



Translating IT Terminology in Educational Textbooks

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Abstract*

Technological term is a crucial aspect in the advancement of science and technology. Translating these terms from English into Indonesian requires a deep understanding of their linguistic forms, particularly the noun classes that dominate the field. Nouns in technological terminology range from technical and abstract terms to culturally bound concepts, each of which presents unique translation challenges. This study examines the procedures used to translate nouns in English technological terms into Indonesian, focusing on accuracy and readability to the preferences of the target readers. By categorizing terms into singular nouns, proper nouns, and common nouns, and analyzing the translation procedures through the Single Approach (SA) and Pair Approach (PA), this study highlights the dominance of certain procedures. The research findings indicate that the PA with its combined procedures that integrate semantic and communicative translation is effective in maintaining terminological integrity while ensuring cultural and contextual relevance. This study emphasizes the urgency of having systematic translation guidelines to improve the consistency and quality of technical term in Indonesia.

1. Introduction

Technological terminology is an integral part of the rapid development of science and technology. As a global communication medium, this terminology is dominated by English, making accurate translation from the Source Language (SL) to the Target Language (TL) crucial for bridging linguistic and cultural gaps. Nouns, which make up a significant portion of technological terminology, often carry complex meanings that require nuanced translation strategies, ranging from technical terms with precise definitions, abstract concepts without direct equivalents, to culture-specific terminology that demands sensitivity to contextual implications.

Research in the field of translation has addressed general challenges in technical translation, but often overlooks the specific complexities of noun translation. As an illustration, a study by Akpaca (2024) revealed that students who struggled to understand terms like "algorithm" and "data structure" faced significant obstacles in operating the software, ultimately

hindering creativity. Similarly, Xiaoyan et al. (2024) highlighted how inconsistent translations of terms like "machine learning" and "neural networks" hampered students' innovation abilities. Widiastutik et al. (2021) also emphasize the importance of explicit strategies such as glossaries and explanatory notes when translating technical nouns to ensure information effectiveness. Saptiawan (2016) documented that ambiguous definition of computer abbreviations like "esc," "del," and "tab" hindered users' operational efficiency, while Umiyati & Yadnya (2017) and Mihaljov (2011) emphasized that poor translation quality undermines institutional credibility and professional preparedness in the IT sector.

This current phenomenon underscores the urgent need for accurate translation in academic texts used by Indonesian students. Terms like "artificial intelligence" and "data analysis" are often translated inconsistently, causing confusion and undermining students' confidence in educational resources. This necessitates standardized, precise, and culturally relevant translation practices.

Despite this urgency, previous studies (Maulidiyah, 2018; Nyangeri & Wangari, 2019) focused more on general procedures without delving into the procedural nuances required specifically for nouns. Tursunovich (2022) examines cultural adaptation but overlooks the technical complexities of noun forms. A real challenge is seen in the dilemma of translating "machine learning" into "pembelajaran mesin" or "mesin-based data processing" in maintaining semantic accuracy and reader accessibility. Aryani & Widiastutik (2024) show that adaptation and explanation strategies, such as translating "web-slinger" into "penembak web," significantly contribute to the understanding of technical nouns in bilingual contexts.

This study fills a crucial gap by exploring the translation procedures for technological nouns from the SL to the TL. By analyzing this process, this research contributes to improve the quality of academic texts for non-native speakers, ensuring access to essential concepts without linguistic barriers, and supporting the standardization of global-quality educational materials.

The significance of this study lies in its focused approach on translation a form of noun, an area still rarely explored in technical communication. Through an examination of the SA (Single Approach) and PA (Pair Approach) strategies, this research aims to formulate guidelines that improve the quality of Indonesian technical terms. The title "Translating IT Terminology in Educational Textbooks" reflects the study's intention to provide significant academic and practical insights. The research problem is focused on identifying the lingual form of noun categorization in source text and its translation into target text, analyzing the procedures for translating technological nouns. It aims to explore how specific noun, common in the field of technology, are translated from English to Indonesian. Furthermore, the concept of translating technical terminology will be explored in depth, focusing on the dominant linguistic form: nouns. This framework is intended to improve translation practices in the technology field.

2. Research Methods

In order to conduct a qualitative research study for the project titled "Translating IT Terminology in Educational Textbooks" using (Creswell & Creswell, 2017) approach, the methodology framed within his qualitative research design.

Creswell's qualitative research design is used in this study, by employed a case study approach, focusing on specific textbook of translated texts in the field of technology. Based on the purpose of this research in examined the category of noun form in the technological term, translation approaches are applied in translated noun of technology term, and strategies employed in translating technical terms and assess how these translations align with Creswell's qualitative methodology for understanding language use and terminology in educational contexts. Case study allows for an in-depth exploration of specific instances of translation, providing detailed

insights into the noun translation process. The qualitative method in this study used with the following steps.

Data collection method: the data collection aligned with the research questions, and qualitative methods involve multiple techniques to gather diverse and in-depth information. First, based on the literature are documented through identify, categorize nouns, and analyze the procedures applied in translating technological terms found from English educational textbook as the source data, aimed to ensure the consistent and appropriate use of terminology within its context, and defined the definition through <https://www.cambridge.dictionary.id> and their Indonesian translations through www.kbb.web.id. Second, the observation focused on analyzing technological education textbooks in both the Source Text (ST) and Target Text (TT) to study the challenges in translating technology technical terms and assess audience reception and preferences (from local educators) to gather qualitative feedback. This approach aligns with Cresswell (2018, p. 15) guidance on maintaining respect for research sites during prolonged observation, ensuring minimal disruption to the studied environment. Third, data grouping by identification or grouping data based on lingual forms (nouns).

Data analysis method: this research outlined an inductive approach to qualitative analysis, involving coding and theme development. First, labelling process as initial coding was done by categorize nouns based on linguistic and functional features (e.g., proper nouns, common nouns, abstract nouns, compound nouns); identify translation procedures (e.g., SA or PA) for each noun, used based on the theories of Newmark (1988) and (Vermes, 2007). Then, analyzed patterns in the dominant translation procedures and their frequency used in corpora. Second, thematic analysis is done by grouped similar translation strategies into broader themes (e.g., fidelity, adaptation), and develop themes addressing each research question, include of: noun categorized the types and characteristics of technological nouns; translation procedures approaches (like SA or PA) are applied to noun translations; dominant procedure analyzed as the most frequently used procedure and its effectiveness.

Data interpretation method: this method emphasized clear presentation of findings, often using visual aids.

- a. Tabular presentation: the following table showed categories of nouns, their translations, and applied procedures:

Tabel 1.

Table of noun categories, translation approach & application

Noun Category	Source Term	Translated Term	Procedure Applied	Approach	Explanation
Proper noun	Google	<i>Google</i>	Borrowing	SA	maintaining the original form of identity/brand
Compound noun	Cloud Storage	<i>Penyimpanan awan</i>	Literal translation	PA	Combining literal strategies with adaptation of terms
Abstract noun	Data integrity	<i>Integritas Data</i>	Equivalence	SA	concept of equivalence; translating with similar technical meaning without additional procedures

This table provided insight into the translation strategies used according to the type of noun in technological terminology.

- b. Graph and chart used to visualize the frequency of translation procedures across categories. Narrative description to provide a detailed explanation of trends and findings to complement the visual data.

Data validation: the triangulation method is conducted by online translation corpora for technological terms (e.g., COCA (M. Davies, 2024), www.english-corpora.id) with the processes are: selecting a corpus of texts containing technological nouns, ensuring diversity in term types (e.g., proper nouns, common nouns, compound nouns). Extract examples and organize them into categories.

3. Result and Discussion

This section presents research findings and an in-depth analysis of the translation procedures for nouns in technological terminology from the SL (English) to the TL (Indonesian). Data obtained through text analysis and observation are classified based on noun categories to dissect how the single procedure approach (SA) and the pair or combinative procedure approach (PA) are applied. This is followed by mapping nouns based on their frequency and rank of occurrence in the corpus. Then, the effectiveness of the procedures used in bridging semantic and contextual gaps is evaluated. The selection of the right translation procedure either high-fidelity through SA or adaptive through PA is crucial for the quality, accuracy, and acceptability of technological terms in academic texts in Indonesia.

3.1 Result

The observation results based on the term classification in this data analysis of this study used a questionnaire distributed to 30 local educators to evaluate the effectiveness of the technology term translation procedure, especially showed insights into their identity (program, semester, and foreign language experience), perceptions of translation ease, clarity, and relevance, and preferences for translation procedures. Respondents were asked to provide an assessment of the application of the SA and PA in translating technical, conceptual, general, and proper noun terms. This assessment includes aspects of clarity, cultural appropriateness, and ease of understanding of the terms by local readers. These findings were calculated based on questionnaires distributed with a Likert scale that was grouped based on a score of 1-5, where: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree, such as the answers from local reader respondents (educators) which have been grouped in the following table.

Table 2.
Table Respondents Assessment

Term Category	Translation Procedure	Average Likert Score	Evaluation Results
Technical Term	SA	4.5	Preferred because it is simple and internationally accepted.
Technical Term	PA	3.8	Helps to understand new terms, but sometimes considered too complex
Conceptual Term	PA	4.2	Effective in explaining complex concepts, especially for new terms.
General Term	SA	4.8	Very suitable because the term is widely known
Proper Name	SA	4.9	Maintains global recognition of the term

The following bar chart illustrated the average score of respondents' assessment of each category of terms and translation strategies.

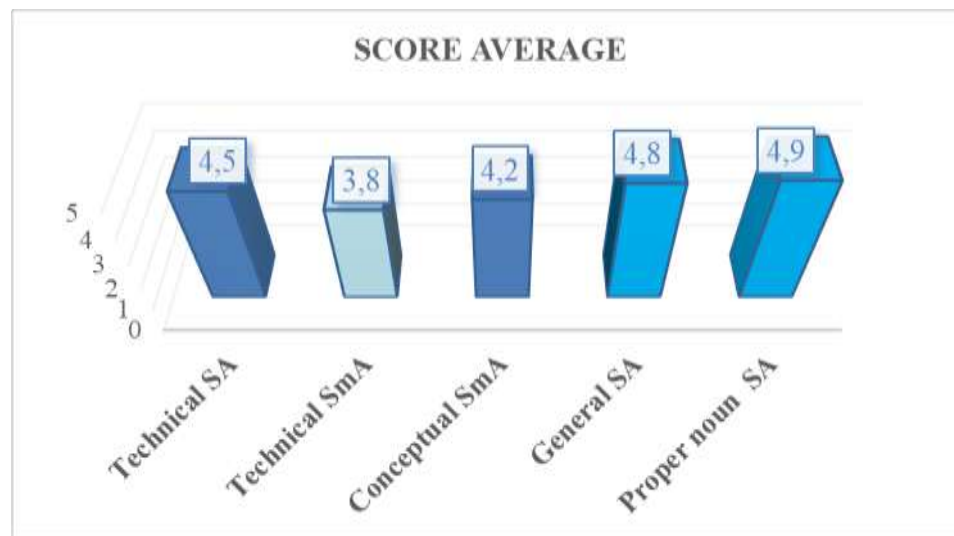


Figure 1. The chart of average score of respondents' assessment

The results of the questionnaire analysis showed that the SA translation procedure was preferred for technical, general, and proper terms due to its simplicity and wide acceptance. This procedure received an average score of 4.5 for technical terms, 4.8 for general terms, and 4.9 for proper names, indicating a very high level of satisfaction among local educators. Meanwhile, for conceptual terms, the PA (or SmA refers to simultaneous approaches) was considered more effective because it was able to explain complex meanings in more depth. This procedure received an average score of 4.2, indicating that respondents appreciated the effort to provide additional context, although this method was considered more complicated. In contrast, for technical terms using the PA, the average score only reached 3.8, indicating that respondents felt this method was less effective for technical terms that were already well-known.

Validation data in this study used a triangulation method with online translation corpora to validate the data and analysis results. This approach involves the use of relevant online corpora, such as COCA (Corpus of Contemporary American English), to ensure the accuracy and consistency of the translation of technology terms as done through the following processes.

- 1) text corpus is selected a text corpus that contained specific technology terms, both in English and their translations in Indonesian; then ensured diversity in the types of technology terms analyzed, including: proper nouns (proper names): javascript, bluetooth; common nouns (general nouns): algorithm, data; compound nouns (compound nouns): cloud computing, machine learning.
- 2) technology term extraction is done by searching for terms in the corpus by found examples of their use in the source context (SL); then searching for their translations in the target language corpus (TL); organized the extracted data into predetermined categories, such as proper nouns, common nouns, abstract nouns, and compound nouns.
- 3) data organization and analysis are grouped the terms found in the corpus according to the translation procedures used: SA→identified terms that are translated directly without significant changes. PA→ identified terms that are translated with a pair or simultaneous of procedures, such as phonetic adjustments with additional explanations. The pattern analyzed and suitability of term translation with the linguistic and cultural context in the corpus.

- 4) validation of findings was compared corpus data with the results of document analysis to confirm the consistency of the translation procedures; ensured that the translation procedure used is relevant to the type of technology terms analyzed.

Based on process above, corpus application explained the frequency of occurrence of technology terms in noun categories (such as proper nouns, abstract nouns, and general nouns in academic or science and technology texts), the corpus app tracking of certain technology terms based on frequency of occurrence (Occ.), rank (R), and frequency class (FC). This finding provided empirical data on the use of terms in various linguistic contexts, included of:

- 1) noun categories examined, including term selected of relevant technology terms, such as *innovation*, *systems*, *server*, and *windows*, are identified based on noun categorization, such as: **proper nouns** (: specific names that refer to certain technological entities, for example: server, windows, javascript, bluetooth. **Abstract nouns** (: abstract terms that include technological concepts, for example innovation, artificial intelligence. **General nouns** (: general nouns that are often used in technological discussions, for example systems, computer, data.
- 2) the corpus data included number of occurrences (showed how many times the term appears in the corpus); rank (showed the position of the term in the entire corpus based on frequency); frequency class explained the level of occurrence of the term in the frequency distribution (lower class = more frequent).
- 3) frequency of occurrence is calculated based on document analysis and online corpus (COCA). The data showed the average occurrence of terms in 1,000 words, included: proper nouns: 15%, abstract nouns: 40%, general nouns: 45% of the total technological nouns found. Data sources are derived from educational academic texts or science and technology articles, with a focus on technology textbooks used by local educators.

These results validated term frequency data is compared with data from other corpora to ensure consistency and accuracy. The term occurrence referred to frequency classes, as the classifying terms based on how often they occur in a corpus. Each number represents a particular frequency category or range, which usually reflects how often the term is used relative to other terms in the corpus. These findings are used to strengthen the interpretation of technology term translation procedures, such as SA or PA approach, as shown in the following table.

Table 3.
Table of findings on term tracking data.

Word	Occurrences	Rank	Frequency Class	Category of Noun
Innovation	36	316,871	19	Abstract
Systems	47	264,453	18	General
Server	14	600,747	20	Proper
e.battery	7	973,975	21	Proper
Bluetooth	1	5,557,368	24	Proper
Smartphone	17,868	2,730	10	General
Computer	9,499	4,877	11	General
Windows	14,244	3,389	10	Proper
Google	113	145,757	17	Proper

The frequency classes illustrated in the table above provide an indication of the level of popularity or Occ of a term in the corpus based on the number of Occ or R. The lower number in the FC, the more frequently the term occurs. Conversely, the higher number, the less frequently the term occurs. In FC 19 (such as for the word innovation) indicates that the term occurs more frequently than terms in frequency class 20 or higher, but less frequently than terms in class 18.

FC 20 (such as for server) means that this term occurs less frequently than those in class 19, but more frequently than those in class 21 or higher.

The R illustrated in the table above illustrate the position of the terms based on the order of their Occ in the corpus: “bluetooth” with R of 5,557,368 is in a very low position in terms of Occ, meaning that the term is very rare. In contrast, “smartphone” with R of 2,730 shows that this term appears more frequently in the corpus, but is still less popular than other terms with lower R. “Innovation” with 36 Occ and FC of 19 shows that this term has a medium frequency, quite often used in the context of technology but not as big as terms such as “smartphone” or “computer”. “Bluetooth” with 1 Occ and FC of 24 is very rarely used in the corpus, so it occupies the highest FC. In other words, this FC helps to provide an idea of the extent to which the term is used in the technology or academic texts in the corpus. This indicated the level of use of these terms in academic or science and technology contexts, which was visualized in more detail in the following diagram.

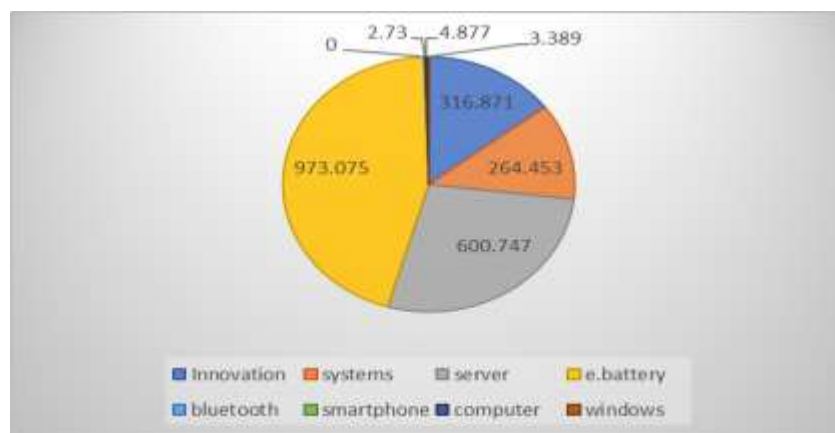


Figure 2. The chart of popularity or occurrence of a term in the corpus based.

These interpretations helped suggestion more effective translation procedures in educational contexts, shows the frequency distribution of technology terms in the corpus app. This data illustrates the dominance of terms such as “smartphone” and “windows”, which have a much higher number of Occ than other terms such as “bluetooth” and “battery”.

In the context of this study, although the most dominant procedure is transference, which maintains the technology term directly without significant changes. However, for less familiar or descriptive terms, adaptation and literal translation procedures are often used simultaneously. This shows the application of Newmark's PA concept, where more than one procedure is used simultaneously to achieve an accurate and understandable translation. This approach is more oriented towards the use of the triplet method, because the combination of three procedures transference, adaptation, and literal translation is often applied to noun technology terms. This triplet method allows the translator to balance between fidelity to the SL and the need for adaptation to the TL, ensuring a translation that is terminologically and contextually accurate.

3.2 Discussion

This research discussion reveals a strong correlation between the frequency of term occurrences in the corpus and the choice of translation procedures. The findings indicate that the SA is highly effective and dominant for high-frequency, globalized technology terms, such as smartphone and computer, in order to maintain universal consistency. Conversely, for low-

frequency terms or abstract concepts such as innovation and e-battery, the use of the PA is a crucial solution. Through the couplet or triplet technique, PA is able to bridge the cognitive distance between TL readers by providing contextual explanations without sacrificing the integrity of the original meaning. These results validate Newmark's (1988) and Vermes' (2003) theories on translation flexibility, where the integration of transference, adaptation, and literalization procedures has been shown to improve the readability of technical texts. Practically, this discussion confirms that standardizing technical noun translation procedures is an absolute prerequisite for improving students' digital literacy and professional readiness. By implementing a systematic strategy whether through high-fidelity SA or an adaptive approach in PA, the quality and accuracy of IT education materials in Indonesia can be significantly improved to face global technological challenges.

Technological Terminology

Technological terminology is a crucial tool in international communication in the fields of science and technology. Theoretically, terminology is defined as a discipline that studies concepts and terms within a specific domain using a consistent classification system (Castellví, 2003). Its main characteristic is its dynamic nature, reflecting cultural evolution and technical innovation, often combining native and loanwords (Miyata et al., 2022; Bowker, 2001).

Technological terms are unique compared to general terms because their meanings are fixed and definitive in specific fields (Subakti, 2022). The Indonesian Dictionary (KBBI) (2016) defines technology as a scientific method for achieving practical goals, while linguistically, this term often appears as a compound noun or acronym that requires in-depth contextual interpretation (Drouin et al., 2020).

In the educational context, Munday (2016) emphasizes that mastering technological terminology is crucial for facilitating global information exchange. However, the emergence of new, multidimensional terms creates significant challenges in translation. Therefore, this research focuses on mapping technological nouns to ensure accurate, consistent, and reader-friendly translations. The goal is to improve the technological literacy of Indonesian students and support the standardization of national technical terminology to ensure its relevance to global developments.

Translating Technology Terminology in Noun Form

Translating technology nouns presents specific challenges due to their multidimensional and highly technical nature. Terms such as "cloud computing" or "server" require high precision to ensure cross-cultural understanding; misinterpretation can hinder global technological engagement (Spahiu & Nuredini, 2023). The quality of educational materials depends heavily on the accuracy of the translation of these nouns. Inadequate translation can compromise the accessibility of resources and hinder students' understanding of core concepts (Meyer, 2001). Given that many English terms lack direct equivalents, the use of glossing and explicitation strategies is crucial to bridging this conceptual gap (Nugraeni & Setiawan, 2021).

The main factors in determining the translation procedure include the context of the term, the audience profile, and the function of the target text (Umiyati, 2017; Xiaoyan et al., 2024). Translators must choose between literal equivalence or dynamic equivalence to achieve clarity and cultural relevance without sacrificing technical accuracy (Saptiawan, 2016). These considerations form the basis for selecting an approach, ranging from SA to PA, to ensure that the terminology remains precise yet accessible to both lay and academic readers.

Table 4.

Table of noun translations across various categories

Category	English Term	Indonesian Translation	Approach Used
Proper noun	Window	<i>Windows</i>	literal (SA)
Abstract noun	Innovation	Inovasi	dynamic (PA)
Common noun	Computer	komputer	literal (SA)
Compoun noun	Email Address	Alamat email	literal (SA)
Nominalization	Data processing	Pengolahan data	dynamic (PA)
Common noun	Network	Jaringan	semantic (SA)
Common noun	Cache	<i>Cache</i>	borrowed directly (SA)
Proper noun	Bluetooth	<i>Bluetooth</i>	transference (SA)
Common noun	Domain	Domain	literal (SA)
Adjective/noun	Electronic	Electronic	borrowing (SA)
Common noun	Mouse	<i>Mouse</i>	Semantical (SA): Often kept as is due to the lack of a more specific translation in tech contexts.
Common noun	Socket	Soket	Direct translation (SA)
Common noun	Data	Data	Common technical term in computing, used directly (SA)
Common noun	File	File or “ <i>berkas</i> ”	The word "file" is often directly translated as "berkas" in Indonesia. (SA)
Proper noun	Google	Google	Transference (SA)
Proper noun	Yahoo	Yahoo	Transference (SA)
Common noun	Browser	<i>Browser</i>	Common term, retained as "drive" for tech context, often untranslated (SA)
Common noun	Drive	<i>Drive</i>	Common term, retained as "drive" for tech context, often untranslated (SA)
Common noun	Disc	<i>Disk</i>	Retained as "disk," commonly understood in both languages. (SA)
Common noun	Server	<i>Server</i>	Retained in its original form, with minimal adaptation. (SA)
Common noun	Link	<i>Tautan</i>	Direct translation, commonly used in Indonesian web contexts. (SA)

This table reflects how Newmark's and Vermes' theories on translation procedures (such as SA for technical terms and PA when flexibility or adaptation is needed) guide the translation of technological terms across languages. Proper nouns typically stay in their original form, while common nouns are either retained or adapted to fit cultural and linguistic contexts.

Single Approach (SA)

Newmark (1988) formulated two main approaches to translation: the Single Approach (SA), which focuses on semantic aspects (lexical and grammatical accuracy), and the more communicative combinative approach. In SA, a text unit is processed through only one specific translation procedure without involving any combination of other methods. This approach aligns with Vinay and Darbelnet's (1995) concept of direct procedures, such as borrowing, calque, and

literal translation. The primary focus of SA is maintaining fidelity to the source source, ensuring terminological consistency, and maintaining denotative appropriateness of the message. Therefore, SA is highly effective for official, technical, or legal documents that demand high accuracy.

Research by Sihombing (2020) supports this, finding the predominant use of SA (121 out of 141 data points) in technical immigration texts to maintain terminological integrity. While SA guarantees accuracy, this approach can sometimes result in translations that feel stilted because they do not take into account cultural nuances or flexibility in the TL. In short, SA is chosen when consistency and structural equivalence between the SL and the target language are the top priority over broad cultural adaptation.

Pair Approach (PA)

The combination approach (PA) referred to in Newmark's theory as the Simultaneous Approach is a method that simultaneously integrates semantic and communicative translation elements. Newmark (1988) emphasized that in practice, translators often cannot rely solely on a single procedure. As a solution, couplet, triplet, or quartet techniques are used to achieve a balance between fidelity to the source language and readability in the target language.

The application of PA is crucial in translating complex or new technological terms for the target audience. For example, the term "Machine Learning" is not only translated semantically to maintain its authentic meaning, but also provided with additional explanations or communicative adaptations (such as its application in e-commerce recommendation systems) to make it relevant to the local Indonesian context. This strategy serves as a "cognitive bridge" that facilitates the understanding of multidimensional technical concepts.

Recent research (Zheng et al., 2020) also shows that PA is increasingly supported by advances in artificial intelligence (AI) to address the demands of rapid and context-sensitive text processing. The comparison between both shown that SA is used to maintain the integrity and consistency of specific vocabulary (high fidelity). While PA is used when terms require rapid adaptation and contextual explanation without sacrificing clarity of meaning. The choice between SA and PA depends largely on the nature of the text and the reader's profile. The integration of these two approaches in research ensures that technological terminology is not only theoretically accurate but also functional in global educational and communication practices.

Table 5.

Table translation of single term (noun) English to Indonesian

Technology Term	SL	TL	
		SA (Single Approach)	PA (Pair Approach)
Software	Software	Perangkat lunak	Perangkat lunak (<i>software</i>)
Hardware	Hardware	Perangkat keras	Perangkat keras (<i>hardware</i>)
Algorithm	Algorithm	Algoritma	Algoritma (<i>algorithm</i>)
Encryption	Encryption	Enkripsi	Enkripsi (<i>Encryption</i>)
Bandwidth	Bandwidth	<i>Bandwidth</i>	Kapasitas Jaringan (<i>bandwidth</i>)

Applying the procedural approach in technical translation as stated by Newmark (1988) formulated two main approaches that form the foundation of this research: SA and PA often referred to as PA. SA focuses on accuracy and fidelity to the meaning and structure of the source language. This approach is particularly suitable for technical or scientific texts that require high

precision to maintain the originality of terminology for expert readers. While PA simultaneously integrates various procedures (such as transference, rendering, addition, etc.) to address the complexity of technical texts (Vermes, 2007). This approach provides translators with the flexibility to adapt to the needs of a broader audience or lay readers.

Theoretically, the choice between SA and PA depends heavily on the purpose of the text and the reader profile. While SA maintains the integrity of specific terminology, PA serves to convey meaning in a more communicative and understandable manner in the target language. These two frameworks provide a comprehensive understanding in analyzing the complexities of translating technological nouns.

So far, this study is analyzed technology terminology through collected data from textbooks and further contextual examination via www.english-corpora.id. Key terms were categorized into conceptual terms (e.g., *algorithm*, *artificial intelligence*), technical terms (e.g., *microprocessor*, *router*), and general terms (e.g., *data*, *system*). Terms were broken into smaller components to reveal their foundational meanings and were analyzed in the contexts of single and PA translation approaches (SA and PA). This classification aimed to evaluate how translation strategies address the semantic and contextual alignment of technology terms between English and Indonesian. A comparative table highlights the translation procedures and contextual adaptations applied to each term. The following table explained the application of SA and PA to translating technological terms, categorized by the type of term (conceptual, technical, general, or proper nouns). Each term is explained with its translation procedure, including the rationale approach behind choosing either SA or PA:

Table 6.
Application of SA and PA to explain the noun categorization.

Term	Type	Translation method	Explanation
Algoritma	Technical	SA	Transference (" <i>Algoritma</i> ") — The term is directly adapted with minor phonetic adjustments, as it's a commonly used term in both languages.
Artificial Intelligence	conceptual	PA	" <i>Intelegensi Buatan</i> " — Rendering the term as " <i>intelegensi</i> " and adding " <i>buatan</i> " (artificial) to clarify its meaning in the target language.
Cloud Computing	Technical	PA	" <i>Komputasi Awan</i> " combines the technical term " <i>komputasi</i> " (computing) with " <i>awan</i> " (cloud) to represent the concept accurately in the target language.
Data	General	SA	"Data" used a direct borrowing from English to Indonesian with no significant modification, as the term is universally understood.
JavaScript	proper noun	SA	"JavaScript" as a proper noun remains unchanged to retain its identity and global recognition in the field.
Big Data	technical	PA	"Big Data" retained in English but occasionally supplemented with a clarifying term like " <i>data besar</i> " (large data) for better comprehension in some contexts.
Cybersecurity	conceptual	PA	" <i>Keamanan Siber</i> " is transferred with " <i>keamanan</i> " (security) and " <i>siber</i> " (cyber) to form a culturally relevant and understandable term.
Bluetooth	proper noun	SA	"Bluetooth" directly transferred as a proprietary term, maintaining its universal recognition without modification.

Database	technical	SA	" <i>Basis Data</i> " — the term "database" is directly translated as " <i>basis data</i> ," which is commonly accepted in Indonesian technical contexts.
Machine Learning	conceptual	PA	" <i>Pembelajaran Mesin</i> " — the term "machine" is translated to " <i>mesin</i> " and "learning" to " <i>pembelajaran</i> ," to convey the full concept in Indonesian.

This table showed how each term is treated differently based on its nature and the complexity involved in its translation. This table illustrates how each term is translated with different approaches based on the nature and complexity of the term. The process of translating technology terms can be influenced by several factors, including the type of term (e.g. technical, conceptual, general, or proper noun), the general understanding of the term in the target language, and the need for additional explanation to make the term's meaning clearer to the reader.

The category of noun as technical terms of technology field, explained that terms such as "Algorithm" and "Data" are usually translated using the SA because they are common in both languages and accepted in the international technology community. Besides, SA often use direct borrowing or minimal localization, such as *algorithm* becoming *algoritma*, or brand names like "Google" retained as is. PA combine procedures, such as "Artificial Intelligence" translated as "*Intelegensi Buatan*", where rendering and additional context clarify meaning. For proper nouns (e.g., *Google*, *Yahoo*), transference maintains their identity. In technical terms like "browser" (*browser*), rendering replaces the English term with a culturally adapted equivalent. Meanwhile, "Drive" retains its original form due to its established familiarity and lack of an Indonesian counterpart. This structured analysis aligns translation procedures with term categories, emphasizing cultural and technical considerations in technological terminology. New or unfamiliar terms may use the PA Approach, such as "Cloud Computing" which is translated to "*Komputasi Awan*" to provide a clearer explanation. Conceptual Terms, such as "Artificial Intelligence" and "Cybersecurity" require the PA because translators add explanations to clarify the meaning, such as "Intelligence Artificial" and "*Keamanan Cyber*." General terms, such as "Data" are usually translated using the SA because they are common and understood in many languages, without the need for significant changes. Proper names such as "JavaScript" and "Bluetooth" are not translated and are retained unchanged because they are internationally recognized entities, using the SA to maintain their global recognition.

Based on the identification of noun categories are found that nouns in technological terminology predominantly consist of simple nouns, compound nouns, and abstract terms. In terms of translation procedures, the most frequently applied methods include transference, rendering, and addition, particularly for terms that involve significant cultural or technical elements. Based on an inductive approach in qualitative analysis, which includes the labelling or coding process and thematic analysis to answer the research questions.

Labelling data, as the first process of identification and categorization of nouns showed the results of the analysis of nouns based on linguistic and functional features, such as: proper nouns (: *javascript*, *Bluetooth*); common nouns (: *data*, *server*); abstract nouns (: *artificial intelligence*, *cybersecurity*); compound nouns (: *cloud computing*, *machine learning*). Second, identification of translation procedures noted that the translation procedures applied to each noun, such as: SA showed direct translation using one procedure, such as transference or literal translation. PA occurred in a combination of translation procedures, such as rendering with additional clarification. Third, process of pattern and frequency analysis showed the results identified patterns in the use of translation procedures (e.g., the dominance of borrowing for proper nouns). The results of the analysis of the frequency of each approach in various noun categories have understood translation trends. And last, by grouping translation strategies into

themes, it was found similar strategies, such as fidelity and adaptation, were grouped into broader themes.

Thematic analysis, as the second proses after the labelling or coding process, the data were analyzed in more depth to develop themes that answered the research questions, including of:

- 1) Noun categories have developed themes based on the types and characteristics of technological nouns, such as: proper nouns retain their original names to maintain global recognition; abstract nouns tend to require an interpretive approach to be conceptually relevant in the target language.
- 2) Translation procedures, the analyze and categorize resulted the procedures used, such as semantic, communicative, borrowing, or calque approaches. This theme describes how these procedures are applied to different types of nouns.
- 3) Dominant procedures identified the most frequently used strategies and evaluate their effectiveness. It found that the SA approach is more dominant for proper nouns due to its simplicity, while PA is often used for abstract or compound terms because it provides the necessary additional context.

The analysis revealed that both SA and PA approaches utilized various translation procedures for technology terms, including direct translation, transliteration, adaptation, and explanation. PA often combines methods within a single term. The method choice depends on factors such as text context, term specificity, and technological advancements introducing new terms without established equivalents.

4. Novelties

The main novelty of this research lies in the confirmation of the Parenthesis Procedure as a priority hybrid strategy within the PA framework for translating disruptive technology nouns. Different from previous studies, this research proves that the systematic use of original terms followed by parenthetical explanations effectively maintains the semantic accuracy of the SL and accessibility in the TL. As a practical contribution, this finding is implemented into an IT E-Glossary Web-Based, an innovative output that presents standardized technological terms with adaptive digital navigation. The synergy between the theoretical model of parenthesis and this e-glossary platform offers a concrete solution for students and educators to minimize the ambiguity of technical terms and accelerate the mastery of digital literacy in Indonesia.

5. Conclusion

This study concludes that the effectiveness of translating technological nouns from the SL to the TL depends heavily on the frequency of the term's use and its conceptual complexity. The following are three key points from the triangulation of corpus data, observations, and text analysis: noun typology and corpus frequency of technology terms range from proper nouns (such as "Windows" and "Bluetooth"), abstract nouns ("innovation"), to common nouns ("system"). Corpus data shows that the higher the frequency of a term (such as "Smartphone" with 17,868 Occ), the greater its likelihood of universal acceptance in its original form. Application of SA vs. PA procedures include of SA shown most optimal for established and globally recognized terms through transference (borrowing). While, PA required for complex or novel technical terms (such as "e-battery") to bridge the meaning gap through a combination of procedures (transference, adaptation, and literalization) in line with Newmark's triplet concept. Audience Preferences and Practical Implications: Users (educators) prioritize consistency for high-frequency terms and require contextual explanations for low-frequency terms. Therefore,

translation strategies must be adaptive: using SA for universality and CA for conceptual precision.

This research implicates the choice of translation procedure should not be solely linguistic, but should also consider sociocultural aspects and empirical frequency. These findings provide a foundation for developing more systematic translation guidelines for IT terms to improve readability and consistency in academic texts in Indonesia.

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