

Framing the future

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Framing The Future: Exploring AI Narratives in Indonesian Online Media Using Topic Modelling

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Abstract

Artificial Intelligence (AI) is a transformative force shaping society, and online media plays a pivotal role in shaping public perceptions of it. Given the media's influence, understanding its framing of recent AI advancements, such as the emergence of Large Language Models (LLMs) like ChatGPT, becomes increasingly critical. These models have revolutionized human-machine interaction and are subject to media narratives that can significantly influence public understanding and policy. This research explores the framing of AI narratives in Indonesian online media through the utilization of topic modelling. The study aims to uncover the dominant narratives and themes surrounding AI, including the nuanced portrayal of LLMs and Chat GPT. Using a dataset of online articles and news pieces on AI in the Indonesian context, topic modelling analysis identifies and analyzes the key topics and sentiments. The findings reveal that Indonesian online media tends to portray AI positively, emphasizing its potential for innovation and economic growth. However, concern about ethical implications and job displacement are also present. These findings provide important insights for AI developers, journalists, and policymakers, highlighting the importance of balanced reporting to shape informed public opinion and ethical AI practices.

Introduction

Artificial Intelligence (AI) has emerged as a disruptive force that is reshaping various aspects of society, from healthcare and education to transportation and communication (Anderson & Rainie, 2023; Păvăloaia & Necula, 2023). Its rapid advancements have captured public attention, generating extensive discourse, particularly in online media, which serves as a pivotal space for shaping and disseminating public perception about AI. Given the media's significant role in shaping public opinion, understanding its framing of AI discourse becomes crucial (Nguyen & Hekman, 2022).

The advent of Large Language Models (LLMs) like ChatGPT marks a significant milestone in human-machine interaction, revolutionizing the way humans interact with machines through their ability to generate human-like text and engage in multi-turn conversations (Abdullah et al., 2022; Awasth & R. Kaveri, 2023; Guzman & Lewis, 2020; Hao et al., 2023; Mieczkowski et al., 2021; Naaman, 2022). However, these advancements are not merely technological milestones; they are subject to media narratives that can significantly influence public understanding, policy decisions, and ethical considerations.

A body of empirical work underscores the instrumental role of mass media in shaping the public concept of AI. A notable study by Vergeer (2020) and Nah et al. (2020), employing a comprehensive methodological framework that includes content analysis, topic modelling, and sentiment analysis, delineates how different media outlets vary in their thematic focus and sentiment toward AI. These studies also reveal notable gaps in AI-related coverage across different media categories, highlighting the need for a closer examination of media framing given its substantial impact on public perception.

An examination of previous literature reveals a variety of perceptions and representations of AI in the media. Garvey & Maskal (2020) critically questions the prevailing notion of a negative bias against AI in news media, contradicting commonly held beliefs and indicating a need for nuanced interpretations (Garvey & Maskal, 2020). In another vein, Yadav (2020) examines sentiment analysis and topic modelling specifically in news headlines, emphasizing the versatility of these techniques in understanding media narratives (Yadav & Shakya, 2022). Additionally, studies by Lee et al. (2020) and Zhai et al. (2020) provide further insight into the public perception of AI education and the evolution of AI conceptualization in mass media discourse, respectively, thereby enriching the understanding of how AI is perceived and discussed in different media platforms.

Collectively, these studies highlight the imperative of thoroughly analyzing media portrayals and public perceptions of AI. Such analysis is crucial for understanding the intricate societal dynamics surrounding AI, thereby informing policy, education, and ethical considerations.

This study will also employ the Social Construction of Technology (SCOT) framework to understand how various social groups interpret and influence AI technologies. SCOT emphasizes the importance of interpretative flexibility, relevant social groups, closure and stabilization, and technological frames in shaping technological development.

This study is particularly important in the Indonesian context, where AI is increasingly integrated into various sectors. Academically, understanding the media's framing of AI and the portrayal of LLMs like ChatGPT contributes to the fields of communication studies, media studies, and AI ethics. Practically, the findings can offer valuable insights for policymakers, journalists, and AI developers in Indonesia, enabling them to craft informed strategies that foster public engagement with AI technologies.

The thematic landscape of Artificial Intelligence (AI) narratives in Indonesia remains uncharted. For comparative insight, a study conducted in the Netherlands from 2000 to 2018 delineated a diverse array of topics frequently covered in AI-related news (Vergeer, 2020). Notably, the study revealed a marked increase in AI coverage in Dutch media, particularly from 2014 onwards. This period precedes the advent of generative AI technologies, such as ChatGPT, underscoring the need for a contextually tailored analysis in the Indonesian setting that incorporates the latest advancements in AI technology.

Despite the growing importance of AI and the increasing capabilities of LLMs, there

is a lack of comprehensive research that delves into how Indonesian online media frames these topics. This gap in the literature poses the research problem: How does Indonesian online media frame the narratives surrounding AI, and what are the dominant narratives and themes, including the nuanced portrayal of LLMs like ChatGPT?

To address this problem, the research aims to:

1. Uncover the dominant narratives and themes surrounding AI in Indonesian online media.
2. Analyze the key topics and sentiments prevalent in the media coverage of AI, with a particular focus on LLMs and ChatGPT.

Unpacking AI, LLMs, and Generative Models

Artificial Intelligence (AI) is a field of computer science that focuses on creating intelligent machines capable of performing tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making, and language translation. Large Language Models (LLMs) are the type of AI model that uses deep learning techniques to process and generate natural language text. LLMs are trained on massive amounts of text data and can generate coherent new content, including text, images, or music, based on patterns learned from existing data. Generative models, which include LLMs, are employed in various applications, such as language translation, content creation, and chatbots (Cao, 2023; Păvăloaia & Necula, 2023; Zhai et al., 2020).

Framing Theory in Communication Research: Understanding Media Narratives of AI

The concept of framing occupies a central position in the field of communication research, providing a nuanced understanding of how news media present and shape the reality of emergent technologies (Chuan et al., 2019; Vliegenthart, 2012). Framing Theory examines how topics are selectively presented, determining which aspects of a subject receive greater emphasis than others. This process is not a mere dissemination of information but a strategic construction that guides the audience's perception, interpretation, and memory. Framing, as part of the broader social construction of reality, underscores the power of media narratives in the co-creation of societal understanding (Güran & Özarslan, 2022; Scheufele, 1999; Vreese, 2005).

In this research, Framing Theory serves as a guiding framework. Media engage in a gatekeeping process, selecting which AI-related issues to discuss and from what perspectives. The framing of AI issues by the media plays a crucial role in shaping public narratives about AI. Media may emphasize specific aspects of AI, such as its potential benefits to advance technology and the economy, or concerns about unemployment and ethics. This framing influences the public's focus, shaping societal understanding and responses to AI technology. For instance, positive framing can increase support and investment in AI development, while negative framing can provoke fear and resistance. Through this framing process, the media not only convey information but also actively shape narratives and public perceptions of AI, ultimately affecting policymaking and direction of AI research.

In their study, Nguyen and Hekman (2022) utilized Framing Theory to dissect the portrayal of Artificial Intelligence (AI) in news media. Their research methodologically examined the interpretative frameworks employed by news outlets, revealing which aspects of AI are brought to the forefront of public discourse. By systematically analyzing content, they identified prevalent frames that shape the narrative around AI, highlighting the media's role in the portrayal of this technology (Nguyen & Hekman, 2022).

The implications of Nguyen and Hekman's findings are significant for

understanding public opinion formation and policymaking related to AI. By mapping the dominant frames, the study suggests potential influences on public attitudes and behaviors toward AI, as well as providing insights for policymakers about the public's perceived benefits and concerns. Such insights are instrumental for developing a balanced public dialogue on AI, ensuring that technology's portrayal is neither naively optimistic nor unduly pessimistic, but rather informed by a well-rounded spectrum of perspectives.

The Social Construction of Technology (SCOT)

The Social Construction of Technology (SCOT) framework offers a robust lens through which to analyze the societal dynamics influencing technology. SCOT posits that technology is not merely a product of technical efficacy but is shaped by social process and interactions among various social groups (Basu, 2023; Bijker, 2010; Octavianto, 2014). The core concepts of SCOT include interpretative flexibility, relevant social groups, closure and stabilization, and technological frames.

Interpretative flexibility means that technologies can have different meanings and uses for different social groups. This concept is crucial for understanding the diverse perspectives surrounding AI and LLM in media narratives.

Relevant Social Groups, or RSGs, are the groups that interact with a technology and shape its development. In the context of AI narratives, RSGs may include tech developers, policymakers, journalists, and the general public. RSG share a common understanding of a technology, and their significance is determined by the meaning the technology holds for them. This concept is closely related to interpretative flexibility, where even within a single RSG, such as journalists, subgroups may have differing interpretations of the technological artifact (Bijker, 2010; Octavianto, 2014).

The core concept of Closure and Stabilization means that over time, through social processes, a technology's design and meaning become stable. Media framing can play a significant role in how certain interpretations of AI become dominant.

Technological Frames are shared understandings and practices around a technology within a social group. The media's portrayal of AI can contribute to forming these frames.

By integrating SCOT, this research provides a nuanced analysis of how AI technologies are socially constructed through media narratives. At this stage of the research, the primary focus is on the interpretative flexibility of AI, examining how different social groups perceive and interpret AI technologies. This will be achieved through a content analysis of news articles on AI, revealing the varying interpretations and meanings assigned to AI by different groups. By analyzing the content, we can identify how these interpretations differ across social groups and uncover the dynamics of these perceptions. Other aspects of SCOT, such as the identification of relevant social groups influencing the discourse and understanding how certain narratives achieve closure and stabilization in public perception, will be addressed in subsequent studies.

Textual Analysis Methodologies in Media Framing of AI Narratives

Topic Modelling and Sentiment Analysis are two textual data analysis methodologies that have proven effective in identifying patterns and trends in media discussions about AI and associated technologies. Topic Modelling, particularly through Latent Dirichlet Allocation (LDA), facilitates the identification of dominant themes within a text corpus, while Sentiment Analysis reveals the tone and emotions contained therein (e.g., positive, negative, neutral). Previous research by Vergeer et al. (2020) and Yadav & Shakya (2022) has demonstrated how the combined application of these methodologies can provide in-depth insight into the perception and discussion

of AI and Language Models in online media. Building on these findings, our analysis will employ Topic Modelling and Sentiment Analysis to delve into the narratives and dominant themes regarding AI and Language Models in online media within Indonesia.

Research Methods

Content analysis has long been a significant part of research in communication and media studies. Traditional content analysis approach relies on human coders to perform information extraction, framing analysis, and sentiment analysis. However, this conventional approach has limitations; it requires a considerable amount of time and incurs high costs, thereby limiting the amount of text that can be processed (Zamith & Lewis, 2015). Advances in computer technology and machine learning provide an alternative to computational content analysis techniques, allowing for faster processing of a significantly larger volume of text documents (Burscher et al., 2015; Zamith & Lewis, 2015). This research adopts a novel computational content analysis approach for framing analysis using topic modelling techniques (Dehler-Holland et al., 2021; Nguyen & Hekman, 2022) and aspect-based sentiment analysis (Wu et al., 2021). Topic modelling is conducted using the BERTopic framework library in Python language programming, while sentiment analysis is performed using the Large Language Model GPT-4 from openAI and Claude 2 from ANTHROPIC.

BERTopic is a relatively new approach to topic modelling. Abudzayed and Al-Khalifa (2021) report that BERTopic outperforms earlier models like LDA (Latent Dirichlet Allocation) and Non-Negative Matrix Factorization techniques. This research, therefore, not only contributes to the discussion on AI and media framing but also pioneers in applying advanced computational methodologies in communication and media studies, particularly within the Indonesian context. The application of these advanced computational techniques is crucial for addressing the research questions, paving the way for a deeper understanding of media framing in the digital era.

This research utilizes computational text analysis to examine the framing of Artificial Intelligence (AI) and Large Language Models (LLMs) in Indonesia online media. Our methodology consists of two stages: the selection of relevant news articles and text extraction for analysis. This approach enables efficient processing of large-scale textual data, facilitating a systematic investigation of framing patterns in media coverage of AI and LLMs within the Indonesian context.

Article Selection

For this study, three Indonesian online news outlets – *Detik.com*, *Kompas Online*, and *CNN Indonesia* – were selected based on their weekly reach as reported by Reuters Digital News Report 2023 (Newman et al., 2023). Among these, *Detik.com* and *CNN Indonesia* ranked first and second respectively in Brand Trust Scores, while *Kompas Online* occupied the fourth position. However, due to unresolved technical difficulties, articles from *Kompas Online* were not included in this study.

Five keywords deemed most representative of the main research topic, with a focus on Generative AI developed based on Large Language Model algorithms like ChatGPT, were selected. These keywords are: “kecerdasan buatan”, “artificial intelligence”, “chatgpt”, “generative ai”, and “large language model.” Each keyword was input into the news search feature of *Detik.com* and *CNNIndonesia.com*. The search process yielded a list of news articles along with their URLs, which were extracted using a Python script. All data collected were stored in JSON format.

This study does not distinguish between hard news, soft news, or adapted news articles, as it does not aim to reveal the actual position of AI or AI narratives in

Indonesian society. Instead, this research focuses on uncovering how the media discusses AI for the Indonesian audience. Consequently, adapted news articles published in the selected media outlets are considered part of the media framing process, reflecting what media deems important for Indonesian audiences to know about AI. This approach acknowledges that the media's choice of content and framing reflects their assessment of what is significant for their readers, regardless of the original source of the news.

Text Extraction

The text extraction phase employed an automated Python script utilizing BeautifulSoup, Request, and Selenium libraries. Following a preliminary accuracy test on a subset of data, the script was deployed to extract key information from each news article, including, title, source, date, time, author, category, and full text content. The extraction process involved:

1. Iterative access to news pages
2. HTML parsing for relevant data retrieval
3. Consolidation of multi-page articles
4. Aggregation of text paragraphs into a single string
5. Duplication check against existing corpus
6. Storage of unique entries in JSON format

This automated approach ensured efficient compilation of a comprehensive corpus, forming the foundation for subsequent analysis of media framing regarding Artificial Intelligence (AI).

Sample Composition

The dataset comprises 1,280 news articles from two sources:

- Detik.com (n=1,097)
- CNNIndonesia.com (n=183)

The articles span from September 1, 2022, to August 7, 2023, with prominent categories including detiknet, detikNews, and detikEdu.

Keyword frequency analysis across both platforms revealed:

- “ChatGPT” as the most frequently occurring term, indicating significant media attention.
- “Kecerdasan Buatan” and “Artificial Intelligence” (synonymous terms in Bahasa Indonesia and English, respectively) showed substantial combined frequency.
- “Generative AI” and “Large Language Models” exhibited minimal coverage, suggesting potential gaps in media narratives.

This keyword distribution provides insights into the focus and potential biases in AI-related media coverage within the Indonesian context.

Table 1. Frequency of Search Keywords in Detik.com and CNN.com News Sources

Keywords	Detik.com	CNNIndonesia.com	Total
Kecerdasan Buatan	975	162	1137
Artificial Intelligence	630	106	736
ChatGPT	1674	381	2055
Generative AI	48	0	48
Large Language Model	40	1	41

The consolidation of the frequencies of “*Kecerdasan Buatan*” and “Artificial

Intelligence” offers a substantial representation of the discourse surrounding AI, while the frequencies of other keywords provide insight into the coverage of newer or more specific facets of AI technology within the Indonesian online media landscape.

Text Pre-Processing

Text pre-processing was conducted on the news corpus content to prepare it for topic modelling and sentiment analysis. A Python script executed the following steps:

1. Conversion to lowercase
2. Removal of irrelevant text (e.g., “ADVERTISEMENT”) and extraneous punctuation
3. Elimination of double spaces
4. Tokenization
5. Removal of Indonesian stopwords

Topic Modelling

Upon acquiring the prepared news corpus, we utilized the BERTopic technique for topic modelling. BERTopic leverages a transformer-based approach, specifically the Bidirectional Encoder Representations from Transformers (BERT) architecture, to extract pertinent text features. This method effectively addresses several challenges inherent in topic modelling, such as multilingual text processing and the ambiguity regarding the number of topics.

The BERTopic algorithm extracts coherent topic representation through a class-based variation of Term Frequency – Inverse Document Frequency (TF-IDF). It generates document embeddings with pre-trained transformer-based language models, clusters these embeddings, and eventually produces topic representations through the class-based TF-IDF procedure. It yields coherent topics and is competitive across diverse benchmarks involving traditional models and the newer clustering approach of topic modelling (Grootendorst, 2022). This algorithm has been deployed in various studies analyzing different datasets, including Twitter posts, Italian long COVID narration, and research publications on the Quality Movement (Guizzardi et al., 2023; Sawant et al., 2022; Scarpino et al., 2022).

One of BERTopic’s strengths is its scalability with new developments in language models while remaining competitive with classical language models. Its versatility across language models enables its application in a broad spectrum of scenarios. However, a limitation is its assumption that each document encapsulates a single topic, which diverges from the reality that documents can harbor multiple topics (Grootendorst, 2022). Additionally, BERTopic has been criticized for struggling to handle out-of-vocabulary terms and for its sensitivity to hyperparameters, which can significantly affect model performance in ensuring the distance between clusters. These limitations can lead to inaccurate topic representations and inconsistent results. To mitigate these issues, researchers can employ domain-specific pre-training, advanced tokenization for out-of-vocabulary terms, robust hyperparameter optimization, and validate results through expert evaluation or complementary analytical approaches (Grootendorst, 2022, 2023).

To enhance the validity of our topic modelling results, the research team conducted an additional manual verification process. This process involved a systematic review of news articles assigned to specific topic categories by the automated analysis, ensuring the accuracy of topic classification and providing a qualitative complement to the computational approach.

BERTopic topic modelling process (Grootendorst, 2022, 2023):

1. Text Pre-processing: Clean and prepare corpus text (lowercase conversion, irrelevant text removal, punctuation handling, stopwords removal)
2. Text Feature Representation: Transform processed text into embeddings using

BERT architecture.

3. Topic Formation: Cluster texts based on feature similarity.
4. Topic Keyword Determination: Identify representative keywords for each topic cluster.
5. Topic Visualization and Analysis: Visualize topic relationships and analyze individual topics.

A custom Python script implemented the BERTopic technique. After pre-processing, the script instantiated a BERTopic object and applied 'fit_transform' to the processed news content, generating topics and their association probabilities with each document. The script accommodates both existing model usage and new model criteria, saving the latter for future use. It displays discovered topics and their representative keywords, facilitating researchers' understanding of the news corpus content and topic evolution. This approach enables comprehensive analysis of themes within the dataset, offering valuable insights into news content and topical developments.

Data Processing and Analysis

After successfully identifying topics, the subsequent step involved capturing essential computational outputs such as embeddings, probability values, and distance metrics of each document to the cluster centroid. These values were catalogued and stored in a database and serialized into a JSON file format for future reference and analysis.

In this study, 'embedding' refers to the numeric representation of text generated by the BERT model, transforming the textual data into numeric vectors, facilitating further algorithmic analysis (Andrabi & Wahid, 2022; Min et al., 2021). The 'probability' variable holds the probability values indicating the extent to which text documents are related to the identified topics (Grootendorst, 2022). Additionally, the 'distance_to_core' column provides a numeric measure of how close each document is to the core of its topic (Manning et al., 2008; Scarpino et al., 2022).

Qualitative Analysis

To enrich the quantitative results from BERTopic, a qualitative analysis was conducted. This process involved reviewing sample news articles from each topic cluster, comparing them with BERTopic-generated keywords, and developing descriptive labels. The top 10 articles per category, based on 'distance_to_core' values, were selected for analysis.

The analysis leveraged AI technology, specifically a Large Language Model (LLM) via ChatGPT Plus, to generate initial contextual labels and topic descriptions. These AI-derived interpretations underwent human researcher review, to ensure alignment with the nuances of each topic cluster. This hybrid approach combined AI efficiency with human expertise, providing a comprehensive understanding of the identified topics and bridging quantitative results with qualitative insights.

The decision to leverage Artificial Intelligence (AI) technology, specifically Large Language Models (LLMs), in this qualitative analysis is aimed at enriching and speeding up identifying contextual nuances within the formed topic cluster. Language Models like GPT4 in ChatGPT Plus possess advanced natural language understanding capabilities (Maddigan & Susnjak, 2023), thus efficiently capturing the semantic and contextual meanings of news text. This technology also enables large-scale analysis that would be difficult to execute manually. However, it is crucial to underline that the model's output is always subjected to a final review and refinement by human researchers to ensure accuracy, as language models, however advanced,

cannot yet fully replace human intuition and understanding.

Sentiment Analysis with LLM

Sentiment analysis was conducted on each news article in the sample group to identify sentiment trends in AI coverage across topic categories. This study explored the use of GPT-4, accessed via ChatGPT Plus, for its advanced natural language understanding capabilities (Wu et al., 2021; Zhang et al., 2023). A tailored prompt was designed to evaluate sentiment within news samples.

Initial testing assessed GPT-4's effectiveness in sentiment analysis on the AI-related dataset. Future research phases plan to employ GPT-4o or higher model API from OpenAI and/or ClaudeAI model from Anthropics for more comprehensive analysis on larger corpus. This approach aims to delineate AI news coverage dynamics within identified topics and evaluate the potential of LLMs for contextual sentiment analysis.

Results and Discussion

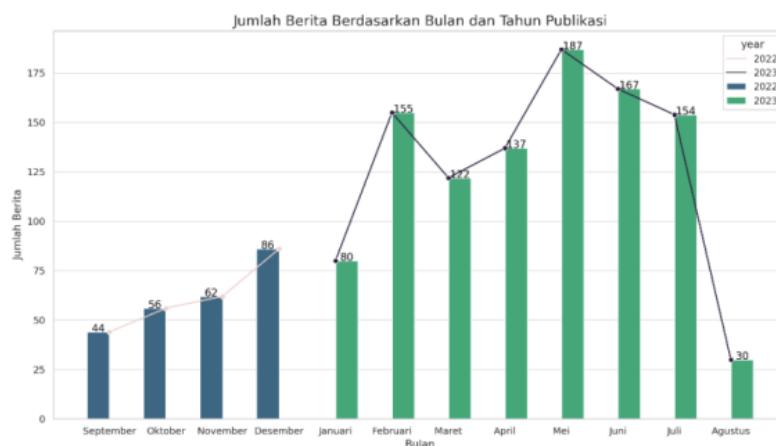


Figure 1. Distribution of the news corpus by month and year

Figure 1 exposes the distribution of AI-related news articles published from September 2022 to August 2023, capturing publication trends over two distinct years: 2022 and 2023.

From the visual representation, several salient points include:

1. **Thematic Focus on Artificial Intelligence:** Each article is inherently themed around Artificial Intelligence (AI), highlighting the escalating prominence and societal engagement with AI, as evidenced by evolving publication rates.
2. **Publication Rate of AI News in 2022 and 2023:** An upward trend in AI-related news articles is observed from September 2022 to May 2023, with a subsequent decline noted in March, June, and July 2023.
3. **Annual Comparison of AI News Publication:** In comparison to 2022, 2023 shows an increased release of AI-centric news articles.
4. **Publication Zenith:** May 2023 marks the highest number of AI-related news publications, with 187 articles.

In summary, the graph indicates rising interest and discourse on AI, as evidenced by the increased number of AI-related news articles from September 2022 to May 2023. However, caution is advised when interpreting data for August 2023 due to its incomplete nature. The overall trends and specific fluctuations observed warrant

further investigation to understand the evolving AI narratives during this period.

Topic Modelling Findings

After several iterations using the BERTopic Python script, the study finalized results from the sixth iteration, which yielded 13 topic clusters. These clusters were labelled from topic -1 to topic 11 according to BERTopic guidelines. The BERTopic manual specifies that topic -1 is an outlier, consisting of text data that lacks sufficient coherence for inclusion in a specific topic (Grootendorst, 2022).

Topic 7 displayed peculiar characteristics, with all news entries categorized under this topic containing headlines featuring words such as 'PHOTO' or 'VIDEO', but no textual content. This anomaly suggests that these entries do not belong in a text-based topic cluster. As a result, topics -1 and 7 were excluded from further analysis. Specifically, 109 entries from topic -1 and 12 entries from topic 7 were excluded, narrowing the field to 11 topic clusters for future examination.

Interpretative Flexibility

The concept of interpretative flexibility is crucial for understanding how different social groups perceive and interpret AI technologies. This study leverages topic modelling results to showcase the diversity of perspectives on AI in Indonesian online media. Table 2 presents the identified topics and their respective interpretations, highlighting the range of meanings assigned to AI by various social groups.

Table 2. Topics and Keywords

Topic	Entry	Keywords
-1	109	{"secara", "sebagai", "film", "seperti", "tentang", "penelitian", "otak", "teknologi", "peneliti", "aplikasi"}
0	838	{"informasi", "secara", "intelligence", "chatbot", "artificial", "bidang", "pendidikan", "chatgpt", "teknologi", "masyarakat"}
1	133	{"secara", "media", "film", "kamera", "gambar", "video", "foto", "perangkat", "teknologi", "aplikasi"}
2	65	{"traffic", "transportasi", "intelligence", "kota", "jakarta", "ruas", "kendaraan", "kemacetan", "mobile", "teknologi"}
3	24	{"perang", "senjata", "udara", "militer", "angkatan", "jet", "drone", "terbang", "balon", "pesawat"}
4	21	{"manusia", "seperti", "dunia", "uang", "kripto", "perdagangan", "robot", "jepang", "robotics", "penipuan"}
5	19	{"web", "media", "instagram", "sosial", "pengguna", "facebook", "twitter", "microsoft", "threads", "aplikasi"}
6	15	{"penemuan", "desain", "ditemukan", "geoglyph", "peradaban", "nazca", "geoglyph", "arkeolog", "ilmuwan", "peneliti"}
7	12	{"", "na"}
8	12	{"suara", "rekaman", "menyanyikan", "cipt", "musik", "seperti", "lagu", "musisi", "sebagai", "musiclm"}
9	11	{"baru", "reality", "dunia", "aktuelle", "miliar", "meta", "virtual", "avatar", "facebook", "metaverse"}

Topic	Entry	Keywords
10	11	{"bolanya", "qatar", "adidas", "stadion", "pertandingan", "football", "pemain", "2022", "sepakbola", "fifa"}
11	10	{"indonesia", "washer", "tablet", "samsung", "dryer", "laptop", "perangkat", "mesin", "mencuci", "teknologi"}
Total	1280	

Next, each category required contextualization through labels and descriptions, facilitated by Artificial Intelligence technology in the form of the Large Language Model GPT-4, accessed via ChatGPT Plus. Semantic analysis with the GPT-4 employed input samples of news articles from each topic cluster, along with keywords representing each generated topic from the BERTopic process.

The selected samples for each topic were identified based on the mathematical distance between the embedding value of each document and the centroid embedding value for each topic. This resulted in the selection of ten documents with the shortest distance to the centroid, representing each of the remaining topic clusters.

Upon inputting news examples and keywords into GPT-4 for semantic analysis, the output is described in Table 3.

Table 3. Topic Labeling Results

Topic	Label (English)	Keywords (Original)	Description (English)
0	Role and Impact of AI in Various Aspects of Life	['teknologi', 'pendidikan', 'intelligence', 'masyarakat', 'chatgpt', 'informasi', 'secara', 'chatbot', 'artificial', 'bidang']	This topic focuses on the role and impact of AI in various aspects of life, including education, employment, ethics, and technological innovation. It highlights the focus on technology, education, and the social aspects of AI, with debates on the benefits and risks, as well as how AI can be used as an innovation tool.
1	AI-Based Camera and Photography Technology	['kamera', 'teknologi', 'secara', 'media', 'gambar', 'perangkat', 'foto', 'video', 'film', 'aplikasi']	Topic 1 focuses on the use of AI in aspects of cameras and photography. This includes AI applications that allow users to edit and optimize images, even emulating the styles of famous artists. News within this topic also highlights potential risks and ethical issues, including the misuse of technology to clone or manipulate images. Keywords characterizing this topic emphasize the focus on cameras, technology, media,

Topic	Label (English)	Keywords (Original)	Description (English)
			and applications related to photography and video.
2	AI-Based Traffic and Transportation Technology in Jakarta	["traffic", "jakarta", "ruas", "teknologi", "transportasi", "kendaraan", "intelligence", "kota", "kemacetan", "mobile"]	Topic 2 focuses on traffic and transportation technology in Jakarta, including the use of AI to regulate traffic flow, analyze congestion data, and support more efficient transportation planning. This also covers the use of AI in smart vehicles and public transportation. Keywords characterizing this topic emphasize the focus on traffic, Jakarta, transportation technology, and AI.
3	AI-Based Aircraft, Drones, and Military Equipment Technology	["pesawat", "balon", "drone", "terbang", "jet", "udara", "militer", "senjata", "angkatan", "perang"]	Topic 3 focuses on the use of AI in the development of aircraft, drones, and military equipment. This includes innovations in aircraft design, the use of drones in both military and civilian operations, as well as the integration of AI into weapon and defense systems.
4	Robotics, Trade, and Fraud in Technology	["robot", "robotics", "jepang", "seperti", "dunia", "perdagangan", "kripto", "penipuan", "uang", "manusia"]	This topic focuses on the development and application of robotics technology. This includes innovations in robot design and functionality, such as robots capable of cooking or performing parkour. The topic also highlights the use of robots in trade, such as instances of trading robots causing financial loss. Ethical issues and controversies are also raised, including fraud in cryptocurrency trading. Overall, this topic depicts the increasingly important role of robotics in daily life and the potential risks and challenges that may arise.

Topic	Label (English)	Keywords (Original)	Description (English)
5	AI-Based Cyber Security and Data Protection	["twitter", "facebook", "media", "microsoft", "web", "threads", "instagram", "sosial", "aplikasi", "pengguna"]	Topic 5 highlights the use of AI in the development of cyber security and data protection. This includes the latest technology in the detection and prevention of cyber threats, security risk analysis, as well as ethical and regulatory issues related to data security. News within this topic underscores the importance of AI in protecting information and systems from increasingly complex cyber threats.
6	Discovery and Research of Geoglyphs with the Help of AI	["arkeolog", "geoglif", "geoglyph", "penemuan", "peneliti", "ditemukan", "ilmuwan", "peradaban", "nazca", "desain"]	Topic 6 focuses on the discovery and research of geoglyphs with the help of AI. This includes the use of AI technology in detecting and analyzing geoglyphs, such as the famous ones in Nazca, and how this contributes to our understanding of ancient civilizations. News within this topic highlights the crucial role of AI in aiding archeologists and scientists in discovering and understanding complex historical remnants.
8	AI Music Development by Google	['musiclm', 'musisi', 'musik', 'suara', 'lagu', 'menyanyikan', 'rekaman', 'seperti', 'cipta', 'sebagai']	This topic focuses on the development of Artificial Intelligence (AI) by Google, known as MusicLM, which can create music based on text descriptions. This includes the AI's ability to generate music that sounds as if it were created by humans, the capability to mimic human vocals, and related issues such as the potential risk of creative content misuse and copyright infringement. The topic also covers comparisons with other AI music technologies and the

Topic	Label (English)	Keywords (Original)	Description (English)
9	Metaverse, Facebook, and the Virtual World	['metaverse', 'meta', 'virtual', 'facebook', 'reality', 'dunia', 'avatar', 'miliar', 'baru', 'aktuelle']	industry's response to these advancements. This topic covers various aspects of the metaverse and virtual world, focusing on the role of Facebook and Mark Zuckerberg in the development of this technology. This includes billion-dollar investments in development and the renaming of the parent company to Meta. News or articles may also cover controversies, recent developments, and future outlooks on the metaverse.
10	FIFA 2022 Soccer World Cup in Qatar	['bolanya', 'fifa', 'sepakbola', 'qatar', 'stadion', 'pertandingan', 'football', 'adidas', '2022', 'pemain']	This topic focuses on the FIFA 2022 Soccer World Cup held in Qatar. It covers various aspects of the tournament, including the opening match, semi-finals, and finals, as well as details like the official ball used (launched by Adidas). There are also references to the company Forward Football and the viral nature of the Al Rihla ball. The focus is on key elements of this tournament, including stadiums, matches, and players, as well as the involvement of AI technology.
11	Launch and Innovation of Technology Devices	['samsung', 'perangkat', 'tablet', 'dryer', 'washer', 'teknologi', 'mesin', 'mencuci', 'laptop', 'indonesia']	This topic highlights the launch and innovation in technology devices in Indonesia, including AI-powered smart washing machines and high-specification laptops. The focus is on features, specifications, and the availability of products to meet the needs of modern consumers.

Intertopic Distance Map

The analysis of the Intertopic Distance Map reveals that several topics demonstrate spatial proximity, suggesting the potential to consolidate into a single thematic cluster. For instance, Figure 2 shows that topic 0, labeled “The Role and Impact of AI in Various Life Aspects” is closely situated to topic cluster 11, which focuses on the launch of AI-based electronic products. Furthermore, both topics are within the same quadrant as topic 4, which examines AI’s implementation in robotic technology and trade. Additionally, topic 5, which delves into AI-based cybersecurity, is also situated within the same thematic proximity, showcasing a thematic relationship between digital security and other innovative technologies.

Therefore, consolidating these four topics into one category is the next logical step to create a more coherent and integrated understanding of how technology and innovations, especially AI, interact and impact daily life. The proposed new label for this consolidated topic category is “Technology and Innovation: Impact and Applications in Daily Life” with a description and keywords that reflect the broad scope of the related topics.

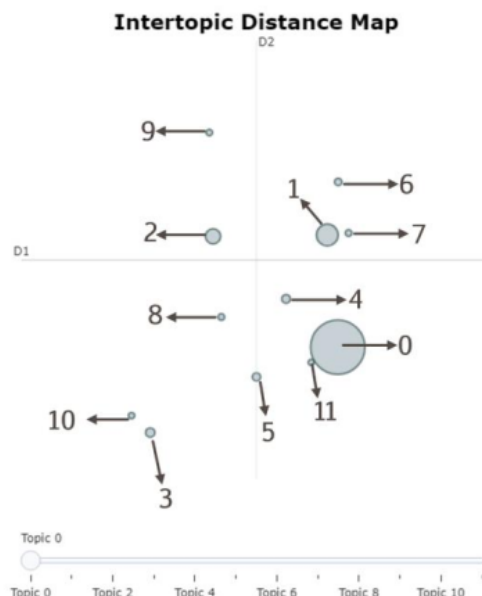


Figure 2. Topic grouping based on thematic similarity

The Intertopic Distance Map visualizes the relationships between topics generated through topic modelling, such as BERTopic. Each circle represents a topic, with its size indicating the topic’s prevalence within the corpus. The position and distance between circles reflect the content similarity between topics, where closer circles suggest higher similarity.

Sentiment Analysis

The next phase of our analysis involves sentiment analysis leveraging the semantic understanding capabilities of Large Language Models (LLMs), specifically GPT-4 and Claude 2. This sentiment analysis was conducted on samples from each identified topic category. Sentiment analysis was conducted on samples from each identified topic category. For each topic, only 10 samples were selected, based on the “distance_to_core” metric, with the ten smallest values chosen. This criterion is based on the premise that smaller “distance_to_core” values indicate news items more closely aligned with the central embedding value of each topic, thus representing the

core essence of the respective topic categories.

In the study of several news samples across various topics, it was observed that certain samples did not address AI issues at all. Consequently, when the Large Language Model was instructed to conduct an Aspect-Based Sentiment Analysis, the model conclusively determined that there was no sentiment associated with AI issues.

Table 4. Sentiment Distribution Towards AI Content Across Different Topic Categories

Topic	Positive	Neutral	Negative
0	3	3	4
1	1	4	5
2	2	6	2
3	1	4	2
4	5	3	2
5	1	5	1
6		6	
8	3	4	3
9	7	3	
10	8	2	
11	8	2	
	39	42	19

Cluster 0 consists of 838 news articles focusing on AI's role and impact across various aspects of life, including education, employment, ethics, and technological innovation. This topic emphasizes the importance of technology, education, and the social aspects of AI, encompassing discussions about AI's benefits and risks and its potential as a tool for innovation.

Table 5. Sentiment Analysis Highlight for Topic 0

Positive Sentiment	Negative Sentiment	Neutral Sentiment
Focus: Innovation & Beneficial Applications (e.g., education, services)	Focus: Risks & Implications (e.g., ethics, layoffs)	Focus: Balanced analysis with expert views
Narrative: Highlights AI potential with real-world examples	Narrative: Explores AI's 'dark side'	Narrative: In-depth context; potential & risks of AI
AI's Role: Enhances efficiency & and quality of services	AI's Role: Technology with Potential Challenges	AI's Role: Potential both positive and negative depending on implementation

As shown in Table 5 above, the keywords emerging from this cluster indicate that the news in this cluster not only delves into AI's technical aspects but also its societal impact, including how AI tools like chatbots and ChatGPT provide information and innovation across various domains.

The analysis of ten samples from topic 0 revealed that positive news emphasizes AI's benefits in areas like education, while negative sentiment highlights its risks, including ethical concerns. Neutral news provides a balanced view of AI's potential. Such media framing potentially influences public perception of AI's potential and risk.

Table 6. Sentiment Analysis Highlight for Topic 1

Positive Sentiment	Negative Sentiment	Neutral Sentiment
Focus: Advancements & Innovations (e.g., smartphone camera features)	Focus: Ethical & Privacy Concerns (e.g., chatbots, photo editing)	Focus: Balanced and Informative (e.g., artist's works, Nostradamus' book)
Narrative: Emphasizes AI's advancements and potential benefits	Narrative: Highlights the risks and concerns in AI applications	Narrative: Objective and without strong bias
AI's Role: Enhancer of user experience & and technological progress	AI's Role: A potential disruptor in privacy & and ethics	AI's Role: Provides a balanced view of both the potential and challenges

Table 7. Sentiment Analysis Highlight for Topic 2

Positive Sentiment	Negative Sentiment	Neutral Sentiment
Focus: Technology as a Solution	Focus: Skepticism Towards Technology	Focus: Objective Reporting
Narrative: AI is viewed as a technology that can provide solutions, especially in addressing the traffic congestion issue in Jakarta.	Narrative: There's doubt regarding the effectiveness of AI in providing a solution to the traffic problem	Narrative: News articles that provide information about the implementation of AI technology without leaning towards portraying it in a positive or negative light.
AI's Role: Enhancing the quality of traffic management and reducing congestion, offering a better experience for road users.	AI's Role: Seen as a technology that might not be entirely effective or has limitations in tackling traffic issues	AI's Role: Imparting knowledge or information about the existence and advancements of AI without influencing readers' opinions

As described in Table 6, Topic 1 explores AI's use in cameras and photography, covering AI applications that enable users to edit and optimize images, even emulating the styles of renowned artists. The analysis also highlights potential risks and ethical issues, including the misuse of technology to clone or manipulate images. Keywords characterizing this topic emphasize the focus on cameras, technology, media, and applications related to photography and video, such as "camera", "technology", "media", "image", "device", "photo", "video", "film", and "application".

Out of the 133 news articles analyzed in this cluster, a subset of ten was selected for further scrutiny. The analysis reveals that five of these articles convey a predominantly negative sentiment towards AI, with concerns centered on ethical, privacy, and social ramifications, exemplified by the issues arising from the Lensa AI application. Conversely, only one article showcases AI in a positive light, emphasizing technological advancements in smartphone cameras.

This prevalent negative media framing could potentially influence public

perception of AI, highlighting the importance of stakeholders understanding and addressing this portrayal. It signifies that public sentiment tends to be influenced by how the media frames AI's use and impact in photography and videography, as well as the ethical implications of this technology.

Table 7 above shows that Topic 2 centers on traffic and transportation technology in Jakarta, including AI's use to regulate traffic flow, analyze congestion data, and support more efficient transportation planning. This also covers AI's use in smart vehicles and public transportation. Keywords characterizing this topic emphasize the focus on traffic, Jakarta, transportation technology, and AI.

In this topic cluster, six news articles view AI from a neutral perspective, while both negative and positive sentiments each constitute 20% of the total sentiments expressed. This suggests a diverse range of perspectives towards AI in current media reporting, especially in discussions around AI as a potential solution for traffic problems.

Generally, samples from the majority of topic clusters depict AI in a neutral or positive light. Topic cluster 0, which contains the largest number of articles, demonstrates a relatively balanced sentiment distribution, although negative sentiments still prevail over neutral and positive ones.

On the other hand, topic cluster 1, focusing on AI in the visual domain, such as photography and videography, exhibits a higher prevalence of negative sentiments. On the other hand, a larger proportion of positive sentiments are found in samples from topic clusters 4, 9, 10, and 11, which tend to discuss the practical implementation of AI in trade, robotics, the metaverse, and digital technology products.

Topic clusters 5 to 11 are categorized as minority clusters, each containing fewer than 20 articles. It is important to note that the sample proportion utilized in this analysis doesn't ensure accurate conclusions regarding sentiment representation, given that the ten samples drawn from each cluster were determined based on the proximity of article embedding values to the cluster center's embedding value, without considering the sentiment representation proportion in each sample.

Therefore, this sentiment analysis provides a preliminary overview and necessitates further exploration through sentiment analysis of the remaining articles in the corpus.

Comparative Analysis with Previous Studies

Garvey and Maskal's (2020) research shares similarities with this study in analyzing sentiment towards AI coverage but focuses on the Terminator Syndrome hypothesis. Meanwhile, Vergeer's (2020) study also resembles this research in analyzing topics and sentiments of AI news coverage but is limited to newspapers in the Netherlands.

Nguyen and Hekman's (2022) research identified dominant news frames related to AI and emphasized the need for critical AI and data literacy in journalistic training. However, their research was limited to English language media.

Compared to these three studies, this research has similarities in conducting topic and sentiment analysis of AI news coverage. However, it focuses on online media in Indonesia and applies novel methods of topic modelling with BERTopic and sentiment analysis with GPT-4 and Claude-2.

Collectively, these four studies elucidate the nuanced and potentially cultural-influenced dynamics of AI framing within media narratives. Each investigation offers unique insights into the media's portrayal of AI, highlighting the intricate interplay between technological discourse and cultural context. Nevertheless, this body of research also underscores the need for further inquiry. Future studies should broaden methodological horizons to encompass a more diverse cross-cultural and cross-media

analytical scope. Such expansion is critical for a more comprehensive understanding of the implications that media framing has on the public's comprehension of AI and the consequent policy formulations.

Contribution to Existing Body of Knowledge

This study significantly advances the understanding of AI discourse in Indonesian online media by emphasizing AI's potential to enhance work efficiency and address broader social implications, such as ethical issues and job displacement concerns. While these findings align with global narratives, they are distinctively contextualized within Indonesia's socio-economic backdrop, offering valuable perspectives for governance and policy development.

Using the Social Construction of Technology (SCOT) framework, this study reveals that AI is perceived differently by various social groups. The public tends to view AI as a tool to enhance efficiency and service quality, as evidenced by numerous news articles highlighting AI's benefits of AI in education and public services. In contrast, journalists often focus on ethical risk and potential job displacement, indicating concerns about AI's social and economic impacts. Technology developers and policymakers adopt a more pragmatic view, frequently emphasizing technological innovation and economic growth driven by AI.

Relevant social groups in the AI conversation within Indonesian media include the general public, journalists, technology developers, and policymakers. The public and journalists often engage in broader discussions about AI's social impacts, while technology developers and policymakers concentrate more on technical and regulatory aspects. This study highlights that journalists and media, as crucial relevant social groups, tend to view AI from positive and neutral perspectives, as reflected in the sentiment analysis.

The stabilization of AI narratives in the media occurs through repetition and emphasis on specific aspects of this technology. For instance, narratives about AI's efficiency benefits are reinforced through various articles highlighting successful AI implementation cases. Conversely, narratives about ethical risk and job displacement become stable through articles that underscore these concerns. These social processes are stable through articles that underscore these concerns.

Media tend to frame AI in specific ways. One dominant frame is AI as a tool for innovation and economic growth, often driven by articles discussing AI's practical applications and economic benefits. Another common frame is AI as a threat to jobs and ethics, propelled by articles addressing the potential negative impacts of this technology. These frames shape how the public understands and responds to AI.

In summary, the SCOT theoretical framework provides a scientific explanation for the social construction of AI technology, particularly in Indonesia. It highlights the interpretative flexibility of AI, the role of relevant social groups, the process of narrative stabilization, and the formation of technological frames. This analysis enriches the body of knowledge by offering a nuanced understanding of how AI is socially constructed through media narratives, paving the way for further research and better-informed policy and governance in the realm of AI.

Conclusion

This study reveals that media narratives about AI in Indonesia are influenced by various social groups within differing interests. Using the SCOT framework, we can understand how different interpretations of AI technology emerge and become dominant in media discourse. These findings are crucial for journalists and policymakers, highlighting the importance of interpretative flexibility in media narratives and its impact on public acceptance of AI.

The study also highlights dominant themes related to AI's potential to enhance work efficiency and its broader social implications, such as ethical issues and job displacement concerns. These findings are contextualized within Indonesia's socio-economic background, offering valuable perspectives for the development of AI governance and policy.

Methodologically, this research explores new ground by employing deep learning-based topic modeling and Large Language Models (LLMs) for large-scale semantic content analysis, demonstrating an efficient and innovative approach within Indonesian Media studies. This method provides a robust framework for analyzing media framing that is replicable and scalable for future research.

However, this study is limited to identifying various interpretations of AI presented through mass media. Relevant social groups have not been well mapped, but this can be addressed in subsequent steps through a named entity recognition (NER) approach to identify which entities are discussing specific topics with their respective viewpoints.

This study provides empirical insight into media framing of AI in Indonesia and offers a methodological template that can catalyze further research in AI discourse analysis across diverse cultural contexts. These findings are important for journalists, policy makers, and technology developers in understanding and shaping balanced and responsible AI narratives.

The narratives on Artificial Intelligence (AI) in Indonesian online media predominantly revolves around its role and impacts across various facets of life. Sentiment analysis indicates a balance, with positive sentiments highlighting innovations and beneficial applications, and negative sentiments concentrating on ethical concerns and job displacement fears. AI's applications in visualization, and photography, and addressing traffic congestion in Jakarta also received significant attention.

Initial findings suggest a slight predominance of positive sentiment within a limited sample, yet a more in-depth sentiment analysis with a more comprehensive dataset and additional media sources is necessary for confirmation and broader understanding.

Furthermore, this study calls for further research expanding the cultural and media scope, as well as detailed investigations into how media framing influences public understanding and policy relating to AI. The implications of media framing on public perception and policymaking represent a rich area for scientific exploration and the practice of ethical journalism. This conclusion also highlights the need for interdisciplinary research combining quantitative and qualitative methods to provide more comprehensive insight into the complexities of AI discourse in society.

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