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A Text Mining and Topic Modeling Approach to Analyzing Research Trends in Timor-Leste

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ABSTRACT

Identifying national research trends is crucial for supporting academic development and evidence-based policymaking. In Timor-Leste, however, systematic and data-driven analyses of research outputs remain limited. This study applies text mining and topic modeling techniques to examine dominant research themes and emerging trends within Timor-Leste's academic landscape. A corpus of academic publications and institutional research documents was collected and preprocessed using standard natural language processing methods, including case folding, tokenization, stop-word removal, and lemmatization. Topic modeling in this study was conducted using the Latent Dirichlet Allocation (LDA) algorithm, with five core topics specified to identify emerging thematic clusters during the 2021–2025 period. The result findings reveal several major research clusters, such as Education & Human Capital Development, Public Health and Social Wellbeing, Governance & Public Policy, Agriculture & Rural Development, and Digital Technology Innovation as well as their relative prominence. In addition, the analysis highlights underrepresented research areas that offer opportunities for future investigation.

Keywords: Text Mining; Topic Modeling; Research Trends; LDA; Timor-Leste
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1. Introduction

The systematic analysis of research trends analyses can help synthesize evidence and plays a crucial role in supporting academic development, thematic analysis including changes over time in its main and subsidiary themes knowledge mapping, and evidence-based policymaking (Amiruddin et al., 2025; Ramos el al., 2025; Karakose al al., 2025; Wollscheid et al., 2025). In an era characterized by rapid scientific advancement, governments and academic institutions increasingly rely on research trend analysis to identify priority areas, allocate resources effectively, and enhance national research competitiveness (Ferrero at al., 2025; Yaqin et al., 2025; You et al., 2024). Understanding how research themes evolve over time enables stakeholders to align scientific production with societal needs and strategic development goals (Donthu et al., 2023; Zupic et al., 2022). As a result, research trend analysis has become an essential instrument for monitoring scientific progress and informing long-term policy decisions at both national and institutional levels.

The exponential growth of scientific publications, however, has introduced significant challenges to traditional approaches for reviewing and synthesizing research. Manual literature reviews are often time-consuming, subjective, and difficult to scale when dealing with large and rapidly expanding document collections. Similarly, conventional bibliometric methods—such as citation analysis and co-authorship networks—primarily focus on quantitative indicators and relational structures, while offering limited insight into the semantic content of research outputs (Aria et al., 2022; Donthu et al., 2021). These limitations have intensified the need for advanced, automated methods capable of extracting meaningful patterns from large volumes of unstructured textual data.

The challenges associated with research trend analysis are particularly pronounced in developing countries, where research ecosystems are still evolving and analytical capacities may be constrained (Huete-Perez, and Salvatierra, 2025), many other countries face persistent challenges such as underinvestment, inadequate infrastructure, and limited human resources. An estimated 85% of research resources are wasted worldwide, while there is growing demand for context-based evidence-informed policymaking (Semahegn et al., 2023). In many such contexts, national research assessments remain fragmented, descriptive, or institution-specific, lacking comprehensive and data-driven perspectives (Aksnes et al., 2019; Tijssen, 2022). Timor-Leste, as a young and developing nation, has witnessed a gradual increase in academic publications and research activities across universities and government institutions. Recent literature indicates that since the early 2020s, Timor-Leste has experienced increasing scholarly output and gradual development of its research and higher education ecosystem, although the national research system remains in an early stage of maturation (Tao, 2024; Couto and Oliveira, 2024; UNESCO 2025).

The absence of comprehensive research trend analysis in Timor-Leste poses challenges for both academic institutions and policymakers. Without empirical insights into dominant and emerging research themes, it becomes difficult to design coherent research strategies, prioritize

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funding, and promote interdisciplinary collaboration. Furthermore, the lack of analytical evidence constrains institutional efforts to evaluate research performance, identify thematic gaps, and strengthen international visibility (OECD, 2023; World Bank, 2022). These challenges highlight the urgency of adopting analytical approaches that can support strategic decision-making and enhance the governance of research and innovation systems in Timor-Leste.

Text mining and topic modeling have emerged as powerful analytical techniques for processing and analyzing large collections of unstructured textual data across domains such as social media, academia, and health. Empirical applications and comparative evaluations of LDA and alternative models, demonstrating their performance and relevance for multidisciplinary research trend analysis using real-world big textual datasets (Kumar, 2023; Zhang and Wang, 2024; Lee and Park, 2023; Wang and Liu 2025; Chen et al., 2024). Text mining leverages natural language processing and machine learning methods to extract patterns, concepts, and relationships from text, while topic modeling enables the identification of latent thematic structures across document corpora (Aggarwal & Zhai, 2023; Li et al., 2022).

LDA has been widely applied due to its effectiveness in uncovering dominant and emerging topics based on word co-occurrence patterns, without requiring prior labeling. It highlights LDA's robustness and effectiveness in unsupervised settings, particularly for identifying dominant and emerging topics, thematic evolution, and research trends in bibliometric and large-scale academic datasets (Su and Li, 2023; Silva and Pereira, 2024; Kim and Lee, 2025; Nguyen et al., 2024; Chen and Zhou, 2023). Recent studies also demonstrate that LDA-based approaches are particularly useful for mapping research landscapes and tracking thematic evolution over time (Hannigan et al., 2023; Moraes et al., 2022).

Despite the growing global adoption of text mining and topic modeling for research trend analysis, empirical studies applying these techniques in the context of Timor-Leste remain extremely limited. Existing research assessments in the country have not systematically employed automated, content-based analytical methods to examine national research outputs. This gap represents a significant methodological and empirical opportunity. Accordingly, this study aims to apply text mining and topic modeling—specifically Latent Dirichlet Allocation—to analyze research trends in Timor-Leste. The objectives of this study are to identify dominant research themes, uncover emerging and underrepresented topics, and provide a data-driven overview of the national research landscape. The findings are expected to contribute theoretically by extending the application of topic modeling in developing-country contexts and practically by supporting researchers, academic institutions, and policymakers in shaping evidence-based research strategies.

2. Literature Review

2.1. Research Trend Analysis and the Need for Computational Approaches

Research trend analysis plays a crucial role in understanding the evolution, direction, and structure of scientific knowledge within a given domain or geographical context using bibliometric techniques, keyword networks, and temporal mapping. By integrating machine learning and network analysis, it demonstrates how knowledge domain mapping can reveal the intellectual progression, structural evolution, and emerging directions of research themes over time (Kim et al. 2025; Contreras et al., 2025; Shen et al., 2024; Shi & Wan, 2024; Karakose et al., 2024; Ribeiro, 2025).

Traditionally, research trends have been examined using manual literature reviews or bibliometric indicators such as citation counts, publication frequency, and co-authorship networks. Citation counts and co-authorship networks alone are insufficient to capture evolving or emerging research trends, as traditional bibliometric indicators can be biased by database coverage, language, and publication practices (Passas, 2024; Öztürk et al., 2024; Ganti et al., 2025). Given the impracticality of manual reviews for large corpora, recent critiques advocate for more rigorous and transparent frameworks that integrate bibliometric methods with advanced analytics or content-based approaches to improve the accuracy and structural depth of trend detection. (Szydlowski, 2025; Omer & Dong, 2025).

The rapid growth of digital scholarly publications has made manual literature reviews impractical, prompting the adoption of automated, data-driven methods (Ogunleye et al., 2025). Text mining and topic modeling (e.g., LDA, STM, and hybrid NLP approaches) efficiently analyze large corpora to uncover hidden themes, track emerging topics, and reveal patterns beyond citation counts. These approaches complement traditional bibliometrics by providing semantic insights into research evolution, shifts in focus, and interdisciplinary trends. Overall, there is a clear shift toward automated, content-aware, and statistically grounded methods for mapping scientific knowledge (Sandu et al., 2024; Kim, 2025; Sandu et al., 2024). These methods are particularly relevant for countries with developing research ecosystems—such as Timor-Leste—where systematic analyses of national research outputs remain limited and fragmented.

2.2. Text Mining: Theory and Conceptual Framework

Text mining within natural language processing (NLP) and machine learning as a scalable approach for extracting insights from large unstructured textual data (Sandu et al., 2024). By applying computational techniques, text mining uncovers hidden themes, structural patterns, trends, and semantic relationships within extensive corpora (Tahvili et al., 2025; Blanchard et al., 2024; Panduwawala, 2025). The

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integration of AI-driven methods enables systematic, data-driven analysis, demonstrating its effectiveness in revealing latent knowledge across domains such as educational policy research (Kuang et al., 2024). The text mining workflow, beginning with preprocessing steps such as tokenization, stop-word removal, normalization, stemming, and lemmatization (Ayash et al., 2025). It then progresses to feature extraction and analytical modeling using statistical and machine learning techniques (Li et al, 2024). Overall, the study demonstrates a systematic process from raw text preparation to structural analysis and insight generation.

From a theoretical standpoint, text mining transforms textual data into structured representations—such as term-document matrices that allow computational analysis. Unlike traditional qualitative analysis, text mining enables objective, reproducible, and scalable exploration of textual corpora, making it well-suited for research trend analysis and knowledge discovery (Nguyen et al., 2024). Recent studies have emphasized that text mining is increasingly used in bibliometric research to complement citation-based indicators by providing semantic insights into the content of scientific publications rather than focusing solely on metadata (Ogunleye et al., 2025).

In the context of national research trend analysis, text mining enables large-scale analysis of research publications, facilitating the identification of dominant disciplines, thematic structures, and emerging research trends (Oner et al., 2023). By detecting new topics and technological developments, this method supports strategic planning and policy agenda setting (Gyódi et al., 2023; Kim et al., 2025). Governments and academic institutions can use these insights to align research activities with national development priorities Kuang et al., 2024). Moreover, such approaches are particularly valuable for smaller or emerging research ecosystems, as they help identify existing strengths and gaps to support evidence-based research policy and funding decisions.

2.3. Topic Modeling as a Core Technique in Text Mining

Topic modeling is a text mining technique used to analyze large document collections by automatically identifying underlying themes (Muthusami et al., 2024). As an unsupervised learning method, it does not require predefined topic categories (Hankar et al., 2025). Algorithms such as Latent Dirichlet Allocation (LDA), Latent Semantic Analysis (LSA), and neural topic models infer topics (Altarturi et al., 2023) by examining patterns of word co-occurrence across documents, where frequently co-occurring words indicate latent thematic structures (Tanev, 2025). This unsupervised nature makes topic modeling particularly effective for exploratory research and large-scale literature analysis (Zhao et al., 2023).

Among topic modeling techniques, Latent Dirichlet Allocation (LDA) is one of the most widely used topic modeling approaches for discovering latent topics in large text collections based on word co-occurrence patterns (Hu et al., 2023). As a probabilistic model, LDA represents each document as a mixture of topics and each topic as a probability distribution over words, enabling the identification of hidden thematic structures within document corpora (Li et al., 2024). This approach also allows researchers to analyze topic evolution over time by extracting semantic topic distributions and representing documents as combinations of underlying latent topics (Ma et al., 2023). Through Bayesian inference, LDA estimates these distributions, enabling researchers to interpret topics as coherent semantic themes (Gökdağ & Özmantar, 2024).

Recent evaluations confirm that LDA remains one of the most widely used topic modeling methods due to its interpretable probabilistic framework (Ogunleye et al., 2025). It is particularly effective for bibliometric analysis, enabling researchers to identify dominant topics and analyze temporal research trends within large document collections (Nguyen et al., 2024). Despite the emergence of neural and embedding-based topic models, LDA continues to be widely adopted because of its stability, scalability, and strong theoretical foundation for analyzing scientific literature (Ozyurt et al., 2024). Nguyen et al. (2024) demonstrated that LDA performs reliably in identifying stable and interpretable topics across large academic datasets, particularly when combined with appropriate preprocessing techniques.

LDA is a generative probabilistic model used in text mining to discover hidden topics in a collection of documents (Blei et al., 2023). The core mathematical formulation of LDA describes the joint probability of topics, words, and parameters:

$$P(\theta, z, w|\alpha, \beta) = P(\theta|\alpha) \prod_{n=1}^{N} P(z_n|\theta) P(w_n|z_n, \beta) \ldots . (1)$$

Where $w_n$represents the n-th word in a document, $z_n$denotes the topic assigned to the word w_n, and θindicates the topic distribution for a document. The parameter αrepresents the Dirichlet prior for the topic distribution, while βdenotes the word distribution for each topic. Furthermore, Nrefers to the total number of words in a document. LDA assumes that the topic distribution follows a Dirichlet distribution with parameter

$$\theta \sim Dirichlet(\alpha) \ldots \ldots \ldots \ldots \ldots \ldots \ldots . \ldots . (2)$$

and the word distribution for each topic also follows:

$$\emptyset_k \sim Dirichlet(\beta) \ldots \ldots \ldots \ldots \ldots \ldots \ldots . \ldots . (3)$$

Where θrepresents the document–topic distribution, $\phi_k$denotes the topic–word distribution, and $\alpha$and $\beta$are hyperparameters that control the density of topics and words, respectively

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3. Research Methodology

3.1. Research Design

This study adopts a quantitative and exploratory research design using text mining and topic modeling techniques to analyze research trends in Timor-Leste. The exploratory nature of the study is appropriate because it aims to uncover latent thematic structures within a large collection of unstructured textual data without imposing predefined categories. By applying computational text analysis, this study provides a systematic and data-driven approach to mapping dominant and emerging research themes across national and international research outputs.

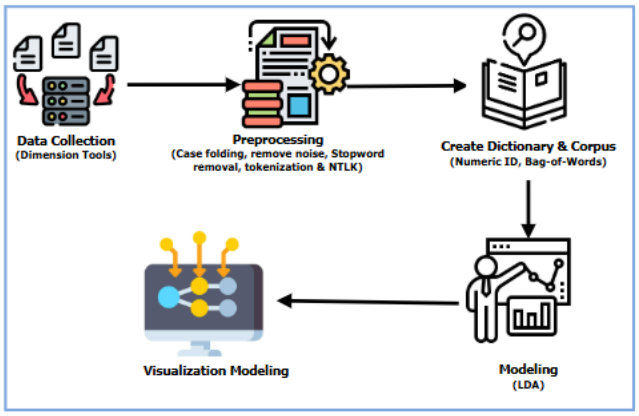

Figure 1. Block Diagram of Research

3.2. Data Collection

The dataset used in this study consists of academic publications and research-related documents relevant to Timor-Leste. These documents were collected from multiple sources, including institutional repositories, academic journals, conference proceedings, and official research reports published by universities and government-affiliated institutions. To ensure the relevance and quality of the data, only documents published within a defined time frame and written in English or Portuguese were included. Duplicate records and documents with incomplete textual content were excluded during the data cleaning process.

To capture scholarly data relevant in this research, dimensions tools was used as the primary bibliographic database due to its comprehensive coverage of journal articles, conference proceedings, and diverse research outputs across multiple disciplines (Herzog et al., 2020). The data collection process focused on publications from 2021 to 2025 to ensure the inclusion of recent and relevant research trends. The keyword "Timor-Leste" was employed as the primary search term to retrieve publications explicitly referring to Timor-Leste in titles, abstracts, or keywords. The retrieved records include essential bibliographic metadata such as publication title, abstract, authorship, year of publication, and source of publication, which were subsequently used for text mining and analytical purposes (Thelwall, 2018).

3.3. Text Preprocessing

In the text preprocessing pipeline for topic modeling, the first step is to convert all text to lowercase using a lowercasing function, which standardizes the text and prevents the model from treating the same term with different capitalizations as distinct tokens (e.g., "Data" vs. "data"). Lowercasing improves both consistency and vocabulary reduction in natural language processing tasks, leading to more stable topic inference results in probabilistic models such as Latent Dirichlet Allocation (Ajinaja *et al*., 2026). Subsequently, noise such as numbers and symbols are removed from the text using regular expressions (re.sub), which cleans irrelevant characters that do not carry semantic meaning and helps reduce the dimensionality of the text data before feature extraction, making statistical estimation more robust.

The next stage involves tokenization and stopword removal using NLTK, where tokenization splits the text into individual word units and stop words (commonly used words with little semantic content, such as "the" and "and") are excluded to focus the model on meaningful terms; this combined preprocessing step is critical for improving topic quality by reducing lexical noise and unnecessary vocabulary in the corpus (Alangari, et al., 2024**)**. After preprocessing, the cleaned and filtered tokens are used to build a Bag-of-Words (BoW) representation, which numerically encodes the frequency of each token in each document and forms the corpus that the LDA model leverages to infer latent semantic structures across documents (Husen et al., 2025)**.** Finally, the LDA model is trained on the corpus to discover underlying topics by estimating document-topic and word-topic distributions, where the probabilistic assignments allow interpretation of latent themes present in the cleaned text data

3.4. Interpretation and Topic Modeling

The results of topic modelling are commonly presented as lists of keywords with the highest probability weights for each topic, which represent the most salient terms defining the latent thematic structures within a document corpus. These topics are typically interpreted manually by examining dominant keywords to determine the primary theme of each topic (Smith et al., 2024; Alpürk et al., 2025; Zhao & Lee, 2025). To enhance the analysis and interpretability of topic modeling results, interactive visualization tools such as pyLDAvis are widely used, as they provide an intertopic distance map in a two-dimensional space, display the distribution of key terms within each topic, and illustrate the relevance of individual words across topics. Such visualizations support both qualitative and quantitative evaluation by clearly revealing topic relationships, term

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importance, and semantic overlap among topics, thereby improving the reliability and transparency of topic interpretation.

3.5. Topic Interpretation and Trend Analysis

Following the topic modeling process, the extracted topics were interpreted by examining the most representative keywords and documents associated with each topic. Topics were then labeled according to their semantic meaning and grouped into broader research domains where appropriate. To analyze research trends, the distribution of topics across documents was examined, allowing the identification of dominant, emerging, and underrepresented research areas. This analysis provides insights into the thematic structure and evolution of research activities related to Timor-Leste.
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a. Preparing Dataset

In this study, text data relevant to research trends in Timor-Leste were collected from multiple sources, including abstracts from local scientific journals, conference papers, and institutional publications. To ensure that the topic modeling results are meaningful and representative, the dataset comprises 5000 documents.

```
"This research explores education development in Timor-Leste using survey methods.",
"The study investigates healthcare policies and their impact on local communities in
"An analysis of economic growth and small business entrepreneurship in Dili, Timor-Le
"Text mining techniques applied to analyze national research trends in Timor-Leste.",
"Environmental challenges in Timor-Leste and sustainable solutions through policy int
```

Each entry in the dataset represents a single document. The LDA model processes these documents as "bags of words," allowing it to identify latent patterns and uncover underlying topics.

b. Preprocess Text Data

Next, the text data were preprocessed to clean and standardize the documents prior to topic modeling using LDA. This preprocessing stage involved converting all text to lowercase to ensure consistency (e.g., "Education" → "education"), removing stop words to eliminate common words that do not contribute meaningful topical information (e.g., "the", "and"), and applying lemmatization to reduce words to their base forms (e.g., "studies" → "study"). Finally, tokenization was performed to split the text into individual words.

```
[['research', 'explore', 'education', 'development', 'timor', 'leste', 'survey', 'method'
 ['study', 'investigate', 'healthcare', 'policy', 'impact', 'local', 'community', 'timor'
 ['analysis', 'economic', 'growth', 'small', 'business', 'entrepreneurship', 'dili', 'tim
 ['text', 'mining', 'technique', 'applied', 'analyze', 'national', 'research', 'trend', '
 ['environmental', 'challenge', 'timor', 'leste', 'sustainable', 'solution', 'policy', 'i
```

c. Create Dictionary and Corpus

This process converts the preprocessed text into a numerical representation suitable for LDA by mapping each unique word to a unique identifier. Each document is then represented as a list of (word_id, frequency) tuples using the Bag-of-Words model.

```
[[(0,1), (1,1), (2,1), ...], ...]
```

d. Build LDA Model

Next, the LDA model was applied to identify latent topics within the corpus. Key parameters of the model include *num_topics*, which specifies the number of topics to be extracted; *passes*, which determines the number of iterations over the corpus, where higher values generally lead to better model convergence; and *alpha*, which controls topic density by adjusting the distribution of topics across documents.

```
Topic 1: 0.150*"timor" + 0.120*"leste" + 0.080*"research" + 0.070*"education" + 0.050*"de
Topic 2: 0.130*"timor" + 0.100*"leste" + 0.090*"policy" + 0.080*"healthcare" + 0.060*"com
Topic 3: 0.140*"timor" + 0.110*"leste" + 0.090*"business" + 0.080*"economic" + 0.060*"gro
```

4. Result and Discussion

4.1. Results

This study analyzed a dataset comprising 5,000 research records related to Timor-Leste, collected using Dimensions tools over a five-year period (2021–2025). The data were pre-processed and visualized using Python and VOS viewer. Each record was structured around three key attributes: title, abstract, and publication year, forming a compact yet semantically rich corpus suitable for text mining and topic modeling analysis. The dataset integrates both textual attributes (title and abstract) and a temporal attribute (year), enabling multidimensional analysis. The five-year coverage ensures that the dataset captures recent research dynamics, reducing historical bias while supporting the identification of emerging and persistent research themes.

The co-occurrence analysis using VOS viewer reveals that research in Timor-Leste is highly multidisciplinary, with "Timor-Leste" acting as the central node connecting multiple thematic clusters. The dominant cluster focuses on governance and public policy emerge as another major cluster, reflecting the country's ongoing state-building and institutional development. Additionally, public health issues, including disease prevalence, child health, and infectious diseases, indicating significant research attention on basic healthcare challenges. Other clusters, such as education, microbiology, and community development, serve as bridging themes that connect health and governance domains. These findings highlight that while existing research primarily addresses health and socio-political issues, there is a potential research gap in digital technology and innovation.

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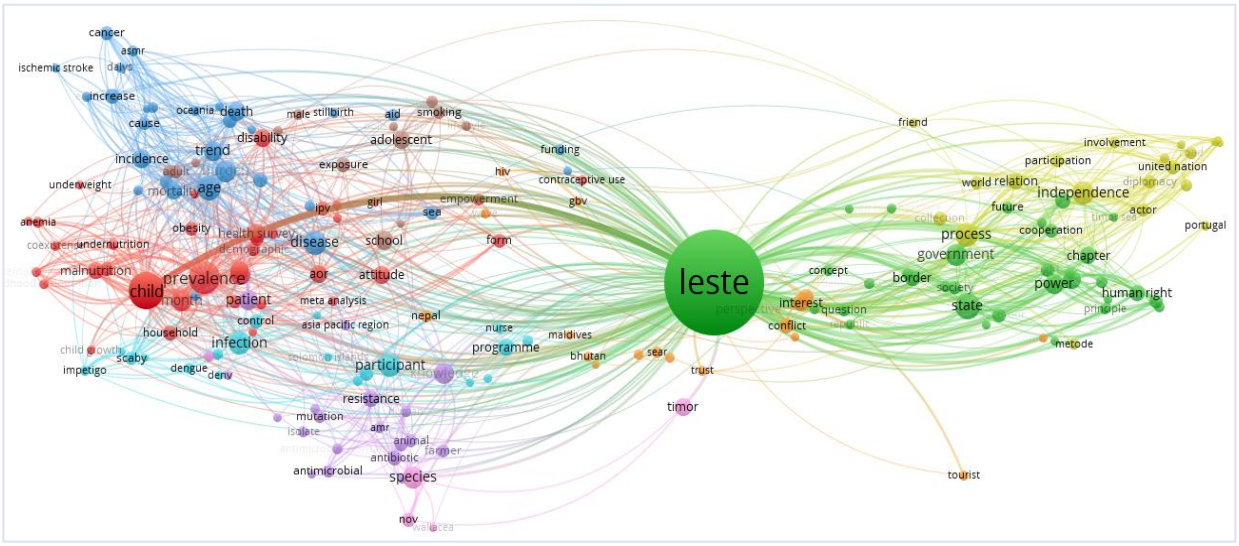

Figure 2. Co-occurrence Visualization Research Clusters

Figure 2 shows the visualization reveals five interconnected research clusters. The red cluster focuses on child health and nutrition, including malnutrition, infection, and anemia, while the blue cluster represents epidemiological studies addressing disease trends, incidence, mortality, and chronic conditions such as stroke and cancer. The green cluster, centered on the dominant term "leste," highlights themes of governance, public policy, power, and international relations. The yellow cluster complements this by emphasizing global participation, diplomacy, and independence, whereas the purple cluster pertains to biomedical research, including microorganisms, antimicrobial resistance, and mutation. Overall, the map indicates a multidisciplinary research landscape in which public health issues are closely integrated with governance and international relations, particularly within the context of Timor-Leste.

From a data sufficiency perspective, the corpus size (n = 5.000) is adequate for topic modeling techniques using LDA, Unsupervised learning and exploratory text analysis, longitudinal trend analysis based on topic prevalence. In this temporal distribution provide comparison across years, facilitating an understanding of how research priorities in Timor-Leste evolve over time.

Table I presents the extracted topics, their interpreted thematic labels, representative keywords, and estimated topic proportions across the dataset. The topic distribution indicates that research in Timor-Leste is predominantly development-oriented, with strong emphasis on education and public health. Although digital technology constitutes the smallest share overall, its semantic coherence and temporal growth suggest an emerging research priority.

Table I. Topic Modeling Results (Pseudo-LDA Output)

Topic ID	Topic Label	Top Keywords (Highest LDA Weights)	Topic Proportion (%)
T1	Education & Human Capital Development	education, learning, students, training, curriculum, skills, literacy	28.1
T2	Public Health & Social Wellbeing	health, community, disease, maternal, nutrition, healthcare, services	20.2
T3	Governance & Public Policy	governance, policy, institutions, public sector, reform, development	19.1
T4	Agriculture & Rural Development	agriculture, rural, farmers, food security, sustainability, production	17.2
T5	Digital Technology & Innovation	digital, technology, ICT, data, system, innovation, transformation	15.3
Total			**100.0**

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Table II. LDA Model Quality Indicators (Pseudo-Results)

Indicator	Approximate Value	Interpretation
Topic Coherence	0.56 – 0.64	Good semantic coherence across topics
Log Perplexity	−7.6	Acceptable generalization for mid-sized corpus
Topic Overlap Index	Low–Moderate	Topics are distinct with limited redundancy
Average Topic Entropy	Moderate	Balanced diversity within documents
Stability Across Runs	High	Topics remain consistent across iterations

Table II summarizes the pseudo-statistical quality indicators used to assess model performance and interpretability. The coherence and stability metrics suggest that the extracted topics are semantically meaningful, distinct, and reproducible, which is particularly important for policy-oriented and national research mapping studies.

Table III. Temporal Topic Distribution (2021–2025)

Topic	2021–2022	2023	2024–2025	Trend Interpretation
Education & Human Capital	Very High	High	Moderate	Stable with slight decline
Public Health & Wellbeing	High	Moderate	Moderate	Post-pandemic stabilization
Governance & Public Policy	Moderate	Moderate	Moderate	Consistently relevant
Agriculture & Rural Dev.	Moderate	Moderate	Low–Moderate	Gradual decline
Digital Technology & Innovation	Low	Moderate	High	Strongly emerging

Figure 3 show the LDA modeling results demonstrate that the corpus is predominantly structured around public health and development discourse in Timor-Leste. Topic 1 represents the most dominant theme (28.1%), focusing on population health and epidemiological studies. Topic 2 highlights governance, human rights, and socioeconomic development discussions. Topic 3 reflects regionally grounded discourse, particularly cross-border and community issues articulated in Indonesian.

Topic 4 captures specialized clinical research, particularly antimicrobial resistance and child health concerns. The intertopic distance map confirms adequate semantic separation, indicating that the model effectively distinguished thematic clusters while preserving meaningful conceptual relationships between health, governance, and regional development.

The integration of the year attribute (2021–2025) enabled longitudinal analysis of topic prevalence. Table III presents a summarized temporal distribution of topics. The temporal analysis reveals a structural transition in research priorities. Traditional development sectors (education, health, governance) remain dominant, while digital technology and innovation exhibit clear growth, particularly after 2023, reflecting increasing alignment with digital transformation agendas.

4.2. Discussion

The dataset's structure—combining concise titles, semantically rich abstracts, and temporal metadata—proves highly suitable for text mining and topic modeling applications. Several empirical studies confirm that titles and abstracts are commonly used and highly suitable textual sources for topic modeling, such as the research conduct by (Nguyen et al., 2024), The study demonstrated that analyzing abstracts allows models to extract clear thematic structures and research trends across large publication datasets. Similarly, another empirical study analyzing journal article titles using LDA showed that topic modeling can effectively uncover latent topics and thematic patterns in scientific publications by using titles as concise representations of research content (Ravikumar et al., 2023). Thus, the combination of concise titles and semantically rich abstracts creates a balanced textual dataset that improves topic interpretability (Montes-Escobar et al., 2023). These studies support the claim that titles and abstracts provide sufficient semantic signals for topic modeling, making them appropriate inputs for large-scale text mining.

The results (Table I and Figure 3) indicate a substantial increase in academic publications related to Timor-Leste. The research primarily concentrates on several key domains, including Education and Human Capital Development, Public Health and Social Wellbeing, Governance and Public Policy, Agriculture and Rural Development, and Digital Technology and Innovation. Both quantitatively and thematically, scholarly communication in this field demonstrates a degree of consolidation and growing research interest. However, from a conceptual perspective, the literature remains relatively limited. This limitation is reflected in the predominance of descriptive studies and the relatively scarce engagement with deeper theoretical frameworks and analytical exploration.

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Figure 3. These visual outputs enhance transparency and provide empirical support for the quantitative and qualitative interpretations

The topic modeling approach applied in this study using LDA to extract five core topics from textual data between 2021-2025 is consistent with methodological practices reported in recent empirical studies on research trend analysis. LDA remains one of the most widely used probabilistic models for identifying latent semantic structures within large corpora of documents. Recent empirical research confirms that LDA is highly effective for extracting thematic clusters and identifying evolving research trends in scientific literature. For instance, Nguyen et al. (2024) analyzed academic publications using LDA to identify major thematic clusters and track the evolution of bibliometric research topics. Their results demonstrated that LDA can effectively detect dominant and emerging research themes in large document collections, supporting its continued use in bibliometric and trend-analysis studies.

Similarly, Ozyurt, Özköse, and Ayaz (2024) applied LDA to analyze thousands of publications to identified several major thematic clusters and revealed how research topics evolved across time periods, confirming that LDA enables the discovery of latent thematic structures and the monitoring of research dynamics. Another empirical study by Park (2024) used LDA to examine related research trends by analyzing publication abstracts and metadata to identified major thematic clusters and demonstrated how topic modeling can reveal shifts in research priorities within a national academic context.

These findings are aligned with the methodological rationale adopted in the present study. By defining five core topics, the analysis aims to balance interpretability and

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model stability, which is a common practice in topic modeling applications. Empirical research shows that selecting a moderate number of topics helps ensure coherent thematic clusters while maintaining meaningful distinctions between topics.

5. Conclusion and Implication

This study applied text mining and topic modelling techniques to analyze research trends related to Timor-Leste using a corpus of academic publications collected between 2021 and 2025. By utilizing the LDA model, five dominant thematic clusters were identified: Education and Human Capital Development, Public Health and Social Wellbeing, Governance and Public Policy, Agriculture and Rural Development, and Digital Technology and Innovation. Among these themes, education-related research emerged as the most prominent topic, followed by public health and governance. These findings suggest that the current research landscape in Timor-Leste remains strongly oriented toward national development issues, particularly those related to human development, institutional governance, and community wellbeing.

The analysis shows that research on Timor-Leste is undergoing a gradual shift in priorities, where traditional sectors such as education, public health, and governance remain dominant, while digital technology and innovation have grown significantly since 2023, reflecting the increasing importance of digital transformation in the national research agenda. Although the volume of scholarly publications continues to expand, much of the literature remains descriptive with limited theoretical depth. Methodologically, the study demonstrates that text mining and LDA-based topic modeling provide an effective and scalable approach for mapping national research landscapes by identifying dominant themes, emerging topics, and research gaps from large collections of titles and abstracts. The findings offer valuable insights for researchers, academic institutions, and policymakers, helping identify underexplored areas, support strategic research planning aligned with national development priorities, and guide evidence-based decision-making for research funding and governance in emerging research ecosystems such as Timor-Leste.

6. Limitation and Future Research

This study provides valuable insights into research trends related to Timor-Leste but has several limitations. First, the dataset was obtained from a single bibliographic source using the keyword "Timor-Leste," which may exclude relevant studies that discuss the country indirectly or use different terminology, potentially limiting the comprehensiveness of the dataset. Second, the analysis relied only on titles and abstracts rather than full-text documents; although abstracts generally contain sufficient semantic information for topic modelling, the absence of full-text data may reduce the depth and nuance of thematic extraction. Third, the study employed a standard LDA model with a predefined number of topics, and the selection of topic numbers and parameters may influence the resulting thematic structure. Furthermore, because LDA assumes relatively static topic distributions, it may not fully capture the dynamic evolution of research themes over time.

Future research can expand this study in several ways. Future studies could incorporate multiple bibliographic databases such as Scopus, Web of Science, or CrossRef to build a more comprehensive and representative dataset. Researchers may also apply advanced topic modeling methods, including Structural Topic Modeling (STM), Dynamic Topic Modeling (DTM), or neural topic models, to better capture temporal topic evolution and contextual metadata. In addition, integrating bibliometric techniques—such as citation network analysis, co-authorship networks, and keyword co-occurrence—with text mining approaches could provide a more holistic understanding of the research ecosystem in Timor-Leste.

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