The recordings were then transcribed to ensure accurate data documentation. Ethical principles, including confidentiality, voluntariness, and honesty, were strictly observed throughout the data collection process. The collected data were reviewed to ensure completeness and to avoid duplication before proceeding to the analysis stage.

Data Analysis

The data analysis followed a mixed-method approach by integrating quantitative and qualitative techniques. Quantitative data obtained from the questionnaire were analysed using

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descriptive statistics, including frequencies, percentages, and mean scores, to identify the most common translation difficulties experienced by students. Prior to analysis, the data were checked for accuracy and completeness. The results of the validity and reliability tests confirmed that the questionnaire data were suitable for further analysis.

Qualitative data from the interviews were analysed using thematic analysis. The interview transcripts were carefully read and coded to identify recurring themes related to linguistic difficulties, conceptual misunderstandings, and translation strategies. These themes were then compared and integrated with the quantitative findings to provide a deeper explanation of the observed patterns.

By combining quantitative results with qualitative insights, this study was able to present a comprehensive and reliable account of students' difficulties in translating physics terminology from English into Indonesian.

RESULT AND DISCUSSION

1. Quantitative Results: Questionnaire Data

Quantitative analysis through descriptive statistics was conducted on the responses of 147 students. The questionnaire consisted of 50 items measured on a five-point Likert scale ranging from 1 (Never) to 5 (Always). Prior to analysis, all data were coded and screened for completeness and consistency. Of the 50 items, 39 were analysed as core measurement items, while the remaining 11 functioned as explanatory statements and were therefore excluded from further analysis.

Descriptive statistics provided a detailed picture of how students responded to each indicator and clearly demonstrated consistent patterns in their reported difficulties. The results show that students generally experienced substantial challenges when translating physics terminology, with mean scores across all aspects falling within the high to very high categories. These findings indicate that students' difficulties are not concentrated in just one area, but are instead distributed across multiple dimensions: linguistic (terminology and grammar), conceptual understanding, and experience or exposure to physics texts in English. This pattern suggests that translation problems arise from a combination of limited vocabulary mastery, challenges in handling scientific sentence structures, insufficient conceptual grounding in physics, and a lack of regular engagement with English-language scientific materials

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Tabel 1. Descriptive Statistics of Students' Problems in Translating Physics Terms (n = 147)

No.	Aspects	Mean	SD Sample	Category	İnterpretation
1.	Terminology	4.17	0.85	High	Students experience difficulties in making a correct translation of scientific terms.
2.	Grammatical Structure	4.15	0.89	High	Students find it hard to handle sentence structure and grammar while translating physics texts.
3.	Concept	4.15	0.90	High	Students experience difficulty in comprehending contextual meaning within scientific texts.
4.	Experience & Exposure	4.15	0.90	High	Students do not have enough exposure and experience in translating physics-related English texts.
5.	Cultural & Educational Factors	4.22	0.83	Very High	Indicates that, on average, students' translation difficulties are very
Overall Mean		4.17	0.87	High	Overall translation difficulties are consistently high across aspects.

The overall mean score of 4.17 indicates that students' translation difficulties fall into the high category. Among the measured aspects, the "Cultural and Educational Factors" dimension shows the highest mean score (M = 4.22, SD = 0.83), placing it in the very high category. This suggests that students' translation challenges are strongly influenced by their learning environment, educational background, and broader cultural exposure to English-language scientific materials. Meanwhile, the terminology (M = 4.17), grammatical structure (M = 4.15), concept (M = 4.15), and experience and exposure (M = 4.15) aspects all fall within the high category, indicating consistent difficulties across linguistic, conceptual, and experiential dimensions. These patterns show that students' translation problems are not limited to a single domain but are shaped by a combination of limited vocabulary mastery, challenges in understanding sentence structure, difficulty interpreting scientific concepts, and insufficient exposure to English-language physics texts. The theory in this research supports the of Farahsani (2021) and Sari (2017) that good instrument quality through semantic consistency and clear terminology ensures that subsequent descriptive and inferential analyses are grounded in valid and trustworthy data.

2. Qualitative Results: Interview Data

This subsection presents the qualitative findings obtained through a semi-structured interview with one student participant. The interview was conducted to complement the quantitative

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results and provide deeper insight into the challenges experienced when translating physics terminology from English to Indonesian. The analysis focuses on recurring themes related to linguistic, conceptual, and experiential aspects of translation.

2.1 Linguistic Difficulties

The participant reported experiencing linguistic difficulties, particularly when encountering physics terms that require deeper conceptual interpretation. She highlighted momentum-related terms as an example, noting that such terminology is challenging to translate accurately due to its scientific complexity. She stated, "Istilah tentang momentum, agak susah untuk diterjemahkan ke Bahasa Indonesia."

2.2 Conceptual Understanding

The student emphasized the importance of understanding the underlying physics concepts before attempting to translate them. Conceptual clarity helps ensure that the translation conveys the correct meaning. She explained, "Cukup membantu… kita jadi tahu sebenarnya apa istilahnya."

2.3 Use of Translation Tools

To support her translation process, the participant relied primarily on Google Translate and textbooks provided by lecturers. However, she expressed that literal translations often resulted in awkward or unclear meanings. According to her, "Kadang kalau diterjemahkan… jadi aneh… makin bingung artinya apa."

2.4 Sentence Structure and Grammatical Adjustment

The participant reported difficulties in translating complex scientific sentences, especially when the structure did not directly align with Indonesian grammar. To resolve this, she often restructured sentences to improve clarity. She stated, "Kalimatnya kurang pas… biasanya saya ubah supaya lebih bisa dimengerti."

2.5 Exposure and Confidence

The interview revealed that limited exposure to English-language physics materials reduces students' confidence. The participant noted that she feels comfortable translating for her own use but is less confident when explaining translations to others due to fear of misinterpretation.

Overall, the interview findings support the quantitative results by demonstrating that students' translation difficulties arise from interconnected linguistic, conceptual, and experiential factors. These qualitative insights provide contextual depth to the statistical trends identified in the questionnaire.

3. Integrated Discussion of Findings

The results show that physics education students experience consistently high to very high levels of difficulty when translating physics terminology from English to Indonesian.

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Among the five measured aspects, Cultural and Educational Factors emerges as the most problematic aspect (M = 4.22), indicating that students' translation performance is strongly influenced by their learning environment, availability of resources, and exposure to scientific English.

The other four aspects Terminology (M = 4.17), Grammatical Structure (M = 4.15), Conceptual Understanding (M = 4.15), and Experience & Exposure (M = 4.15) show equally high levels of difficulty, with no lowest category identified. This uniformity demonstrates that translation problems are multidimensional rather than concentrated in a single linguistic skill.

The interview data support this pattern by illustrating concrete obstacles behind the statistical trends. The participant's reported difficulty with momentum-related terminology aligns with the high mean score in the Terminology aspect. Her dependence on Google Translate and the perception that literal translations become "awkward" reflect linguistic limitations and inadequate support for domain specific translation. In addition, her need to restructure sentences mirrors the difficulties reported under Grammatical Structure, while her emphasis on concept understanding corresponds with the high difficulty score in Conceptual Understanding.

Overall, the findings strongly indicate that physics students' translation difficulties are driven by a combination of contextual educational constraints, limited linguistic mastery, inadequate conceptual grounding, and insufficient engagement with English-language scientific texts. Because all aspects score similarly high, translation challenges are systemic and pervasive rather than isolated.

CONCLUSION

In view of the results of this study, it can be concluded that the research objectives have been successfully achieved. The findings reveal that physics education students experience consistently high levels of difficulty in translating physics terms from English into Indonesian, particularly in the linguistic, conceptual, and experiential dimensions. These challenges indicate that students still struggle to interpret scientific meanings accurately and to convey them appropriately within the Indonesian context. Therefore, future instructional efforts should prioritize the reinforcement of linguistic and conceptual understanding, accompanied by increased exposure to authentic English-language physics materials. In addition, further research is recommended to explore more effective translation-based learning strategies and to examine how language proficiency interacts with students' conceptual comprehension in physics.

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