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Exploration of nouns translation procedures in technological terminology

Sri Widiastutik[1*], Ni Luh Sutjiati Beratha[2], I Made Rajeg[3], I Gusti Agung Istri Aryani[4]
[1]Doctoral Linguistics Program Study, Faculty of Humanities, Udayana University, Denpasar, 80114, Indonesia; sriwidiastutik@instiki.ac.id (S.W.).
[2,3,4]Bachelor of English Literature, Faculty of Humanities, Udayana University, Denpasar, 80114, Indonesia; sutjiati@unud.ac.id (N.L.S.B.) made_rajeg@unud.ac.id (I.M.R.) istri_aryani@unud.ac.id (I. G.A.I.A.).

Abstract: Technological terminology serves as a critical aspect of scientific and technological advancement. Translating these terms from English to Indonesian requires a thorough understanding of their linguistic forms, particularly nouns, which dominate the field. Nouns in technological terminology can range from technical and abstract terms to culturally bound concepts, each posing unique challenges in translation. This study investigates the procedures used to translate nouns in English technological terminology into Indonesian, focusing on their accuracy, readability, and appropriateness of the target readers preference. By categorizing terms into simple nouns, proper noun, general or nouns, and analyzing translation procedures such as SA and SmA approaches, this research highlights the predominance of certain strategies. The findings reveal that the SmA approach with a combinative procedure integrating semantic and communicative translation is effective in maintaining terminological integrity while ensuring cultural and contextual relevance. This exploration underscores the necessity for systematic translation guidelines to enhance the consistency and quality of Indonesian technical terminology.

Keywords: *Technical Terms, Technology, Translation procedures.*

1. Introduction

Technological terminology is an integral part of the rapid development of science and technology. Serving as a global communication medium, this terminology is predominantly derived from English, making its proper translation critical in bridging linguistic and cultural gaps. Nouns, which constitute a significant portion of technological terms, often carry intricate meanings that require nuanced translation strategies. These include technical terms with precise definitions, abstract concepts that lack direct equivalents, and culturally specific terminology that demands sensitivity to contextual implications.

Research in the field of translation has addressed general challenges in technical translations but has often overlooked the specific complexities of noun translation in technological terminology. For instance, studies by (Akpaca, 2024) revealed that students in education institution struggling with terms like "algorithm" and "data structure" faced significant difficulties in using related software tools, leading to hindered creativity and practical engagement. Similarly, (Xiaoyan et al., 2024) highlighted how inconsistent translations of terms such as "machine learning" and "neural networks" impeded students' abilities to innovate and apply these concepts effectively, affecting their professional competencies. (Widiastutik et al., 2021) examined how the noun translation of health terminology as technical terms, influences public understanding, by highlighted the importance of accurate and explicit translation strategies, such as glosses and explanatory notes, to clarify complex terms and ensures effective communication and health information during the pandemic. Saptiawan (2016) documented how shortened technical terms in translated textbooks limited student understanding, and highlights the need for clear translations of computer-related abbreviations like "esc", "del", "Ctrl", alt", "tab", "PgUp" and "PgDn" in teaching materials and bilingual dictionaries, as unclear definitions hinder users' ability

* Correspondence: sriwidiastutik@instiki.ac.id

to operate computers efficiently, resulting in decreased participation in global technological advancements. (M. Umiyati, 2017) further emphasized the broader academic impacts, where poor translations reduced the quality of student research output and project reports. (Mihaljov, 2011) noted the institutional ramifications, showing that poorly translated technological texts diminished educational credibility and hindered professional readiness in IT sectors.

Adding to this phenomenon, recent studies underscore the need for accurate translations in academic texts utilized by Indonesian students to understand English technical terms. For example, terms such as "artificial intelligence" and "data analysis" are frequently encountered in academic materials but are often translated inconsistently, leading to confusion and limited comprehension. Such difficulties hinder students' ability to effectively engage with technological tools, stifle their creativity, and delay professional competency development. Furthermore, inconsistent or inaccurate translations can diminish a student's confidence and trust in educational resources, ultimately affecting their ability to innovate and compete in global technological fields. This underscores the urgent necessity for standardized, precise, and culturally relevant translation practices.

Despite the critical need, studies like those by (Maulidiyah, 2018; Nyangeri & Wangari, 2019) have primarily focused on broader translation procedures without delving into the procedural nuances required for translating nouns. Similarly, (Rustamov Ilkhom Tursunovich, 2022) examined cultural adaptation but overlooked the technical intricacies of noun forms in translation. Case-specific issues, such as translating "machine learning" to "*pembelajaran mesin*" or "*pengolahan data berbasis mesin*," illustrate the challenges translators face in maintaining both semantic accuracy and reader accessibility. (Aryani & Widiastutik, 2024) the study looks at how technical nouns are translated in a bilingual context, that focused on how terms related to the movie, like character names and technology, are adapted for clarity in both languages. For example, "web-slinger" is translated as "*penembak jaring*" (web shooter) to explain the meaning clearly. Similarly, "power suit" becomes "*pakaian kekuatan*" (power suit) to keep the technical meaning. The study shows how using simple strategies like explaining or adapting terms helps make technical nouns understandable in translation.

This research fills a critical gap by exploring the translation procedures employed in converting English technological nouns into Indonesian. By examining these processes, this study aims to contribute to the improvement of translation practices, particularly in the context of academic texts used by non-native speakers. Accurate translation ensures that students can access and comprehend essential concepts without unnecessary barriers, thereby enhancing their learning experience and professional preparedness. Moreover, it supports the creation of reliable, high-quality educational materials that meet global standards.

The significance of this study lies in its focused approach to noun translation, an area that remains underexplored despite its importance in technical communication. By examining the procedures and strategies used, this research aims to contribute to a deeper understanding of translation practices and to propose guidelines that can enhance the quality of technical terminology in Indonesian. The title "Exploration of Nouns Translation Procedures in Technological Terminology" apply reflects the study's intent to address these critical issues, offering insights that are both academically and practically significant.

Further, the concept of translating technical terminology will be explored in detail, focusing on the dominant linguistic forms identified in this study: nouns. This element is examined to provide a comprehensive framework for understanding and improving translation practices in the field of technology. Thus, the focus of problem in this research is 3 things, are: (1) What are the categories of nouns in technological terminology? (2) How is the application of the procedure approach to noun translation in technological terminology? (3) What translation procedure is most dominantly used in translating nouns in technological terminology?

2. Literature Review

2.1. Technological Terminology

The discussion in this subsection began by introducing the definition of the terminology and technological term, then continues with the role of the technological term in this study. The role of

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terms is very important in the science and technology field as a vehicle for the implementation of global international communication. Several scholars have discussed the definition of terminology and technology terms, providing insight into their linguistic context and practical applications. In a work entitled "Terminology: Theory, Methods, and Applications", (Castellví, 2003) defines terminology as a discipline that studies concepts and terms in a particular domain, with a focus on a consistent system of classification and presentation. Terminology involves the relationships between terms and their relationships to concepts in a particular domain, including technology. (Miyata et al., 2022) in "The Dynamics of Terminology", they defines terminology as a dynamic process that reflects the evolution of technology, culture, and society. Technological terms are often a hybrid of native and loanwords, adapting to local needs.

(Hani Subakti, 2022) emphasized that a term is a word, either a basic word, a derived word, a repeated word, or a combination of words whose meaning is fixed and definite, and is only used in certain fields of science or activities, so it is clear that not all words are terms. In the context of translation, language experts generally agree that a term is a word or phrase that has a specific meaning in a particular field, and a general meaning in various fields, and emphasizes more specifically that translating terms is a complex task that requires in-depth understanding.

Based on (Cambridge University Press, 2024) https://dictionary.cambridge.org/, technology is a form of noun [UK /tekˈnɒl.ə.dʒi/ US /tekˈnɑː.lə.dʒi/], it refers to the study and knowledge of the practical, especially industrial, use of scientific discoveries: computer, modern, and a long-term policy for investment. According to (Badan Pengembangan dan Pembinaan Bahasa, 2016) to www.kbbi.web.id the definition of "technology" as "*teknologi*" is a scientific method to achieve practical goals and applied science; the definition of "technological" as an adjective is "*teknologis*" in Indonesia. In order to support the study of terminology in this study, it is necessary to understand and apply the basic concept of technological terms that are relevant to the translation context. These definitions have been studied by research experts in the field of translation, such as: (Drouin et al., 2020) defines technology terms as special terms that refer to concepts and artifacts that develop in and for the purposes of technology. These terms are often compound words or abbreviations that require contextual interpretation. In their book "Working with Specialized Language", Bowker (2001) states that technology terms refer to words or phrases that are exclusively used in the technology domain. They emphasize that these terms are usually influenced by technological developments and innovations, so they often experience updates.

In line with the scholars' opinion, technology has a strong foundation covering various media of technologies. (Munday et al., 2022) Munday's thoughts (2016 pp. 211) were a useful framework in this study, as a form of contribution in the field of Linguistics, especially in the field of translation, and the field of science and technology are generally used in the context of business operations along with the development of science and technology in this modern era. The concept of the specific term of technology in this study, contributed very importantly to the development of knowledge in the field of Education, supported the exchange of information and global communication based on technological tools, helped facilitate students' understanding of technological studies and utilized technology efficiently and appropriately.

These studies underscore the pressing need for research focused on improving the translation of technological nouns. Technological terms are inherently specific to their field, yet the emergence of new, multidimensional terms presents challenges in translation. Consistent, accurate, and reader-friendly translations are essential for empowering students, enhancing their technological literacy, and preparing them for global challenges. This research addresses these needs by mapping technology terms to ensure the suitability of written text translations according to the context and forms of specific technological terms. By systematically exploring noun translation categories, evaluating translation approaches, and identifying effective procedures, this study aims to address existing gaps and contribute to the advancement of Indonesian technical education and terminology.

2.2. Translation of Technological Terminology in Noun Form

The translation of technological nouns presents distinct challenges due to their specificity and multidimensional nature. (Spahiu & Nuredini, 2023) highlighted terms like "cloud computing," "data"

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and "server" require precise translation to ensure their comprehensibility across linguistic and cultural contexts. Misinterpretations of such terms can limit understanding and hinder global technological engagement.

The role of noun translation becomes critical in maintaining the quality and accuracy of educational materials. (Meyer, 2001) emphasized that inadequate translations of technological nouns undermine the accessibility and effectiveness of resources, affecting students' ability to engage with core concepts. (Nugraeni & Setiawan, 2021) noted that English loanwords often lack direct equivalents, necessitating the use of glossing and explicitation to bridge conceptual gaps. Some scholars are also underscored the dynamic evolution of technical terms, advocating for adaptive procedures to accommodate linguistic and conceptual shifts.

The challenge lies in exploring appropriate translation procedures to address the multifaceted nature of technological nouns. (Spahiu & Nuredini, 2023) advocated for the integration of explicitation and cultural adaptation as effective strategies. These approaches ensure that technological nouns remain accessible, precise, and relevant to their intended audience. The considerations for translating technological nouns, especially technical terms, involve several key factors. According to (Akpaca et al., 2020; M. Umiyati, 2017; Xiaoyan et al., 2024) , these factors include the context of the term, its intended audience, and the function it serves in the target text. Translators must determine whether the term requires a literal translation or a more dynamic equivalence to meet the needs of the target language's readership, considering aspects like clarity, accuracy, and cultural relevance. (Septiawan, 2016) also emphasizes the importance of maintaining terminological consistency and adapting terms to be accessible for lay audiences while preserving technical accuracy. These factors guide the choice of translation procedures, ranging from single translation to combinative approaches, and here is table of technological noun translations across various categories:

Table 1.
Table **of** noun translations across various categories.

Category	English term	Indonesian translation	Approach used
Proper noun	Window	*Windows*	literal (SA)
Abstract noun	Innovation	Inovasi	dynamic (SmA)
Common noun	Computer	komputer	literal (SA)
Compoun noun	Email address	Alamat email	literal (SA)
Nominalization	Data processing	Pengolahan data	dynamic (SmA)
Common noun	Network	Jaringan	semantic (SA)
Common noun	Cache	*Cache*	Borrowed directly (SA)
Proper noun	Bluetooth	*Bluetooth*	Transference (SA)
Common noun	Domain	Domain	Literal (SA)
Adjective/noun	Electronic	Electronic	Borrowing (SA)
Common noun	Mouse	*Mouse*	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 "*berkas*"	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	*Browser*	Common term, retained as "drive" for tech context, often untranslated (SA) (SA)

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Common noun	Drive	*Drive*	Common term, retained as "drive" for tech context, often untranslated (SA)
Common noun	Disc	*Disk*	Retained as "disk," commonly understood in both languages. (SA)
Common noun	Server	*Server*	Retained in its original form, with minimal adaptation. (SA)
Common noun	Link	*Tautan*	Direct translation, commonly used in Indonesian web contexts. (SA)

This table reflects how Newmark's and Vermes' theories on translation procedures (such as single approach for technical terms and SmA/combinative approaches 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.

2.3. Single Translation Approaches or in Short SA

(Newmark, 2003) in his book "A Textbook of Translation" (1988, p. 89-92) proposed two main approaches in translation, namely single translation and simultaneous translation. Single approach (SA) refers to semantical process that emphasized accurate lexical and grammatical meaning, while Simustaneous approach (SmA) is more concerned with communicative translation focused more dynamic process on achieving the same effect on the target reader. These approaches would be the theoretical basis in analyzing the translation procedures used in this study. The application of translation approaches, whether SA or SmA, has been extensively explored in various studies, offering insights into the practical and theoretical implications of these methods. Newmark's (1988) foundational framework emphasizes the adaptability of translation procedures to the text's context and purpose, which has been validated in recent research findings.

(Vinay & Darbelnet, 1995) introduced seven basic procedures (borrowing, calque, literal translation, transposition, modulation, equivalence, and adaptation), which reflect the concept of SA in translation. This concept emphasizes the application of one procedure specifically to a text unit, without involving a combination of methods. In certain contexts, SA is often identified with literal translation, as defined by Newmark in the semantic approach. This approach is relevant to Vinay and Darbelnet's division between literal translation (direct procedure) and oblique translation (indirect procedure), each of which is chosen based on the needs of the text. Thus, SA functions as a basic framework in determining the appropriate translation technique, especially to maintain the lexical, syntactic, and message conformity of the source text (ST).

The single approach translation that commonly emphasizes fidelity to the ST. The translation used this approach attempt to translate every word, phrase, and sentence structure directly from the ST to the TT. In other words, the resulting translation of SA tries to be as close to the original text as possible. A characteristic of this approach is consistency of terminology, where technical terms are translated uniformly throughout the text to maintain accuracy of meaning. This approach is often used in the translation of official, technical, or legal documents where accuracy and consistency of terminology are critical. While it ensures accuracy, SA can sometimes result in translations that are less natural or stilted, because it does not take into account the nuances of the TT. In addition, the SA is also less flexible in translating culturally specific concepts. Compared to the semantic or communicative approach, the SA places more emphasis on denotative meaning rather than connotation or broader implications.

(Sihombing, 2020) conducted a study on immigration texts that applied both SA and SmA translation approaches. Their findings revealed a predominance of single approaches, with 121 out of 141 data instances employing literal techniques and calque. The SmA approaches, represented by 17 data instances of couplets (combining compensation and adaptation) and 2 instances of triplets,

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highlighted the complexity of addressing multi-faceted textual requirements. This balance reflects the nuanced decision-making translators employ when selecting techniques to maintain the source text's integrity and adapt to the target audience's cultural and linguistic expectations. The juxtaposition of SA and SmA translation approaches across these studies reveals their respective strengths and applications. SA are often preferred for texts requiring high fidelity to the source, as observed in the immigration texts, where literal techniques ensure terminological consistency. In contrast, SmA are crucial in dynamic, time-sensitive scenarios, leveraging technology to enable immediate communication across languages (as discussed in the next part of this study).

2.4. Simultaneous Translation Approach (SmA)

A combined method can be understood as an approach that integrates elements of semantic and communicative translation in one translation process simultaneously. Newmark acknowledged that in real translation practice, translators often could not use only one approach exclusively. Instead, they might need to combine various methods to achieve a balance between fidelity to the source text and readability in the target language, as he stated about concept of *quplet*, *triplet*, and *quadruplet*. For example, in translating technical terms that might be unfamiliar to the target reader, the translation might begin with transliteration (semantic element) to preserve the original term, but then added explanations or adaptations (communicative element) to ensure that the term could be clearly understood by the reader. This approach was in line with what the following experts describe.

Newmark (1988, p.91) stated that "The translator may wish to retain some degree of the literal meaning while also ensuring that the translation is effective and accessible to the target audience, thus combining aspects of both semantic and communicative translation." Although Newmark did not explicitly use the term "hybrid method," the idea of combining elements of different methods in the translation process (or quplet) was central to his view of flexibility and contextuality in translation practice that this study referred to.

In an educational textbook, the term "Machine Learning" translated using this hybrid method allowed students to better understand the concept. They gained access to a translation that was faithful to the original meaning (through the semantic approach), but also had a guide to understanding how the term was used in a global context (through the communicative approach). Translation added examples of applications of "Machine Learning" in the local Indonesian context, such as its used in e-commerce recommendation systems, to help students related the concept to the real world. In this way, the hybrid method facilitated the teaching and understanding of complex Technology terms in Indonesian, while bridged the gap between the source and target languages.

Similarly, (Zheng et al., 2020) examined the application of SmA translation in real-time contexts such as international conferences and legal proceedings. This research underscores the technological advancements enabling SmA translation, integrating machine translation, speech recognition, and synthesis to address the challenges of concurrent source and target text processing. These findings illustrate the increasing reliance on artificial intelligence to manage the intricate demands of SmA translation, which has traditionally been one of the most challenging aspects of translation work.

Both translation approaches—SA and SmA—are highly significant in technical translation, particularly in fields of technology. As highlighted in Newmark's theory, these approaches can be adapted to various translation contexts, including the translation of complex technological terminology. In the context of this research, the application of both approaches is essential. The single approach ensures accuracy and consistency when translating technical terms, which is particularly important in maintaining the integrity of specialized vocabulary. On the other hand, the SmA approach is vital in addressing real-time translation challenges, especially when translating complex, context-sensitive terms that require quick adaptation without sacrificing clarity.

Thus, the development of these approaches by Newmark becomes crucial for the technical translation of technology terms, ensuring that both fidelity to the ST and the immediate needs of the target audience are met. In the research presented here, both approaches will play a pivotal role in achieving accurate and contextually appropriate translations of technology terminology, contributing to a more precise understanding of technological concepts in educational texts. The choice between SA and

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SmA translation approaches depends largely on the text's nature and purpose. Newmark's theory provides a robust basis for understanding these applications, while the contributions of (Ginting et al., 2020) and (Zheng et al., 2020) enrich the discourse by illustrating the practicalities and advancements in the field.

In the context of technical translation of Newmark's (1988) concept, both approaches have their place. The SA is used when technical terms require fidelity to the source, while the SmA is more suitable for situations where the translation needs to be adapted to the wider context of the target reader. The table 2 below is an example of the application in translating the technical term in the form of noun within both approaches.

Table 2.
Table translation of single term (Noun) English to Indonesian.

Technology term	**SL**	**TL**	
		SA (Single approach)	**SmA (Simultaneous approach)**
Software	Software	Perangkat lunak	Perangkat lunak (*software*)
Hardware	Hardware	Perangkat keras	Perangkat keras (*hardware*)
Algorithm	Algorithm	Algoritma	Algoritma (*algorithm*)
Encryption	Encryption	Enkripsi	Enkripsi (*Encryption*)
Bandwidth	Bandwidth	*Bandwidth*	Kapasitas Jaringan (*bandwidth*)

Newmark (1988, p.83-92) discusses both approaches, the single approach and the simultaneous approach (often referred to as the combinative approach in this context). The single approach (SA) focuses more on accuracy and faithfulness to the meaning and structure of the source text, suitable for texts that require high accuracy, such as in technical or scientific texts. The simultaneous approach (SmA), on the other hand, combines various strategies in translation to suit the needs of a more general or different audience. Vermes (2007), on the other hand, emphasizes the application of the SmA, which is the application of several translation strategies simultaneously (such as transference, substitution, rendering, modification, omission, and addition) to deal with the complexity of technical texts or texts with a wider audience. This allows the translator to be more flexible and adaptive in choosing the method that suits the context. The two theoretical frameworks above provided a better understanding of the complexities in translating technical terms of technological noun. The choice between both translation approaches depended on the purpose and audience of the text. SA translation preserved the original meaning and specific terminology, which was important for technical texts or expert readers. On the other hand, SmA translation aimed to convey meaning in a more understandable way, which was important in texts intended for a wider audience or lay readers.

3. Methods

In order to conduct a qualitative research study for the project titled "Exploration of Noun Translation Procedure in Technological Terminology," using (Creswell & Creswell, 2017) approach, the methodology framed within his qualitative research design, which involves the following steps:

4. Research Problem and Purpose

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 phrases, common in the field of technology, are translated from English to Indonesian. The purpose of this research is to examine the category of noun form in the technology 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.

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5. Research Design

Using Creswell's qualitative research design, the study employed a case study approach, focusing on specific textbook of translated texts in the field of technology. 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:

5.1. Data Collection Method

The data collection aligned with the research questions, and qualitative methods involve multiple techniques to gather diverse and in-depth information.

a. Document analysis: to identify and 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 cambride.dictionary.id and their Indonesian translations through www.kbb.web.id ;

b. 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.

c. Data grouping by identification or grouping data based on lingual forms (nouns).

5.2. Data Analysis Method

This research outlined an inductive approach to qualitative analysis, involving coding and theme development.

a. Coding Process

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 SmA) for each noun, used based on the theories of Newmark (1988) and (Vermes, 2007). Then, analyze patterns in the dominant translation procedures and their frequency used in corpora.

b. Thematic Analysis

Grouped similar translation strategies into broader themes (e.g., fidelity, adaptation), and develop themes addressing each research question, include of: (1) Noun categoried the types and characteristics of technological nouns. (2) Translation procedures approaches (like SA or SmA) are applied to noun translations. (3) Dominant procedure analyzed as the most frequently used procedure and its effectiveness.

5.3. Data Interpretation Method

This method emphasized clear presentation of findings, often using visual aids.

a. Tabular Presentation

Tables showing categories of nouns, their translations, and applied procedures:

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Table 3.
Table of noun categories, translation approach & application

Noun Category	Source term	Translated term	Procedure applied	Approach	Explanation
Proper noun	Google	Google	Borrowing	SA	Maintaining the original form of identity/Brand
Compound noun	Cloud Storage	Penyimpanan awan	Literal translation	SmA	Combining literal strategies with adaptation of terms
Abstract noun	Data integrity	Integritas data	Equivalence	SA	Concept of equivalence; translating with similar technical meaning without additional procedures

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

b. Graphs and charts to visualize the frequency of translation procedures across categories.

c. Narrative description to provide a detailed explanation of trends and findings to complement the visual data.

5.4. 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 process 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.

6. Process and Results

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 SmA translation approaches (SA and SmA). 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 SmA 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 behind choosing either a single or SmA approach:

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Table 4.
Application of SA and SmA to explain the noun categorization.

Term	Type	Translation method	Explanation
Algoritm	Technical	SA	Transference ("Algoritma") — The term is directly adapted with minor phonetic adjustments, as it's a commonly used term in both languages.
Artificial intelligence	Conceptual	SmA	"Intelegensi Buatan" — Rendering the term as "intelegensi" and adding "buatan" (artificial) to clarify its meaning in the target language.
Cloud computing	Technical	SmA	"Komputasi Awan" — Combines the technical term "komputasi" (computing) with "awan" (cloud) to represent the concept accurately in the target language.
Data	General	SA	"Data" — Direct borrowing from English to Indonesian with no significant modification, as the term is universally understood.
JavaScript	Proper noun	SA	"JavaScript" — The proper noun remains unchanged to retain its identity and global recognition in the field.
Big data	Technical	SmA	"Big Data" — Retained in English but occasionally supplemented with a clarifying term like "data besar" (large data) for better comprehension in some contexts.
Cybersecurity	Conceptual	SmA	"Keamanan Siber" — Transferred with "keamanan" (security) and "siber" (cyber) to form a culturally relevant and understandable term.
Bluetooth	Proper noun	SA	"Bluetooth" — A direct transfer as a proprietary term, maintaining its universal recognition without modification.
Database	Technical	SA	"Basis Data" — The term "database" is directly translated as "basis data," which is commonly accepted in Indonesian technical contexts.
Machine learning	Conceptual	SmA	"Pembelajaran Mesin" — The term "machine" is translated to "mesin" and "learning" to "pembelajaran," 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. SmA 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

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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 SmA 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 SmA Approach 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 Single Approach 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 coding process and thematic analysis to answer the research questions.

a. Coding process

- 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.
- 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. SmA accured in a combination of translation procedures, such as rendering with additional clarification.
- Pattern and frequency analysis:
- 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.
- Grouping translation strategies into themes, it was found similar strategies, such as fidelity and adaptation, were grouped into broader themes.

b. Thematic Analysis

After the coding process, the data were analysed in more depth to develop themes that answered the research questions:

- 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.
- 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.
- 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 SmA is often used for abstract or compound terms because it provides the necessary additional context.

The analysis revealed that both single (SA) and SmA (SmA) approaches utilized various translation procedures for Technology terms, including direct translation, transliteration, adaptation, and explanation. SmA 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.

Questionnaire. Based on the results of observation the term classification in this data analysis of this study used a questionnaire distributed to 30 local educators to evaluate the effectiveness of the

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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 SmA 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 5.

Table 5.
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	SmA	3.8	Helps to understand new terms, but sometimes considered too complex
Conceptual term	SmA	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 illustrate the average score of respondents' assessment of each category of terms and translation strategies.

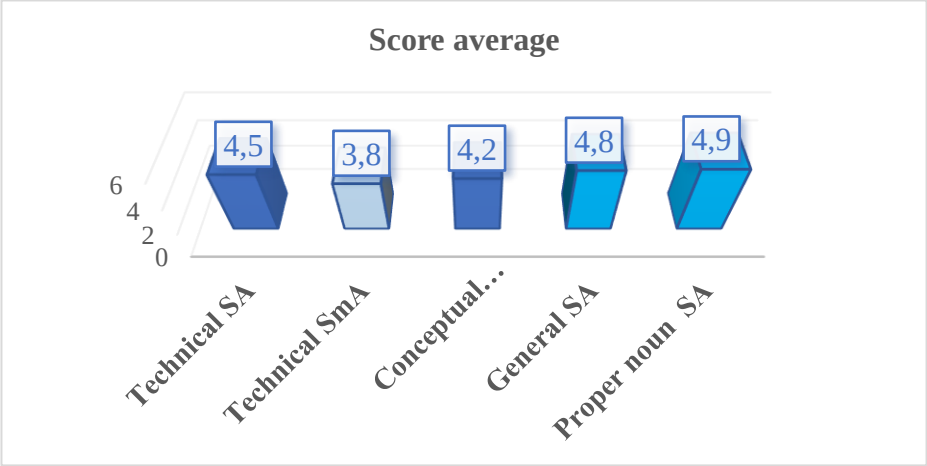

Figure 1.
The chart of average score of respondents' assessment.

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 SmA 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

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terms using the SmA, 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.

a. text corpus selection:

- Selecting a text corpus that contains specific technology terms, both in English and their translations in Indonesian.
- Ensuring 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.

b. technology term extraction:

- Searching for terms in the corpus to find examples of their use in the source context (Source Text/ST).
- Searching for their translations in the target language corpus (Target Text/TT).
- Organize the extracted data into predetermined categories, such as proper nouns, common nouns, abstract nouns, and compound nouns.

c. data organization and analysis:

- Group the terms found in the corpus according to the translation procedures used: SA→identified terms that are translated directly without significant changes. SmA→ identified terms that are translated with a combination of procedures, such as phonetic adjustments with additional explanations.
- Analyze the pattern and suitability of term translation with the linguistic and cultural context in the corpus.

d. validation of findings:

- Compare corpus data with the results of document analysis to confirm the consistency of the translation procedures.
- Ensure 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, rank, and frequency class. This finding provided empirical data on the use of terms in various linguistic contexts, included of:

a. noun categories examined, including term selected of relevant technology terms, such as innovation, systems, server, and windows, are identified based on noun categorization:
: (1) proper nouns: specific names that refer to certain technological entities, for example: server, windows, javascript, bluetooth. (2) abstract nouns: abstract terms that include technological concepts, for example innovation, artificial intelligence. (3) general nouns: general nouns that are often used in technological discussions, for example systems, computer, data.

b. 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).

c. 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.

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Validation results. 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 SmA approach, as shown in the following table.

Table 6.
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 occurrence of a term in the corpus based on the number of occurrences or rank. The lower the number in the frequency class, the more frequently the term occurs. Conversely, the higher the number, the less frequently the term occurs. In Frequency Class 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. Frequency class 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 ranks illustrated in the table above illustrate the position of the terms based on the order of their frequency of occurrence in the corpus. "bluetooth" with a rank of 5,557,368 is in a very low position in terms of frequency of occurrence, meaning that the term is very rare. In contrast, "smartphone" with a rank of 2,730 shows that this term appears more frequently in the corpus, but is still less popular than other terms with lower ranks. "Innovation" with 36 occurrences and a frequency class 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 occurrence and a frequency class of 24 is very rarely used in the corpus, so it occupies the highest frequency class. In other words, this frequency class helps to provide an idea of the extent to which the term is used in the technology or academic texts in the corpus.

This indicates the level of use of these terms in academic or science and technology contexts, which was visualized in more detail in the following diagram.

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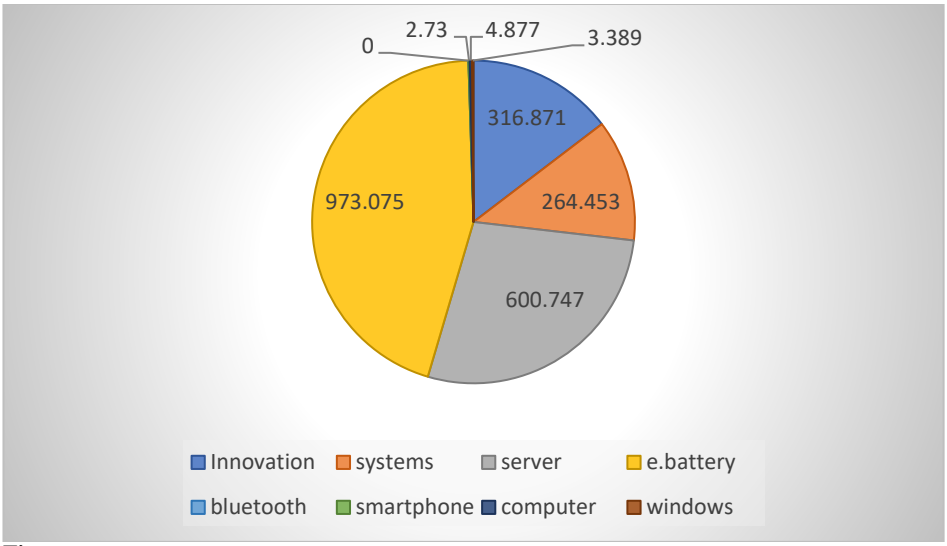

Figure 2.
The chart of of popularity or occurrence of a term in the corpus based.

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 occurrences than other terms such as "bluetooth" and "e. 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 SmA 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 source text and the need for adaptation to the target language, ensuring a translation that is terminologically and contextually accurate.

7. Conclusion

This study concludes the importance of exploring translation procedures for nouns in technological terminology. The SmA approach, which integrates transference, rendering, and addition, effectively bridges the meaning gap between English and Indonesian. As global communication relies heavily on accurate technical translations, especially for noun-dominated terminology, this study highlights the need for systematic guidelines. SA is optimal for widely recognized terms, while SmA is better suited for conceptual terms requiring clarification. Through text analysis, observation, and triangulation of frequency data, this research addresses its core problem formulations, providing a foundation for further studies. Based on the results of text data analysis, observation, and triangulation of frequency data and numbered rank of technology terms from the table above, this study answers the three core problem formulations as follows:

(1) Forms of technology terms: the analysis shows that Technology terms can be categorized into several types of nouns, namely: Proper Noun, such as "windows" with 14,244 occurrences and ranked 3,389th, and "bluetooth" which is less frequently used (1 occurrence, ranked 5,557,368th). Abstract noun, such as "innovation" with 36 occurrences (ranked 316,871) which appears quite often in academic and technology texts. General/common noun, such as, "systems" with 47 occurrences (ranked 264,453). These data confirm that the variation in noun forms reflects the need for terminology to accommodate the diversity of technology concepts in various educational and technological contexts.

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(2) Translation procedures used as the results of text analysis and observation identified the dominant translation procedures: SA used for widely known terms such as "smartphone" (17,868 occurrences, ranked 2,730th) and "computer" (9,499 occurrences, ranked 4,877th). SmA applied to complex terms such as "innovation" or "e. battery" (7 occurrences, ranked 973,075th), which require additional context to clarify their meaning in the target culture. The triangulation results showed that low-frequency terms tend to require more adaptive procedures to improve audience understanding. Transference procedures dominate in the translation of noun technology terms because many of these terms have become globally recognized loan terms, especially in the context of science and technology. However, for less familiar or descriptive terms, adaptation and literal procedures are more often used to ensure proper understanding in the target language context.

(3) Audience preferences for translation results: observations and surveys showed that educators prefer translations that are consistent and adaptive. Consistency of terms usage that appear frequently in the corpus (smartphone, computer) are expected to be translated uniformly to support understanding. Adaptively, terms with low occurrences (bluetooth, e. battery) are recommended to be translated using additional approaches such as context explanations to make them easier to understand.

The analysis of frequency, ranking, and occurrence of technological nouns using corpus tools reveals that transference is the dominant translation procedure. High-frequency terms like "smartphone" (17,868 occurrences) and "computer" (9,499 occurrences) retain their original form, as these are internationally recognized. Similarly, "bluetooth" remains unchanged due to its status as a trademark. The adaptation procedure adjusts terms like "innovation" to "i*novasi*", aligning with target language structure while preserving meaning. Meanwhile, literal translation applies to descriptive terms like "e. battery" (translated as *electronic battery*) or *server*, which retain their form due to widespread acceptance. The findings indicate that the dominant procedure combines transference, adaptation, and literal translation, reflecting Vermes' (2003) and Newmark's (1988) SmA concept and aligning with the triplet method. This approach ensures fidelity, contextual relevance, and readability, particularly in the technological and academic domains.

Research Implications: this study reveals that the choice of translation procedures should consider the level of term frequency and the context of its use. The triangulation approach with corpus frequency data and observations supports this finding, providing a strong basis for more effective Technology term translation recommendations in academic contexts. Translating Technology terms requires consideration of the context and complexity of the term. Simpler or universal terms tend to use the SA with little or no adjustment, while more technical terms or new and complex concepts often require the SmA to ensure clear and precise understanding in the target language. This approach also reflects how cultural and linguistic factors in the target language play a significant role in choosing the most effective translation procedure. This research opens up opportunities for further exploration in the field of applied linguistics, particularly regarding the translation of cross-cultural terms and the influence of socio-cultural context on the adaptation of new terms.

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