

## A longitudinal network analysis of research trends and policy implications: southernmost of Thailand case study

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### ABSTRACT

The government funds research projects to address problems, advance knowledge, and support national development. Data repositories are often used to store this research information; however, such information is not optimally used when making the decision. This is particularly important, especially in the areas that require extensive effort and budget allocation to drive development, such as the southernmost provinces of Thailand. This area has been in a violent situation for more than twenty years, leading to poor education, economic challenges, and many more. This study aims to analyze the trends in research topics on these provinces over 30 years (1982–2020) using epistemic network analysis (ENA) on data from the Southern Border Provinces Research Database (SOREDA). Key findings showed a prolonged focus on “education” and “Islamic studies,” reflecting steady government support but raising concerns about its effectiveness. Another important point was that conflict management research arose in response to the surge in violence in 2004 and prolonged existing. The current trending research focused on local-based capital and how it is used to drive society and the economy, such as through tourism. These highlight evolving priorities in addressing the region's challenges and opportunities.

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## 1. INTRODUCTION

Research creates new knowledge, seeking truth, knowledge, and explanation of specific questions [1], and contributed to the discovery of new scientific advancements thereby strengthening national development in terms of economic competitiveness, social development, and national sustainability [2]. It also provides benefits for use as a guideline for development and problem solving across all social levels, from individual issues to community, society, and national levels. Knowledge gained through research has been used to enhance understanding, solve various issues, and address causal questions about phenomena. Moreover, its research has also been used to inform policymaking, planning, and factual problem-solving [3]. Therefore, driving research for development has become a very important tool for creating new knowledge that will help create innovations. However, in each step of the research development process, information is required to be used as data for studying and reviewing issues and finding knowledge gaps to support research. Due to the huge amount of research stored in the database that does not analyze the content

of the research knowledge in depth, and the system has limitations in listing metadata, it is impossible to know the relationship between the research content and the problems or policies, development strategies of the area, including the trend of research that may be duplicated or have gaps that have not been clearly resolved by the funding agency. Therefore, in order to make it easy to see the gaps in knowledge, issues, trends, and directions of research, as well as confirm knowledge and support research in the South, it is necessary to analyze the content of the research in-depth to obtain research information that is easy to use to confirm and see the gaps in knowledge. Research trends and easy application of knowledge [4]–[6] clearly cause and effect connections, help in separating the relationships of related and unrelated areas of knowledge from each other, and affect the increase in effectiveness in helping with decision-making or helping to further develop knowledge to lead to the process of creating areas of knowledge in integrating research to solve people's problems and the appropriate development of the south.

The southern region of Thailand is situated on the Malay Peninsula. It shares its southern boundary with Malaysia and is bordered by two seas: the Gulf of Thailand to the east and the Andaman Sea to the west. The region comprises 14 provinces [7]. The region benefits from its abundant resources to generate substantial national income from agricultural and fisheries products as well as tourism. According to a study by [8], the southern region is noted for its unique potential, rich cultural heritage, stunning tourist destinations, and abundant natural resources. Therefore, the economic structure of southern Thailand is divided into five main sectors. Agriculture, particularly rubber and palm oil, is the region's primary economic driver, contributing 29% to the gross regional product (GRP). This is followed by industry (12%), border trade (10%), transportation (9%), and tourism (8%) [9].

However, a comparison of Southern Thailand's economic growth rate between 2021 to 2024 shows that there is growth at a rate of 2.8% to 4.4% annually, which is higher than the 1.5% to 3.0% annual growth rate of the whole country [8]. Yet, the three deep south provinces, including Pattani, Yala, and Narathiwat, were ranked as the top 10 poorest provinces in Thailand [10]. The challenges to economic growth in these provinces were due to several constraints, including economic structure, production expansion challenges, education, regional instability, deterring business investment, and continuous growth [7]. Especially, regional instability has been a major concern due to its prolonged violence, which impacts community economic activities, tourism development, income generation, and security of living [7]. In an attempt to ease the situation in the southern provinces, several policies and strategic plans have been implemented to address these issues. Among these plans is allocating the budget to support research activities focusing on resolving the problems that occurred in Thailand's deep south provinces.

The record of research conducted concerning Thailand's deep south provinces reveals the areas that were concerned at a particular time and identifies the potential areas that need further investigation. However, these documents are rarely used for analysis or synthesis to confirm knowledge trends aligned with policies, strategies, and issues relevant to the southern border provinces. This lack of utilization prevents a comprehensive understanding of the interconnectedness and diverse dimensions of relevant knowledge, such as research topics, relationships among research issues, and academic disciplines [2]. Consequently, researchers, funding agencies, and development organizations lack critical information on research trends and topics to implement and drive development effectively in the southern border provinces [11]–[13]. This also makes it challenging to establish relationships among research topics and identify relevant knowledge from research content synthesis, leading to the misalignment of research trends and topics with actual issues, funding support, or development policies. It affects the analysis of knowledge gaps, hindering the formulation of new research questions [14].

Research data that is not thoroughly synthesized complicates its application, especially in interdisciplinary contexts, and fails to cover clear knowledge scopes. Therefore, to facilitate the access to and utilization of research trends and topics for problem-solving and development and to keep pace with global changes, a thorough analysis and synthesis of research is essential. This provides valuable information for decision-making, linking related disciplines, identifying knowledge gaps, resolving conflicts or weaknesses in research, and formulating policies and strategies for further development [15].

This study aims to unveil the evidence-based reflection of twenty years of research studies by focusing on the deep southern border provinces of Thailand. Moreover, the study outcomes and recommendations can lead to the identification of existing and missing knowledge on the southern border, confirming the alignment between research and development strategies for the region. It will highlight region-specific research topics, facilitating the use of research information for future studies. The researchers hope that the findings of the analysis of existing and missing knowledge on the southern border can help set research directions for problem-solving and development, address knowledge gaps, and leverage regional development [16] appropriately and sustainably following the real problems and knowledge gap of the region.

The results of the analysis consist of three parts: the first part presents the introduction, principles, and problem of research analysis in a database; the second part describes a literature review on southernmost border provinces and research and the research topic analysis; and the last section reveals the results of the analysis that may reflect the topic Islamic education, conflict management, and sustainable tourism development in the southernmost provinces of Thailand: a longitudinal network analysis of research trends and policy implications. Importantly, these findings can lead to interesting issues regarding the research trends and identification of existing and missing knowledge on Thailand's deep southern border provinces for further appropriate development.

## 2. LITURATURE REVIEW

### 2.1. Southernmost border provinces and research

The southernmost border provinces of Thailand consist of Pattani, Yala, and Narathiwat. These three provinces have distinctive societal characteristics attributed to their multicultural composition. Differ from other parts of Thailand, where a majority of them are Buddhist, a majority of populations in these three provinces are Muslim. Throughout the century, they were influenced by Chinese, Malay, Hindi, and Arabic cultures. Due to this difference from other regions of Thailand, the southernmost provinces require unique educational management approaches that combine the Islamic curriculum. The Ministry of Education established the Southern Border Provinces Education Coordination and Administration Center (SPEC) to coordinate and manage education in the special development zone of the southern border provinces. This zone includes Pattani, Yala, Narathiwat, Satun, and four districts in Songkhla Province: Thepha, Chana, Na Thawi, and Saba Yoi [17]. However, this cultural divergence has led to a sense of alienation among some residents. Simultaneously, certain groups have exploited cultural conditions to distort and incite social conflict. Additionally, some government officials' lack of understanding of the local culture and way of life has become a factor that dissenting groups use to justify the use of violence. This series of incidents surged violently in 2004; several Muslims were captured during the fasting month of Ramadan. As a result, this incident claimed 107 Muslim lives [18]. Since then, unrest and violence have emerged, resulting in the downturn of the economy, tourism, society, and others. From the review of literature related to factors affecting the development of the southern border, it was found that in the economic situation in the south, there has been a contraction in the production processes in both the agricultural and industrial sectors, which has affected the income from the export of the main industrial products of the south. At the same time, tourism has also been affected by the political situation, which has affected the confidence of foreign tourists and the inconvenience of tourists traveling. However, the political situation that has improved has resulted in improved confidence [19].

Research indicates that production across various business sectors has significantly declined since 2004. Notably, the quantity of seafood landings has decreased [20], and raw rubber sheet production has also fallen. Safety concerns have forced locals to shorten their daily rubber tapping hours, shifting to morning tapping instead of nighttime, resulting in lower latex yields and adversely affecting the overall economy. The rubber industry is central to and a driving force behind other economic activities in the region [21]. Facing such a challenge, the government attempted to stimulate the economy by increasing budget expenditures in the region. For instance, in 2004 and 2005, actual budget disbursements were 18,143.6 million Thai Baht and 25,335.4 million Thai Baht, respectively. However, initial measures seemed insufficient to significantly boost the regional economy, as noted in the Independent Committee for National Reconciliation report [20]. The situation has persisted for more than a decade, leading to local adaptations over time. A research study conducted by Jitpiromsri [22] posited that, amidst a decade of violence and unrest, the southern border provinces' economies did not contract as commonly believed. Even if it did not grow, it remained stable, contrary to the prevailing violence. This stability is attributed to the massive governmental budget allocations for both development and security projects, resulting in substantial public sector employment and a considerable amount of money flowing across various levels of society. This observation aligns with the phenomenon noted in the community studies.

According to the employment survey of the southern population, there are 5.5 million laborers, most of whom are in the agricultural sector (48.5%) and non-agricultural sector (51.5%), such as the construction sector, manufacturing sector, and service sector [8]. This includes social development in accelerating the resolution of the unrest in the southern border provinces through peaceful means and awareness of the value of cultural diversity, as well as the development of the quality of education that emphasizes the development of people and communities towards a learning society and organizing local wisdom knowledge as a learning resource for communities and local areas that are easily accessible [19].

Several research studies have been conducted throughout the surge of violence and ease of the situation in recent years. Besides the downturn of the economy and the change of lifestyle, research also found the key advantage of this region. Such an advantage is the use of the Malay language, despite

the common Thai language in other regions of Thailand. Malay is the primary language of the member countries in the Indonesia–Malaysia–Thailand growth triangle (IMT–GT) economic cooperation initiative. Additionally, the region’s Islamic identity offers potential for excellence in the halal food industry and the goal of becoming a global Muslim kitchen. The development of Islamic financial institutions and the promotion of local Muslim entrepreneurs were also suggested by researchers, as most state-supported industries in the area are currently driven by external investors, such as in the frozen seafood industry. Some research also suggested the development of agro–industrial economies, such as establishing latex processing plants, and emphasized the need for an economy that supports ecological preservation. This includes developing cultural and eco–tourism in the region’s tropical rainforests. Crucially, human resource development is essential. Although locals increasingly recognize the economic necessity of language proficiency for participating in the modern economy, a significant issue persists, *i.e.*, students graduating from both public and private Islamic religious schools struggle to compete at the higher education level or in the job market compared to their Buddhist Thai counterparts from other regions [23].

As presented thus far, several attempts have been made to resolve the problems, and many research studies have been conducted. This resulted in the declaration of the newly developed Border Security Management Action Plan (2023–2027). The action plan aims to develop an integrated security information system, enhance mechanisms for driving the national security strategy, and create effective, unified, and integrated security measures. Urgent security issues that need addressing include personal and property safety, drug problems, unrest in the southern border provinces, cybercrime, and corruption within the civil services [20]. In terms of human resource development and capacity enhancement, the government declared the need for improving the efficiency of the education management system at all levels and types. This includes elevating specialized educational institutions to excellence, reforming educational finance to enhance quality and efficiency by directly allocating budgets to students, promoting private sector participation in education, and developing an independent educational quality assurance system that focuses on student outcomes. Furthermore, it involves reforming examination systems to assess essential 21<sup>st</sup>–century skills rather than just knowledge levels and incorporating research and technology in teaching and knowledge management. Additionally, it includes career skill development aligned with local contexts [24]. Yet much effort is needed to achieve such goals given the consequences of prolonged unrest, violence, and existing problems. However, not much research has been done to explore if the budget allocation for the research aligns with the problems and challenges that have occurred over time. From the review of the integrated plan to drive the resolution of the southern border provinces’ problems, in the budget allocation of the southern border provinces administrative center, the goal is to enhance the image and promote tourism in the southern border provinces, consisting of research projects related to promoting the development of sports and recreation skills, promoting the potential of tourism in the economic triangle, promoting and supporting education management, promoting Halal production and business, and strengthening good relationships and understanding to reduce conflicts, which is considered a challenge for researchers in developing the quality of life and growth of society in the area [25].

In 2007, Prince of Songkla University, Pattani Campus, initiated a research project titled “Information Technology and Communication for National Peace”, supported by the NRCT, together with the other parallel project entitled “Development of Information Systems and Knowledge Base for the Southern Border Provinces”, which was supported by the Southern Health and Development Research Institute. These projects led to the establishment of the “Southern border research database (SOREDA)”, a repository for research data concerning the southern border provinces, including Pattani, Yala, Narathiwat, and Satun. This database encompasses various aspects such as politics, governance, arts, culture, lifestyle, history, landscape, tourism, resources and environment, education, health, religion, and law. The data reflects the unique identity of the three southern border provinces, aiding in understanding and providing benefits for development and research related to the area.

In 2011, the documentation related to the southern border provinces was revised and expanded beyond the existing research. The SOREDA project was conducted to enhance the system’s connectivity, ensuring it is easily accessible and user–friendly, allowing for quick and efficient information retrieval. This serves as a foundation for generating new knowledge or enhancing existing knowledge that is beneficial for the development and problem–solving in the southern border provinces. Even though SOREDA enables and provides a repository of research relevant to the southernmost provinces of Thailand, there is no research study to examine the trend of research over time. This is important because a large amount of budget has been invested, yet the return on investment is unknown, as is the possible trend of the research topic in this area.

## 2.2. Research topic analysis

The research topic provides an overview of the research content. It is a reflection of the most substantial and focal points of the research. Previous research uses research topics to identify the trend of the research. This is usually done when conducting a systematic literature review, scoping review, or mapping review. For example, Kee *et al.* [26] conducted a scoping review on mindfulness research with the aim of identifying topics focused on mindfulness research. They use probabilistic topic modeling based on latent Dirichlet allocation (LDA). They suggested that such a method could be used to discover the main research topics, which were the major trends. Polley [27] used VOSviewer, a text mining-based tool, to visualize the topic coverage of the collection from the institutional repository. They demonstrated that using the tool can help the librarian detect research clusters in the librarian-managed repository. Nurdin *et al.* [28] used a VOSviewer to analyze the bibliometrics of research retrieved from Scopus.

As presented thus far, topics are generally analyzed to synthesize the theme or trend of research studies, whether domain-specific (keyword searching) or repository-specific. Traditional research grouped the topics manually by using a thematic analysis. When analyzing data from a large corpus, manual topic identification becomes a high challenge and time-consuming task. Therefore, data mining techniques such as text mining, topic mining, or VOSviewer are usually applied to identify prevalent themes and trends. This helps researchers understand the landscape of existing research and pinpoint areas that require further exploration. Topic modeling is a technique that enables the retrieval and detection of specific thematic structures hidden in a large number of documents [29]–[31]. It is based on a probabilistic model that can be used to explain data related to a topic in any statement and involves the following key components: i) topics, *i.e.*, the fundamental concepts or themes that represent a statement (for instance, in a corpus of newspaper articles, there may be fundamental topics related to finance, climates, politics, sports, and news); ii) a probability distribution, which explains an article by distributing the probability in order to identify the similarity. Topic modeling can be used to draw conclusions, enable retrieval, and order files based on topics rather than words [32].

VOSviewer is another tool used to visualize the themes of the topics. The term visualization of similarities (VOS) stands for visualization of similarities (VOS), which refers to a technique used for the allocation of nodes in a network graph. The VOS method was initially built based on text mining algorithms to analyze the bibliometric network [33]. It locates terms closer to their ideal coordinates on the map and gives weight to indirect similarities [33].

Network analysis is another frequently used approach to visualize the connections between items of interest, such as the use of networks to depict the connections among the researchers when conducting the citation analysis by using tools like VOSviewer. It is also applied in topic analysis to demonstrate the connection among the topics. Epistemic network analysis (ENA) is another type of network analysis that offers a novel approach to understanding the structure of connections within data. It rests on three key assumptions: first, that the data can be systematically broken down into meaningful elements (codes). Second, the data exhibits a local structure, consisting of smaller units like conversations or documents. Finally, the way these codes connect within these local structures holds significant meaning [34]–[36]. ENA goes beyond simply identifying these connections. It quantifies their strength by analyzing the co-occurrences of codes within conversations. This allows for the creation of network models that visually represent these relationships. Notably, ENA analyzes these networks simultaneously, enabling researchers to compare and contrast them statistically and visually. As presented thus far, studying the research trend, whether domain-specific or repository-based, can be done by using advanced techniques such as topic modelling [26], [37], bibliometric analysis [27], [28], [38] and others. However, there remains a lack of research studies to examine the differences between the topic detection model and its precision in coordinating human judgment in understanding topics based on the collected data in the institutional library-managed repository.

## 3. METHOD

### 3.1. SOREDA system

The dataset used in this study was retrieved from an institution-managed repository called the Southern border provinces research database (SOREDA). This database serves as a platform for presenting research reports, articles, and theses related to the southern border provinces, including Pattani, Yala, Narathiwat, Songkhla, and Satun. The database was developed by using MySQL as an open-source database and PHP for web programming. The system's functionality was tested by individuals with technical and operational expertise. It aims to provide a resource for academic and research development by emphasizing specifically those research studies concerning the southern border provinces, regardless of the researchers' affiliates and research fields [39].

SOREDA is currently managed and maintained by the librarians. Figure 1 presents the simplified use case diagram to describe the general and main functions of the SOREDA librarian–managed web–based system. The librarians’ task involves collecting data from several other research repositories in Thailand, such as ThaiLIS digital collection (TDC), PSU Knowledge Bank repository, Thai Journal web–based system (ThaiJo), NRCT web-based system, universities’ libraries and repositories, and others. The data inserted into SOREDA involves theses, research papers, and articles that were relevant to the provinces of Pattani, Yala, Narathiwat, Songkhla, and Satun. The selection of research data is based on the title and abstract, with content manually grouped into 11 categories by the librarians as presented in Table 1. This includes Economy and Society, Politics and Governance, Arts and Culture, Lifestyles and Traditions, History, Landscape and Tourism, Resources and Environment, Education, Health and Hygiene, Religion, and Law. They then insert data into the system, identify the corresponding categories, update data, and delete data. Users can view the available categories, research, and search data.



Figure 1. A simplified use case diagram describes the main functions of the SOREDA system

### 3.2. Data analysis method

Figure 2 illustrates the methodology used to answer the formulated research questions. Initially, the data were retrieved from SOREDA, and 1,148 numbers of research data were recorded in the SOREDA system (data up to June 30, 2024). Authors retrieved these data for the analysis by using the following fields: years of publications; types of publications; title, abstract, topic, subtopic, and number of accesses. The data were then translated from Thai to English. However, some fields of data were missing; hence, they were excluded from this study. Based on the observation, this missing data was relevant and happened during the system development testing. Hence, excluding this data did not affect the analysis. Consequently, only 1,142 records were included in this study.

Table 1. Topics and corresponding sub-topics coded by the librarian of data recorded in SOREDA

No.	Main topics	Sub-topics
1	Economy and society	– Policy and development – Community economy – Economic issues – Community leaders – Schools and communities – Women, children, and youth – Social participation – Social change – Social problems – Mass communication
2	Politics and governance	– Governance policy – Local organizations – Political participation
4	Arts and culture	– Language and communication – Painting – Handicrafts – Architecture – Literature – Historical sites and artifacts – Performing arts
4	Lifestyles and traditions	None
5	History	None
6	Landscape and tourism	– Pattani – Yala – Narathiwat – Satun
7	Resources and environment	– Resource and environmental management – Environmental issues
8	Education	– Educational policy – Educational management – Educational personnel – Educational issues
9	Health and hygiene	– Food and consumption – Community hygiene – Public health services
10	Religion	– Religious history – Religion and society – Religious leaders
11	Law	– Law and enforcement – Islamic law
12	Halal food	None
13	Rubber	None
14	Islamic studies	None
15	Seafood	None
16	Palm oil	None
17	Conflict management	None
18	Songkhla lake	None

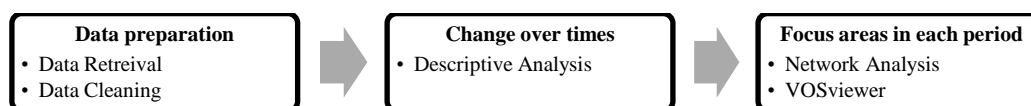


Figure 2. Overview of research methodology

Then, the data were assigned to an era based on the violent incidents. As presented in the background of the study, the major incidence in the southern border provinces of Thailand happened in 2004; therefore, the research studies published prior to 2004 are considered the ‘prior conflict era’; the research published during 2004–2016 is assigned to research ‘during conflict era’; and others were ‘post–conflict era’. This decision was made based on the number of incidents that happened in the three southern border provinces. The number of these incidents was also the result of political implementation in the three southernmost provinces and political disruption of Thailand as a whole. That is, the Thailand’s political instability began in 2004 with the military coup. The unstable politics continued until 2016, when Thailand finally restated the general election of the prime minister. Consistent with the unrest in the southern border

provinces in 2004, there were clashes between soldiers and insurgent groups in several areas, causing physical and mental losses to many local people during the Thaksin Shinawatra Government [40]. As presented in Figure 3, after 2016, the number of incidents significantly decreased and became lower than the incidents that happened during the earliest stage of violence in 2004. This number gradually remained stable until the day this research was written. Hence, this research considered the paper published after 2016 as the post-conflict era. The descriptive analysis was initially applied to give an overview of the data and examine the density of research during each era.

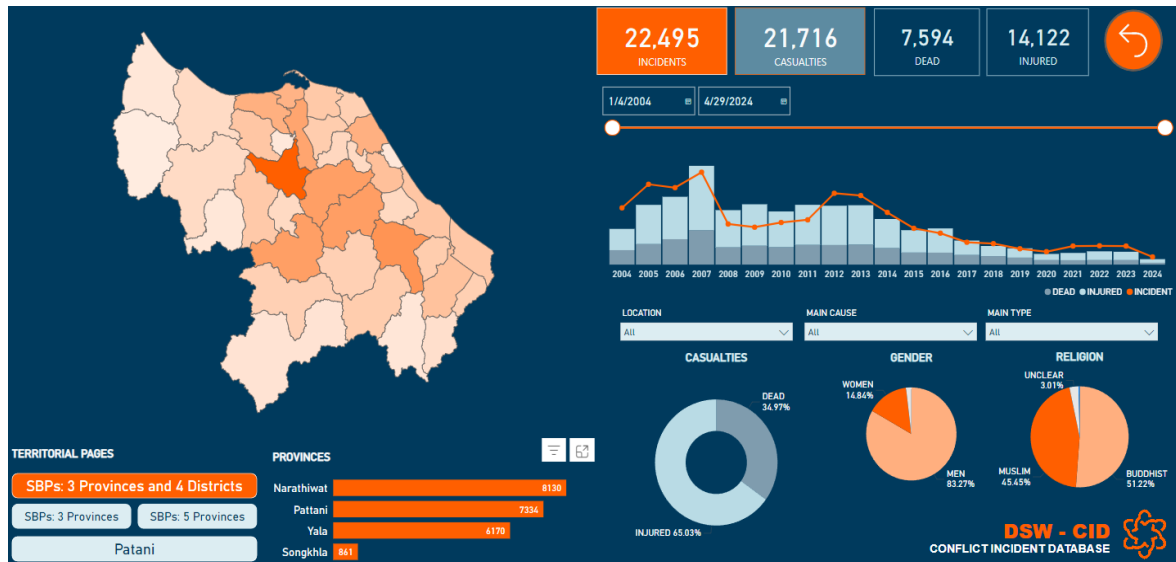


Figure 3. Number of incidents that happened in the southern border provinces as recorded by Deep South Watch [41]

The ENA Web Tool (version 1.7.0) was used to visualize the research area. To analyze using ENA, all sets of data were combined, and corresponding topics were formulated in 0 and 1 format, which were then used as input to the ENA Web Tool. This research aims to examine the research focus in each conflicted era, and each era consists of several unique subsequent years. Therefore, the following parameters were used when formulating the ENA graphs, including: i) the units of analysis and conversation were period (*i.e.*, pre-conflict, conflict, and post-conflict era) and unique identification numbers of research and ii) the code represents the node in ENA, which was defined based on the main topics identified manually by the librarian in Table 1 identification of these parameters was done following the tutorials [34], [36], [42], [43].

The ENA model normalized the networks for all units of analysis before they were subjected to a dimensional reduction, which accounts for the fact that different units of analysis may have different numbers of coded lines in the data. For the dimensional reduction, the ENA Web Tool used a singular value decomposition, which produces orthogonal dimensions that maximize the variance explained by each dimension (see [34] and [36] for a more detailed explanation of mathematics). Networks were visualized using network graphs where nodes correspond to the codes (*i.e.*, topic) and edges (lines) reflect the relative frequency of co-occurrence, or connection, between two topics. Each node represents research-focused area or concept, as presented in Table 1. The size of the nodes indicates the frequency or importance of that theme within the dataset. Edges connecting the nodes represent the relationships or co-occurrences between research-focused areas. The thickness of the lines indicates the strength or frequency of these connections.

The result is two coordinated representations for each unit of analysis: i) a plotted point, which represents the location of that unit's network in the low-dimensional projected space and ii) a weighted network graph. The positions of the network graph nodes are fixed, and those positions are determined by an optimization routine that minimizes the difference between the plotted points and their corresponding network centroids. Because of this co-registration of network graphs and projected space, the positions of the network graph nodes-and the connections they define-can be used to interpret the dimensions of the projected space and explain the positions of plotted points in the space.

ENA can be used to compare units of analysis in terms of their plotted point positions, individual networks, mean plotted point positions, and mean networks, which average the connection weights across



individual networks. Networks may also be compared using network difference graphs. These graphs are calculated by subtracting the weight of each connection in one network from the corresponding connections in another. In this study, we use mean networks to compare each pair of eras as identified earlier. The research topics and their changes through time were examined using VOSviewer. This program enables the detection of the most frequently used keywords in the topics, enabling automated topic detection and visualization of the results.

## 4. RESULTS AND DISCUSSION

### 4.1. General Information about the research in SOREDA database

A collection in SOREDA can be found dating back to 1982. As shown in Figure 4, there are a total of 1,142 research items in SOREDA. When analyzed by time period, it was found that the conflict era had the highest number of research items, totaling 640 (56.04%). This was followed by the pre-conflict period with 360 items (31.52%), and the post-conflict period with 142 items (12.43%).

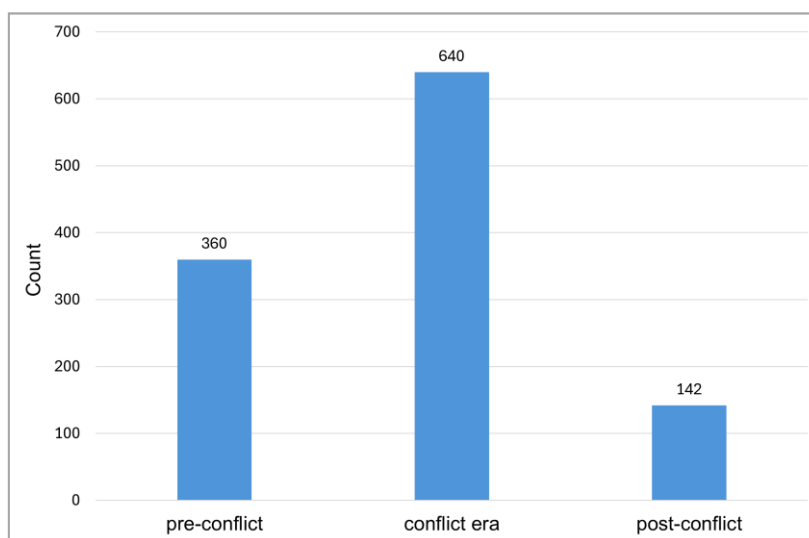


Figure 4. A number of academic works are classified by time period of conflict

As presented in Figure 5, the data recorded in SOREDA was conducted mostly by Prince of Songkla University, Pattani Campus, with 919 items. This is due to the fact that the university is located in the area of interest. The second highly contributed research team is Prince of Songkla University, Hat Yai Campus, with 64 items, followed by Ramkhamhaeng University with 33 items, King Mongkut's University of Technology Thonburi with 23 items, and King Mongkut's University of Technology North Bangkok with 15 items, respectively.

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From Figure 6, during the pre-conflict period, there were 360 academic research outputs, including 149 research reports, 143 theses, and 68 articles. During the conflict era, there were 640 research outputs, including 144 research reports, 418 theses, and 78 articles. In the post-conflict period, there were 142 research outputs, consisting of 21 research reports and 121 theses.

The number of accesses recorded in the clickstream to the specific research outputs. In Figure 7, the boxplot illustrates the quartiles (Q1 and Q3) of accessing the articles published in each era. The middle line located in the box represents the median number of people accessing the articles. The small dots represent the outliers. As presented, the research outputs published prior to the conflict contained the highest access (Med=2696 (2066, 3844)). This indicated the highest number of accesses. In the conflict era, there was a medium level of access (Med=1650 (1018, 2725)). The post-conflict showed the lowest accessing number

(Med=304 (199, 525)). Even though the paper publication years seem to have a higher number of access but in literature posited that years of publication does not affect the citation of the paper [44]. This is commonly observed and well recognized by many systematic literatures review [45].

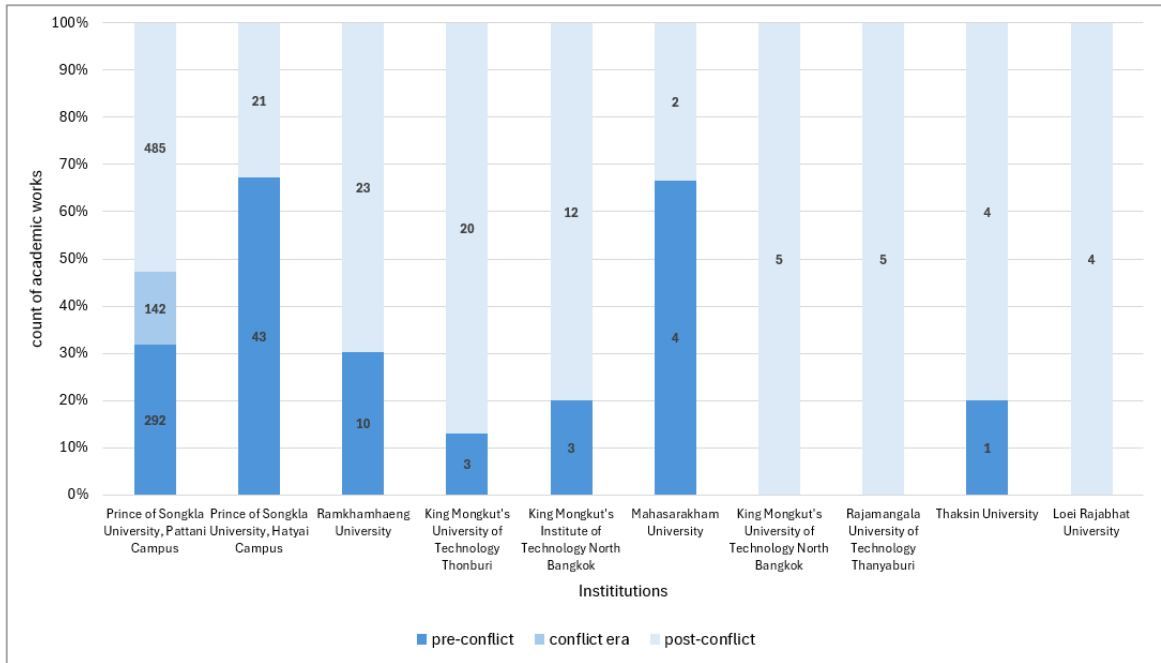


Figure 5. The top 10 institutions that publish academic works are classified by time period of conflict

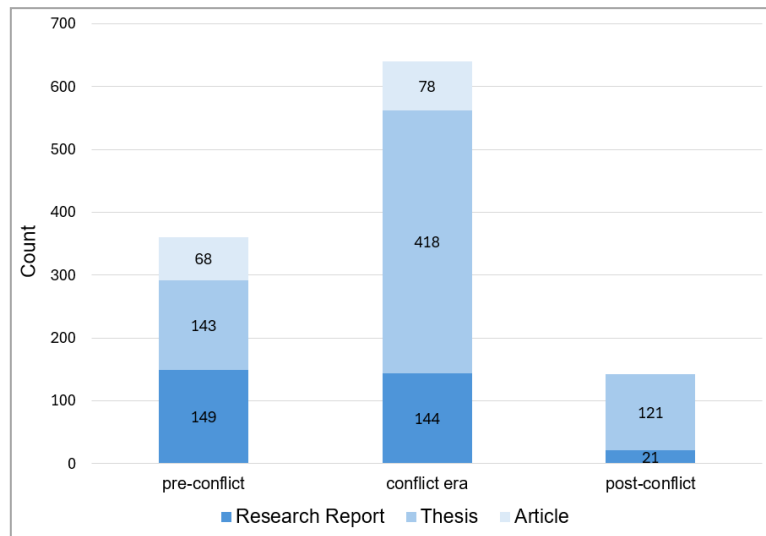


Figure 6. Types of academic work are classified by time period of conflict

**4.2. Research trend reflected from SOREDA database**

The ENA graph presented in Figure 8 illustrates the connections between research topics across three distinct periods: pre–conflict, conflict era, and post–conflict, as recorded by the SOREDA system. The period was represented by using different colors to differentiate the nodes. That is, the pre–conflict era was represented by using red, and the and the conflicted era was represented by blue and purple for the post–conflict era. The circle node refers to the year, and the square node is the mean value calculated by computing the average location of all relevant years’ datasets. The dot–square shape around the dense square

node refers to the confident interval. As presented, the red dots are mostly concentrated in the upper left quadrant, indicating the primary research topics during this period. The close clustering suggests a high degree of similarity and interconnection among the research topics. This period seems to have a relatively balanced spread, with some outliers indicating diverse but interconnected topics. The blue dots are clustered in the central area, overlapping slightly with the pre–conflict period, indicating continuity and some evolution of research topics. This period exhibits a distinct grouping, highlighting specific themes that were prevalent during the conflict. The purple dots are mainly located in the lower right quadrant, indicating a shift in research focus after the conflict. The dispersed nature of the dots within this cluster suggests a broader and more diverse range of research topics post–conflict. This separation from the other periods’ clusters indicates new research themes emerging in the post–conflict era.

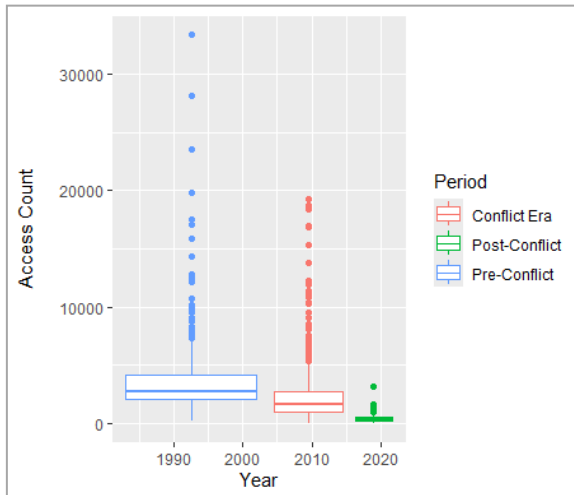


Figure 7. Boxplot presenting the number of accesses to each era’s research studies

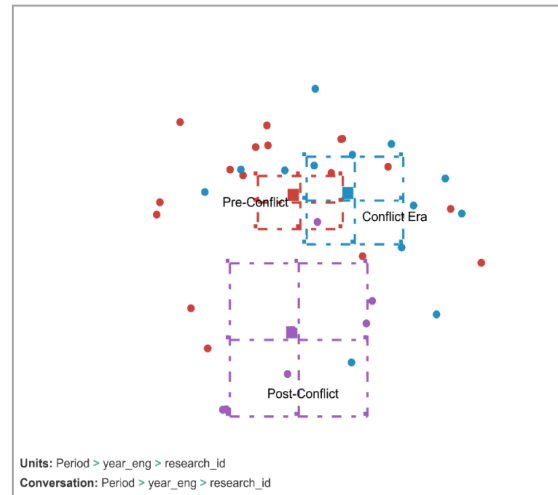


Figure 8. Overview of network analysis

Network graphics presented in Figure 9 present the connection between research topics conducted during the pre–conflict era. Each node in the graph signifies a topic, while the lines (edges) connecting the nodes illustrate the co–occurrence and strength of relationships between these topics. Thicker lines denote stronger connections. The ENA graph reveals that during the pre–conflict period, the central node (*i.e.*, the largest dot) of the research focused on “Islamic Studies”. “Islamic Studies and Education” have centrally strong connections, especially between each other, indicating these areas were heavily interconnected and prominent in research during this period. “Economic and Society” also shows significant connectivity, linking strongly with “Islamic Studies”.

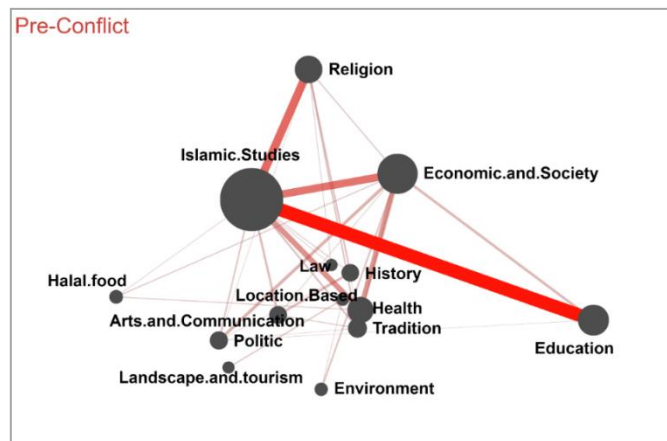


Figure 9. ENA networks of research topics prior to the conflict in 2004

Figure 10 illustrates the relationships of keyword co-occurrence in pre-conflict. It showed the presence of five interconnected clusters. Cluster 1 (blue) contains the keywords: ‘General Education’, Teacher’, ‘Characteristics’, ‘Private Islamic School’, and ‘Narathiwat Province’. Cluster 2 (red) includes the keywords: ‘Primary School Administrator’, ‘Educational’, ‘Region’, ‘Opinion’, and ‘Behavior’. Cluster 3 (green) comprises the keywords: ‘Southern Border Province’, ‘Evaluation’, ‘Thai Muslims’, ‘Economic’, and ‘Need’. Cluster 4 (purple) consists of the keywords: ‘Rural Development’, ‘Roles’, and ‘Primary School’. Lastly, Cluster 5 (yellow) features the keywords: ‘Study’, ‘Pattani Province’, ‘Pattani Bay’, ‘Area’, and ‘Survey’. This result was well aligned with the ENA graph (refer to Figure 9). The central focus of the topics was related to ‘Education’ and ‘Islamic Studies’. The region showed to be the most commonly used in research topics.

Network graphics in Figure 11 present the connection between research topics conducted in the conflict era. the research during the conflict era prominently focused on ‘Islamic Studies’. The connection between ‘Islamic Studies’ and ‘Education’ outweighs other connections. However, there were a couple of highly strong connections that could be visibly observed. This included the relationship between ‘Islamic Studies’ and ‘Economics’, ‘Society’, and ‘Religion’. ‘Conflict Management’ research appeared during this period, with a smaller dot overlapping with ‘Islamic Studies’. It showed a connection with ‘Education’, ‘Islamic Studies’, ‘Economics’, and ‘Society’. Another appearance of research areas was ‘Rubber’ and ‘Songkla Lake’.

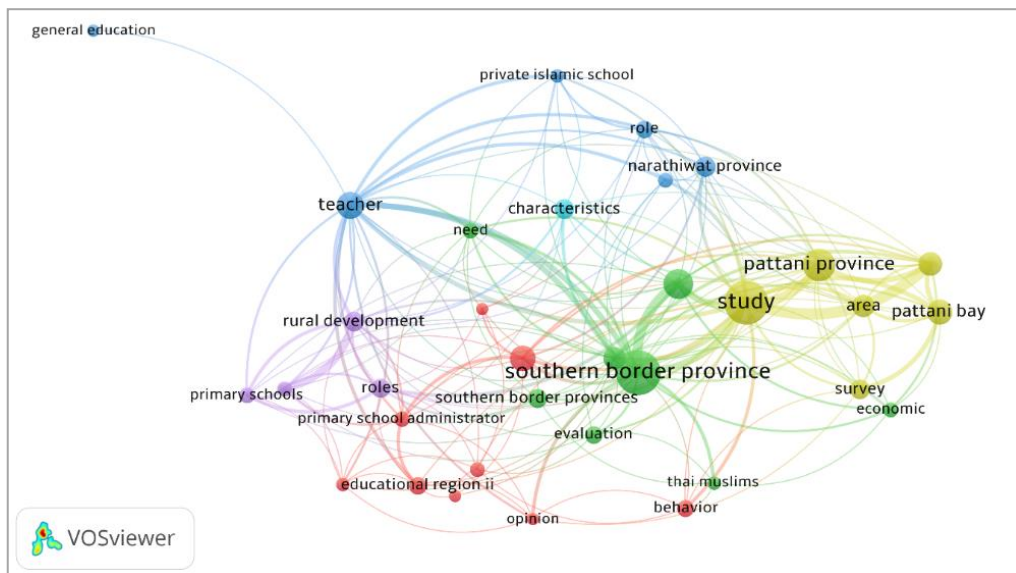


Figure 10. Clusters of research on bibliometric analysis based on the co-occurrence of keywords in pre-conflict

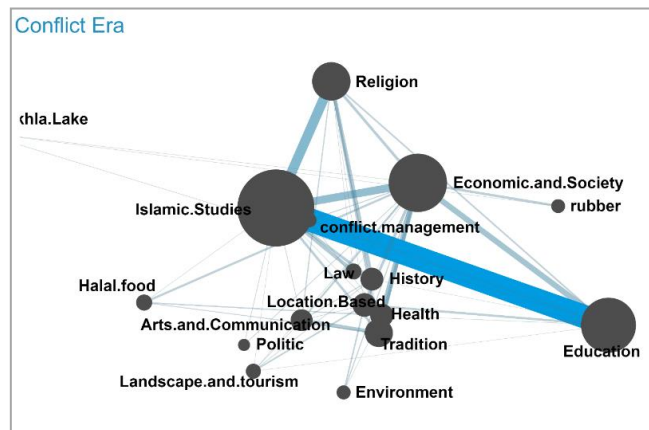


Figure 11. ENA networks of research topics prior to the conflict in 2004–2016

Figure 12 illustrates the relationships of keyword co-occurrence in conflict era. It showed the presence of five interconnected clusters. Cluster 1 (blue) contains the keywords: ‘Southern Border Province’, ‘Participation’, ‘Relationship’, ‘Perception’, and ‘Peace’. Cluster 2 (red) includes the keywords: ‘Management’, ‘Education’, ‘Pattani’, ‘Yala’ and ‘History’. Cluster 3 (green) comprises the keywords: ‘Student’, ‘Achievement’, ‘Learning’, ‘Islam’, and ‘Undergraduate Student’. Cluster 4 (purple) consists of the keywords: ‘Study’, ‘School Administrator’, ‘Situation’, ‘Unrest’, and ‘Rubber’. Lastly, Cluster 5 (yellow) features the keywords: ‘Development’, ‘Teacher’, ‘Application’, ‘Perceived’, and ‘Islamic Private School’. Even though, the ENA graphs present the strongest connection between ‘Education’ and ‘Islamic Studies’, the research topics reflected in Figure 12 were much more diverse. The central point was still relevant to education and region. But the other topics, such as rubber, unrest, and peace were presented. This is in echo with the rising conflict situation in the three southern border provinces.

Network graphics presented in Figure 13 present the connection between research topics conducted in the post-conflict has eased, and a shift in research areas can be observed. That is, the central node has been changed from ‘Islamic Studies’ to focus more on ‘Location-based’, relevant topics. However, the strongest connection between ‘Islamic Studies’ and ‘Education’ was clearly visible. The connection between ‘Location-based’ topics and ‘Landscape and Tourism’ has emerged. It is worth noting that ‘Economics’ and ‘Society’ had a relatively strong connection with the ‘Location-based’ topic as well. ‘Art and Communication’, ‘Health’, and ‘Landscape and Tourism’ have appeared to show a strong connection with other nodes.

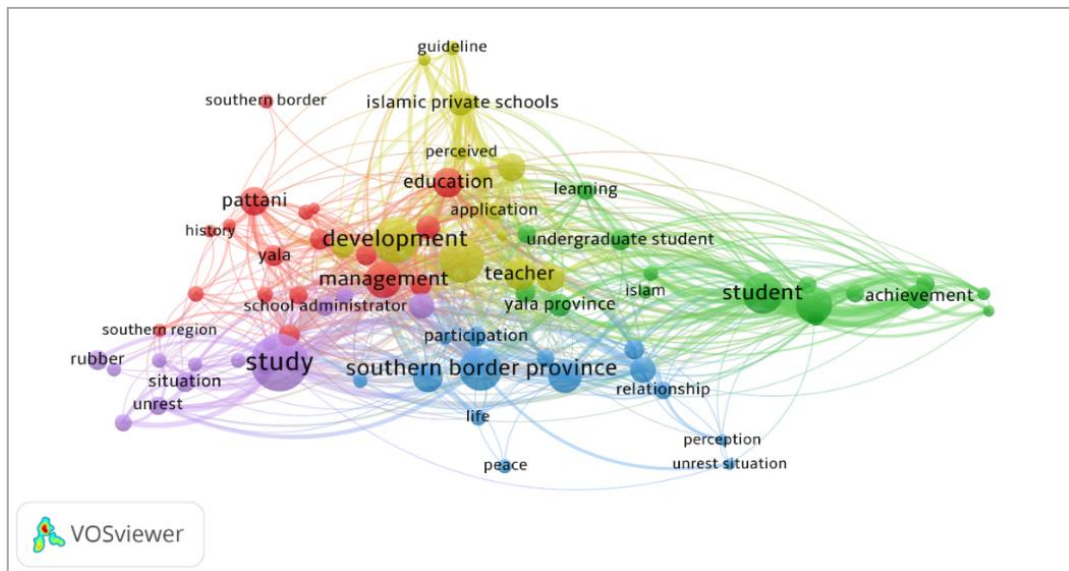


Figure 12. Clusters of research on bibliometric analysis based on the co-occurrence of keywords in conflict era

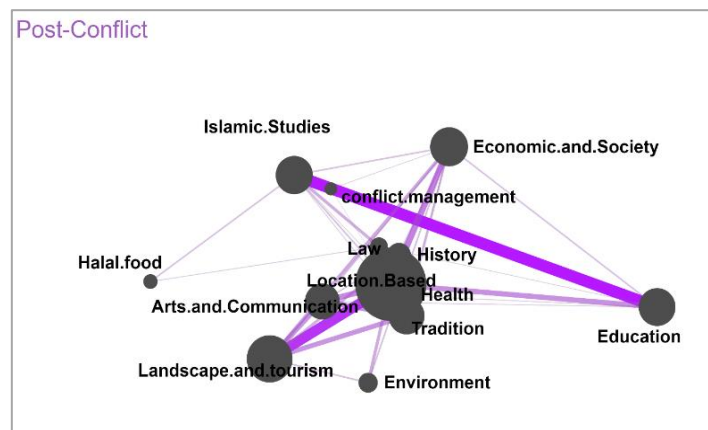


Figure 13. ENA networks of research topics after an eased situation

Figure 14 illustrates the relationships of keyword co-occurrence in post-conflict. It showed the presence of five interconnected clusters. Cluster 1 (blue) contains the keywords: ‘southern border province’, ‘local intellectual’, ‘community’ and ‘friday khutbah’. Cluster 2 (red) includes the keywords: ‘narathiwat province’, ‘islamic law’ and ‘problem’. Cluster 3 (green) comprises the keywords: ‘pattani province’, ‘teacher’, ‘development’, ‘factor’ and ‘southernmost province’. Cluster 4 (purple) consists of the keywords: ‘muslims’ and ‘analytical study’. Lastly, cluster 5 (yellow) features the keywords: ‘yaring district’, ‘management’, ‘model’ and ‘student’. The topics were well aligned with the ENA graphs. The diverse research topics relevant to the local-based topic were visually observable, such as ‘local intellectuals’, and ‘yaring districts’.

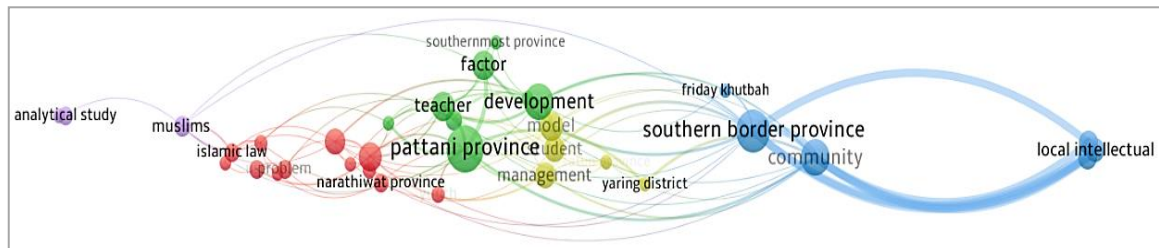


Figure 14. Clusters of research on bibliometric analysis based on the co-occurrence of keywords in post-conflict

As presented thus far, the trend of research as recorded in SOREDA, a repository that collected research documents relevant to Thailand’s southernmost provinces can be observed. It is expected that the results of research studies could be used to improve the southern border provinces’ quality of life. By considering the most prevalent event that highly impacted the people living in these areas in 2004, the collected data can be divided into three periods: the pre-conflict period (prior to 2004), the conflict period (2004–2016), and the post-conflict period (after 2016). The results reflected three outstanding trends.

Firstly, Islamic studies showed a strong connection with education. Across three eras of research in the Thailand deep south provinces, network analysis revealed that the majority of research focused on Islamic studies, education, economy, and society. The evidence based on the research network analysis showed that Islamic studies were the central focus of the research in the deep south provinces of Thailand. Additionally, the topic analysis showed that private Islamic schools, teachers, and school administration were the most frequently appearing keywords in research topics across three eras. This was reflective of the educational context. As known around the world, the majority population in Thailand is Buddhist, except for the southern parts of Thailand, where a majority practice Islamic beliefs. Hence, the education system was influenced by such beliefs and established Islamic private schools [46], [47]. For example, Madmarn [48] explored the Muslim attitude toward Thai secular education and Thai educational policy. The research suggested that Islamic practice plays a significant role in Muslim education in the southernmost provinces. The education policy was suggested to incorporate ‘moral ethics’ and consider ‘Islamic culture and practice’. In an early era, the worry about the influence of different beliefs seemed to be among the highest concerns of the population in the southernmost provinces [48]. As time has progressed, the blending of Islamic practices and education has emerged but has become much more cooperative. This was evidenced through research topics such as the exploration of technology-integrated education [47], 21<sup>st</sup> century skills [46], and the infusion of Islamic Shura with science, technology, engineering, and mathematics professional learning communities (STEM PLC) [49]. They found that such approaches were empowered and enabled to change the understanding and perception of teachers toward the STEM teaching approach [49].

It can be seen that the trend in education is aligned with the long-term policy of the sustainable development goals (SDGs). The sustained research in education with an Islamic context has been clearly highlighted throughout the three eras. Apart from the fact that education has been the center of world challenges, it might also be due to the fact that the fact that education is a field that constantly requires change and update. Regardless of any disruption encountered, to promote the development of the country, education needs to be continuously refined, up-to-date, and enhanced to cope with global changes and challenges.

Secondly, conflict-management research arose amid violent incidents. The conflict management research studies were not presented until 2004. In response to the violence that arose, several research studies were carried out to inform the policy to resolve the deadly violence [50]. For instance, Jory [51] argued that

due to the reluctance in accepting the Pattani Malay identity of majority population resides in this area, radicalism arose. This was among the main roots of the 'cultural political issue' [52], [53]. Several policies had been implemented, including the Martial Laws Act in 2004, the Emergency Decree in Public Administration in State of Emergency in 2005, and other suggested policy implementations issued by the National Reconciliation Commission (NRC) [50]. The surged violence had deep and prolonged impacts on several aspects, such as education, economy, and society. However, conflict management research has relatively smaller numbers as compared to other areas of research.

In addition, managing conflicts between the public and government agencies, including providing knowledge and creating understanding in the form of education management in the area, is increasingly important. However, the majority of people in the area are Muslims. Therefore, the development approach and creating understanding to solve problems in the area must be consistent with the context of the area and religious beliefs that are the spiritual anchors, which is the combination of Islamic religious practices and Islamic education management for people in the area. Therefore, research on Islamic education is an educational issue that plays an important role in creating correct perception, reducing bias against government agencies, and creating equality for youth in the area. In addition, the results of the research also lead to the determination of state education policies that are consistent with the identity of the area, focusing on allowing students to learn religious subjects alongside general subjects and be able to practice according to Islamic teachings [54], helping to reduce conflict and create harmony between races and religions. However, Islamic education also helps create an understanding of the basic concepts and philosophies in Islamic education management, for which the state should provide policies and quality assurance systems for education that are standard and appropriate for state schools that teach Islamic studies [55]. Therefore, it can be mentioned that research on Islamic practices and education is a research issue that is important for the development of the southern border provinces because both regular education and education that integrates Islamic practices are important for human resource development, creating correct awareness, helping to solve problems, and developing areas appropriately.

Thirdly, the future direction of research seems to point to the use of local-based resources to drive the economy, especially in the tourism sector. As presented in the network graph, local-based research seems to be the new focus of research in the southernmost provinces. It is aligned with the government's policy of promoting and publicizing tourism through a community-based. Efforts included tourism campaigns, communication strategies, and activities grounded in multiculturalism, such as community-based tourism in Saikhaw, local food festivals, and the multicultural triangle. These initiatives aimed to attract and build confidence among tourists, portraying the area as safe for both Thai and international visitors. This aligns with [56], who asserted that the three southern border provinces possess significant potential due to their abundant natural resources and unique local cultural lifestyles, which are crucial tourism assets. Despite the political and security challenges that render the area's image high risk [57], there are opportunities to enhance the local community's value and improve their quality of life.

In addition, research on Islamic practices and education plays an important role in achieving tourism goals in many dimensions, especially tourism in countries with ethnic and cultural diversity. The results of Islamic education and Islamic practices can help promote cultural tourism, Halal tourism, and religious tourism, such as promoting cultural and religious tourism on a multicultural basis. Islamic practices emphasize people understanding and respecting the cultures and traditions of others. Islamic studies help tourists realize the importance of appropriate behavior in diverse contexts or areas, promoting peaceful and harmonious coexistence, such as dressing modestly, respecting sacred sites, and following local rules related to religious practices [58]. It helps create understanding of local religions and cultures and creates a good travel experience for tourists [59]. This is also consistent with [60], who stated that education also helps promote Halal tourism and local resources. Islamic principles regarding the consumption of Halal food and services are important. Studying these practices enables the tourism industry to develop and adapt to suit tourists [58]. Similarly to education and cultural exchange, Islamic studies can create a deeper understanding of the culture and religion of local communities, leading to respect and understanding between different cultures. These studies enable tourists to learn and interact meaningfully with local communities and promote sustainable tourism [61].

Therefore, it can be said that research on Islamic practices and education play an important role in driving the economy, especially in the tourism sector in the southern border provinces, both in terms of erasing stereotypes about the violence in the area, helping to reduce misunderstandings and potential conflicts, enhancing the image of Muslim-friendly tourism, creating understanding and harmony in society, and ultimately leading to the development of Islamic study and research centers, which are sources of knowledge about Islam. Students and researchers can come to learn and study local culture and Islam, resulting in the three southern border provinces becoming the center of Islamic studies in the region. Therefore, Islamic practices and Islamic studies play an important role in creating and promoting tourism in the southern border provinces, helping to create sustainable economic and social growth in this region.

Furthermore, considering the tourism research issues, there is potential to foster community participation and acceptance and reduce social conflicts and disparities [62]. This would help elevate the local community's stability, prosperity, and sustainability. Therefore, post-conflict tourism research is imperative, as it can build confidence in the area and provide guidelines for all stakeholders to work cohesively towards enhancing the area's quality of life while balancing economic, social, and environmental dimensions. Additionally, to drive economic and tourism development in the region, it is essential to foster tourism through the development of cooperation with neighboring countries. This can be achieved under the framework of the joint development strategy for border areas (JDS) between Thailand and Malaysia and the Indonesia–Malaysia–Thailand growth triangle (IMT–GT). These collaborative frameworks will help guide development strategies and emphasize leveraging international cooperation networks for further development.

## 5. IMPLICATIONS AND LIMITATIONS

The database collected an insightful trace of research. This research strengthens this notion by demonstrating how recorded research studies can be analyzed using machine learning algorithms. As argued by Asmussen and Møller [63], a traditional review of the research articles required an extensive investment of time, affordance, and cost. Advanced techniques such as data mining and machine learning can be used to extend the review process. Several techniques can be used, such as topic modeling [26], [64], bibliometric mapping [27], [28], [38], and text mining. The results depict twenty years of research, which evolve through timelines and incidents that happen. It provided tangible evidence of a research-driven resolution to the existing problem. For instance, in the case of the three southern border provinces of Thailand, education and Islamic studies were the most prominent research fields. This is aligned with sustainable development goals, such as the one that emphasizes quality education. Additionally, given the situation of violence, conflict surged in 2002 and crested in 2004, research has been one of the instruments used to monitor and seek a potential resolution to the conflict. Hence, research is crucial to inform policy. Research is strongly associated with the context and location in which it is conducted. However, research utilization remains a debated issue and needs further exploration. Even though this research revealed the topics across timelines and reported a number of access points through the research document, this does not guarantee the utilization of the research. Further studies need to consider how the research was utilized in order to investigate the return on the government's investment in the research.

Additionally, this research does not assess the quality of research collected in the repository. The quality of the research is important, however, due to the diversity of research types, the quality assessments are subjective to the types of research recorded in the system. Further research might be conducted to explore the specific types of research, in that case, the quality of research articles could be accessed. Therefore, the results would reflect empirical studies carried out in the regions. Also, this study does not address other potential biases in the data such as publication types, publications years, or other selection biases.

Another point that needs to be carefully considered is that when using data mining and machine learning algorithms, they need to be accompanied by human expert review. For instance, this paper utilized both machine and human approaches. That is, the network analysis was conducted based on the librarian's indicated areas of research, and the topic analysis was done through the automated detection of keywords. Both provide insightful information, but some limitations need to be treated with caution. That is, the use of human-identified topics needs to be done by those with expertise, such as librarians or experts in the field, to ensure accurate classification. The use of automated topic analysis needs to be done by carefully considering the algorithms of detection. For instance, there are a growing number of topic modeling analysis approaches such as term frequency-inverse document frequency (TF-IDF), LDA, and others. These algorithms perform much better in the task of privileged issue-oriented topics over coherent but meaningless topics composed of frequently occurring common words.

## 6. CONCLUSION

This research aimed to observe the trend of development among the southernmost provinces of Thailand as recorded in the database. The ENA and VOSviewer were used to provide visual representations of the evolution of research topics over time, showing how academic focus shifts in response to socio-political changes. The clustering and dispersion patterns indicate the nature and interconnections of research themes across different periods, as documented by the SOREDA system. The results indicated a predominant focus on educational development, teacher development, community and social development, and Islamic studies. This focus likely stems from the longstanding unrest in the three southern border provinces—Pattani, Yala, and Narathiwat—along with various challenges, including historical issues, separatist movements, and the unjust treatment of local residents. Additionally, these provinces face poverty and inequality compared to



other regions of the country. The unrest has resulted in injuries, deaths, property damage, psychological vulnerability, and disruptions to daily life and education. Recently, there has been an emphasis on leveraging existing local-based capital to restore and improve quality of life in tourism and education. The results of research on education, Islamic studies, and tourism using resources as a base are intended to elevate the southern border provinces to become historical tourism cities to attract both Thai and foreign tourists to learn about multicultural and historical societies. Furthermore, the results of Islamic studies will create knowledge and understanding, reduce conflicts, and live together in harmony.

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## REFERENCES




- [1] C. Phothisita, *The science and art of qualitative research*. (in Thai), Mahidol IR, 2007. Accessed: Jul 22, 2024. [Online]. Available: <https://repository.li.mahidol.ac.th/items/1f9e68e0-e683-475a-a745-495e38356196>
- [2] W. Warawit, *Development of engineering research database*. Bangkok, Thailand: Faculty of Engineering, King Mongkut's University of Technology North Bangkok, (in Thai), 2003, doi: 10.14457/KMUTNB.res.2003.11.
- [3] W. Phonprasit, *Strategic management in Hospital Administration Unit 1*. Nonthaburi, Thailand: Sukhothai Thammathirat Open University, (in Thai), [Online]. Available: <https://ebook.stou.ac.th/detail/18424/การจัดการเชิงกลยุทธ์ในการบริหารโรงพยาบาล หน่วยที่ 1, 2009>.
- [4] A. Salaba and L. Chan, *Cataloging and classification: an introduction*. McGraw-Hill, 1985.
- [5] B. Hjørland, "Nine principles of knowledge organization," The University of Arizona Libraries, USA, 1994.
- [6] N. J. Williamson and C. Beghtol, *Knowledge organization and classification in international information retrieval*. Pennsylvania, USA: Haworth Information Press, 2003.
- [7] N. Kewsuwun, K. Kwiecien, and C. Sae-Chan, "The synthesis of problems, needs and strategies of 14 Southern Province Group Administrative Office in accordance with academic fields of National Research Council," (in Thai), *Parichart Journal*, vol. 32, no. 1, pp. 389–423, 2019.
- [8] Bank of Thailand, "Southern economic structure," 2016. [https://www.bot.or.th/content/dam/bot/documents/th/thai-economy/regional-economy/southern/monthly-press/2559/FullSouth\\_Report\\_Apr2016.pdf](https://www.bot.or.th/content/dam/bot/documents/th/thai-economy/regional-economy/southern/monthly-press/2559/FullSouth_Report_Apr2016.pdf) (accessed May 01, 2024).
- [9] S. Sanongphan, "The political violence in the three southern border Provinces of Thailand," (in Thai), *Rajamangala University of Technology Srivijaya Research Journal*, vol. 4, no. 2, pp. 31–45, 2012.
- [10] N. Useng, A. Smuseneto, and A. Tamkrong, "Poverty eradication in Pattani: Kor Lae model," (in Thai), in *Proceedings of the 9th International Virtual Conference of Regional Network on Poverty Eradication*, 2021, pp. 31–49.
- [11] P. Meesad, W. Nuijian, and P. Boonrod, "Semantic search for information system domain bibliographic data," (in Thai), *Journal of Information Science and Technology*, vol. 4, no. 1, pp. 11–20, 2013, doi: 10.14456/jist.2013.2.
- [12] P. Phunnaputtimok, S. Nuntapichai, and S. Boonbrahm, "Using facet analysis for analyzing the data structure of bibliographic record," (in Thai), *Journal of Information Science Research and Practice*, vol. 31, no. 3, pp. 1–29, 2013.
- [13] S. Loipha, "The elderly and information technology," (in Thai), *Journal of Information Science Research and Practice*, vol. 29, no. 2, pp. 53–64, 2011.
- [14] C. Boonwong, "Development of knowledge-based management system using ontology: a case study of the graduate school, Silpakorn University," M.S. thesis, Department of Educational Information, Silpakorn University, Thailand, 2015.
- [15] N. Mueanri, W. Chaopanon, and L. Manmart, "Analysis of current status of online research information sources in Thailand," (in Thai), *KKU Research Journal (Graduate Studies)*, vol. 13, no. 4, pp. 73–87, 2013.
- [16] S. Chittmittrapap, "The National Research Council of Thailand recommends teaching research for practical use," *Komchadluek.net*, 2011. <https://www.komchadluek.net/kom-lifestyle/94981> (accessed May 30, 2024).
- [17] Southern Border Provinces Educational Coordination and Administration Center-Ministry of Education, "Educational strategic plan for the special development zone of the Southern Border Provinces, 20 years (2017-2036)," Ministry of Education, 2017. [https://planning.pn.psu.ac.th/plan\\_doc/procedure/docs\\_procedure/200\\_1509510396.pdf](https://planning.pn.psu.ac.th/plan_doc/procedure/docs_procedure/200_1509510396.pdf) (accessed May 10, 2024).
- [18] S. D. Dorairajoo, "Violence in the south of Thailand," *Inter-Asia Cultural Studies*, vol. 5, no. 3, pp. 465–471, Dec. 2004, doi: 10.1080/1464937042000288741.
- [19] N. Kewsuwun, K. Kwiecien, and C. Sae-Chan, "The development of research recommendation system for Southern Thailand development," *International Journal of Managing Information Technology*, vol. 11, no. 4, pp. 21–40, Nov. 2019, doi: 10.5121/ijmit.2019.11402.
- [20] A. Songsom, "Household economy in Pattani Province under the southern unrest," (in Thai) *Journal of Humanities and Social Sciences Prince of Songkla University*, vol. 5, no. 2, pp. 37–70, 2009.
- [21] S. Agarwal, M. Tyagi, and R. K. Garg, "Conception of circular economy obstacles in context of supply chain: a case of rubber industry," *International Journal of Productivity and Performance Management*, vol. 72, no. 4, pp. 1111–1153, Nov. 2021, doi: 10.1108/ijppm-12-2020-0686.
- [22] S. Jitpiromsri, "9 months into the 9th year: Amidst the enigmatic violence, the Pa(t)ani peace process still keeps on moving," *Deep South Watch*, 2012. <https://deepsouthwatch.org/ms/node/3803> (accessed May 30, 2024).
- [23] B. Chaijaroenwattana, C. Wongtani, U. Wangsni, Y. Sattar, N. Paiboon, and I. Saha, "Research project on local communities and participation processes in watershed management in Songkhla Province's security area," (in Thai), *Prince of Songkhla University, Hat Yai Campus*. 2012, doi: 10.14457/PSU.res.2012.14.
- [24] Office of the National Economic and Social Development Board, "National strategy 2018-2037 (summary edition)," *National Strategy Secretariat Office*, 2018.
- [25] MGR Online, "Open budget to solve the southern violence problem from 2004-2020, totaling more than 300 billion baht," *MGROnline.com*, 2020. <https://mgronline.com/south/detail/9630000069937> (accessed Sep. 05, 2024).
- [26] Y. H. Kee, C. Li, L. C. Kong, C. J. Tang, and K.-L. Chuang, "Scoping review of mindfulness research: A topic modelling approach," *Mindfulness*, vol. 10, no. 8, pp. 1474–1488, Apr. 2019, doi: 10.1007/s12671-019-01136-4.

- [27] D. E. Polley, "Visualizing the topical coverage of an institutional repository with VOSviewer," in *Data Visualization: A Guide to Visual Storytelling for Libraries*, vol. 111, Lanham, MD: Rowman & Littlefield., 2016, pp. 1–27.
- [28] B. V. Nurdin, S. S. Hutagalung, Yulianto, R. C. Kurniawan, and D. Hermawan, "Bibliometric analysis on governance index topics using Scopus database and VOSviewer," *Journal of Physics: Conference Series*, vol. 1933, no. 1, p. 012047, Jun. 2021, doi: 10.1088/1742-6596/1933/1/012047.
- [29] A. Louis, "Natural language processing for social media," *Computational Linguistics*, vol. 42, no. 4, pp. 833–836, Dec. 2016, doi: 10.1162/coli\_r\_00270.
- [30] L. Liu, L. Tang, W. Dong, S. Yao, and W. Zhou, "An overview of topic modeling and its current applications in bioinformatics," *SpringerPlus*, vol. 5, no. 1, p. 1608, Sep. 2016, doi: 10.1186/s40064-016-3252-8.
- [31] S. Junlabuddee and K. Tuamsuk, "Analysis of research data in information science using the topic modeling method," *Journal of Mekong Societies*, vol. 7, no. 1, pp. 89–109, 2021.
- [32] D. M. Blei, "Probabilistic topic models," *Communications of the ACM*, vol. 55, no. 4, pp. 77–84, Apr. 2012, doi: 10.1145/2133806.2133826.
- [33] N. J. van Eck and L. Waltman, "VOSviewer manual (manual for VOSviewer version 1.6.18)," *Universiteit Leiden*, 2022. [https://www.vosviewer.com/documentation/Manual\\_VOSviewer\\_1.6.18.pdf](https://www.vosviewer.com/documentation/Manual_VOSviewer_1.6.18.pdf) (accessed May 30, 2024).
- [34] D. Bowman *et al.*, "The mathematical foundations of epistemic network analysis," in *Advances in Quantitative Ethnography*, Springer International Publishing, 2021, pp. 91–105, doi: 10.1007/978-3-030-67788-6\_7.
- [35] D. W. Shaffer *et al.*, "Epistemic network analysis: a prototype for 21st-century assessment of learning," *International Journal of Learning and Media*, vol. 1, no. 2, pp. 33–53, May 2009, doi: 10.1162/ijlm.2009.0013.
- [36] D. W. Shaffer, W. Collier, and A. R. Ruis, "A tutorial on epistemic network analysis: analyzing the structure of connections in cognitive, social, and interaction data," *Journal of Learning Analytics*, vol. 3, no. 3, pp. 9–45, Dec. 2016, doi: 10.18608/jla.2016.33.3.
- [37] S. I. Nikolenko, S. Koltcov, and O. Koltsova, "Topic modelling for qualitative studies," *Journal of Information Science*, vol. 43, no. 1, pp. 88–102, Jul. 2016, doi: 10.1177/0165551515617393.
- [38] J. T. McAllister, L. Lennertz, and Z. Atencio Mojica, "Mapping a discipline: a guide to using VOSviewer for bibliometric and visual analysis," *Science & Technology Libraries*, vol. 41, no. 3, pp. 319–348, Dec. 2021, doi: 10.1080/0194262x.2021.1991547.
- [39] Office of Academic Resources-Prince of Songkla University-Pattani Campus, "Southern border provinces research database," *Office of Academic Resources, Prince of Songkla University*, 2007. <https://soreda.oas.psu.ac.th> (accessed May 23, 2024).
- [40] Thairath Online, "History in 2004, robbery of guns in Kru Se, Tak Bai, the origin of special laws in the southern border provinces," *plus.thairath.co.th*, 2022. <https://plus.thairath.co.th/topic/politics&society/102296> (accessed Sep. 05, 2024).
- [41] Deep South Watch, "Number of incidents that happened in the southern border provinces as recorded by Deep South Watch," *Deep South Watch*, 2024. <https://deepsouthwatch.org> (accessed Jun. 28, 2024).
- [42] C. Nantasri and D. L. Manmart, "Current situation of knowledge management for consulting company in Thailand," *Khon Kaen University Journal (Graduate Studies)*, vol. 13, no. 3, pp. 27–41, Jul. 2013, doi: 10.5481/kkujgs.2013.13.3.3.
- [43] D. W. Shaffer and A. R. Ruis, "Epistemic network analysis: a worked example of theory-based learning analytics," in *Handbook of Learning Analytics*, Society for Learning Analytics Research (SoLAR), 2017, pp. 175–187, doi: 10.18608/hla17.015.
- [44] E. K. Barto and M. C. Rillig, "Dissemination biases in ecology: effect sizes matter more than quality," *Oikos*, vol. 121, no. 2, pp. 228–235, Aug. 2011, doi: 10.1111/j.1600-0706.2011.19401.x.
- [45] I. Tahamtan, A. Safipour Afshar, and K. Ahamdzadeh, "Factors affecting number of citations: a comprehensive review of the literature," *Scientometrics*, vol. 107, no. 3, pp. 1195–1225, Feb. 2016, doi: 10.1007/s11192-016-1889-2.
- [46] M. Afeefee and A. M. Kaba, "21st century Islamic education in Southern Thailand and Pondok: system, conditions and challenges," *Journal of Namibian Studies: History*, vol. 35, pp. 1–5, 2023, doi: ht10.59670/jns.v35i.3080.
- [47] S. Binsaleh and M. Binsaleh, "4P-2E model: teaching and learning process through ICT integration for private Islamic schools in Thailand," *Asian Journal of University Education*, vol. 16, no. 4, Jan. 2021, doi: 10.24191/ajue.v16i4.11944.
- [48] H. Madman, "Secular education, values and development in the context of Islam in Thailand: an outlook on Muslim attitudes towards Thai educational policy," in *Asian Interfaith Dialogue. Perspectives on Religion, Education and Social Cohesion*, Singapore: Centre for Research on Islamic and Malay Affairs (RIMA), 2003, pp. 66–77.
- [49] T. Vasinayanuwatana, T. W. Teo, and J. Ketsing, "Shura-infused STEM professional learning community in an Islamic School in Thailand," *Cultural Studies of Science Education*, vol. 16, no. 1, pp. 109–139, Nov. 2020, doi: 10.1007/s11422-020-09990-8.
- [50] P. Daorueng, "Conflict management in Betong district - managing differences in the context of Southern Thailand insurgency violence," in *No More Guns: Documenting Local Conflict Resolution Initiatives in Select Asian Communities*, Miagao, Iloilo: University of the Philippines Visayas, 2015, pp. 11–22.
- [51] P. Jory, "From Melayu Patani to Thai Muslim: the spectre of ethnic identity in Southern Thailand," *South East Asia Research*, vol. 15, no. 2, pp. 255–279, Jul. 2007, doi: 10.5367/00000007781509535.
- [52] M. Noor, N. Shnabel, S. Halabi, and A. Nadler, "When suffering begets suffering: The psychology of competitive victimhood between adversarial groups in violent conflicts," *Personality and Social Psychology Review*, vol. 16, no. 4, pp. 351–374, Mar. 2012, doi: 10.1177/1088868312440048.
- [53] S. Jitpiromsri, "An inconvenient truth about the deep south violent conflict: a decade of chaotic, constrained realities and uncertain resolution," *Deep South Watch*, 2014. <https://deepsouthwatch.org/node/5904> (accessed May 30, 2024).
- [54] Y. Kuakul, N. Wae-useng, and R. Ha, "Islamic studies provision in government schools: states, problems, and development guidelines," (in Thai), *Journal of Islamic Studies, Prince of Songkla University*, vol. 12, no. 1, pp. 14–26, 2021.
- [55] N. Wae-u-seng, M. Salaeming, and M. Baka, "Conditions, problems, and needs of Pondok institutions on managing education in southern border provinces," *College of Islamic Studies, Prince of Songkla University, the Office of Inspector, Ministry of Education 12*, 2008. <http://kb.psu.ac.th/psukb/handle/2553/3945> (accessed Aug. 30, 2024).
- [56] S. Chutrakul, "Guidelines for community tourism development from community tourism promotion programs on television," (in Thai), *Journal of Community Development and Life Quality*, vol. 10, no. 1, pp. 35–44, 2022.
- [57] N. Buakwan, P. Chaiyakot, and D. Suwanwong, "Community based tourism management in five Southern border province (Satun, Songkhla, Pattani, Yala, and Narathiwat) and four states (Kelantan, Perak, Kedah and Perlis) of Malaysia under community based tourism standard to ASEAN," 2016. [https://digital.library.tu.ac.th/tu\\_dc/frontend/Info/item/dc:55741](https://digital.library.tu.ac.th/tu_dc/frontend/Info/item/dc:55741) (accessed May 30, 2024).
- [58] J. C. Henderson, "Halal food, certification and halal tourism: Insights from Malaysia and Singapore," *Tourism Management Perspectives*, vol. 19, pp. 160–164, Jul. 2016, doi: 10.1016/j.tmp.2015.12.006.
- [59] D. J. Timothy and D. H. Olsen, *Tourism, religion and spiritual journeys*. Routledge, 2006.
- [60] M. Battour and M. N. Ismail, "Halal tourism: concepts, practises, challenges and future," *Tourism Management Perspectives*, vol. 19, pp. 150–154, Jul. 2016, doi: 10.1016/j.tmp.2015.12.008.




- [61] T. Duman, "The value of Islamic tourism: Perspectives from the Turkish experience," *ICR Journal*, vol. 3, no. 4, pp. 718–739, 2012, doi: 10.52282/icr.v3i4.513.
- [62] P. Chaiyakot, M. Hatthayanont, and D. Phatthano, "Studying the element of tourism product of community based tourism in five southern border provinces (Satun, Songkhla, Pattani, Yala and Narathiwat)," *National Science and Technology Development Agency*, 2018. [https://digital.library.tu.ac.th/tu\\_dc/frontend/Info/item/dc:146333](https://digital.library.tu.ac.th/tu_dc/frontend/Info/item/dc:146333) (accessed May 30, 2024).
- [63] C. B. Asmussen and C. Møller, "Smart literature review: a practical topic modelling approach to exploratory literature review," *Journal of Big Data*, vol. 6, no. 1, Oct. 2019, doi: 10.1186/s40537-019-0255-7.
- [64] S. Koltcov, S. I. Nikolenko, O. Koltsova, V. Filippov, and S. Bodrunova, "Stable topic modeling with local density regularization," in *Internet Science*, Springer International Publishing, 2016, pp. 176–188, doi: 10.1007/978-3-319-45982-0\_16.

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