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Revealing geography teachers' cognitive structures on Indonesia's strategic maritime position through a word association task

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Abstract

This study examines geography teachers' understanding of Indonesia's strategic maritime position in order to investigate the extent to which their cognitive structures support coherent geographical reasoning using a Word Association Task (WAT). Thirty-five teachers generated spontaneous associations in response to structured prompts related to geographical settings, consequences, implications, and the spatial and ecological perspectives. The results indicate that teachers' knowledge is predominantly oriented toward descriptive first nature geography, with strong emphasis on physical geographical conditions and commonly used maritime terms. However, the range of associations reveals limited activation of second nature concepts that represent relational spatial structures, including spatial interaction, connectivity, and economic space. Most teachers demonstrate one-sided reasoning, with limited attention to reciprocal human–environment relationships. Their responses also reveal conceptual ambiguity between the spatial and ecological perspectives, as well as frequent reliance on non-geographical policy-related terminology. Taken together, the findings indicate fragmented and insufficiently organised cognitive structures, with limited integration of spatial concepts required to interpret Indonesia's strategic position as an interconnected economic space. These results highlight the need to strengthen spatial thinking and conceptual clarity through more explicit use of relational and organising concepts in geography teacher education.

Keywords: Word Association Task, Cognitive Structures, Spatial Concepts, Spatial Organisation, Geographical Perspectives

1. Introduction

Geography is a broad field of study that encompasses the spatial settings in which humans live, and is concerned with questions about where phenomena are located, how they are connected to the spatial context, and how physical and human processes shape patterns on the Earth's surface, thereby enabling explanations of why something develops where

it does and how spatial arrangements evolve (Standish, 2021). Given the extensive scope of geographical inquiry, some scholars distinguish between what is studied within geography and what is studied with geography, with the latter referring to the application of geographical knowledge to a wide range of development and environmental issues (Gregg and Leinhardt, 1994). Geography is especially relevant for learning about complex issues, as illustrated by cases such as COVID-19, climate change, and food insecurity (Van der Schee, 2020; Cox et al., 2019; Mitchell, 2023). Consequently, teachers are required to articulate and teach topics in a structured way in the classroom. This ability is crucial, especially in teaching topics related to applied geography, as teachers play a central role in relating geographical knowledge to broader environmental and economic issues.

Although teaching geography requires teachers to possess well-structured, and well-developed conceptual knowledge that enables them to organise ideas and develop coherent understanding of topics, empirical studies indicate a more problematic reality. Research shows that both in-service and pre-service teachers demonstrate considerable variation in their geographical knowledge, including limitations in conceptual understanding and spatial representation (Martin, 2008; Kaya and Aladağ, 2018; Krajňáková et al., 2024). At the disciplinary level, research on teachers' conceptions of geography suggests that such knowledge is often limited and does not fully capture the breadth or depth of the discipline (Puttick et al., 2017). This is often reflected in conceptions of geography that are encyclopaedic and narrowly descriptive, centred on places and facts (Puttick, 2016), rather than as a form of understanding concerned with relationships among spatial, environmental and human processes. This concern is particularly important because geography teaching involves comprehensive geographical knowledge and systematic geographical thinking (Gong et al., 2021), as well as forms of knowledge that have explanatory power and systematicity and provide relational understanding (Virranmäki et al., 2019).

Against this background, this study investigates the extent to which geography teachers possess knowledge of a topic that requires a comprehensive and integrated understanding of Indonesia's geographical phenomena, namely its strategic position as an archipelagic state (Figure 1).

As an archipelagic state, Indonesia has a highly interconnected spatial organisation across a maritime domain comparable in scale to Europe. This is reflected in the Indonesian Archipelagic Sea Lanes (ALKI) system (Figure 2), which structures maritime connectivity, and in its tectonic setting (Figure 3), which generates diverse landforms, resources and environmental risks.

According to the Standard Dictionary of the Indonesian Language, the term strategic refers to locational positioning associated with the pursuit of broader objectives (KBBI Daring, n.d.). Indonesia's strategic position is understood as a locational advantage associated with wider opportunities and constraints. Understanding the topic therefore requires teachers to connect geographical location, physical and marine conditions, socio-cultural characteristics, environmental risks, and development implications within a coherent framework of reasoning. The topic is thus particularly suitable for examining the breadth and organisation of teachers' cognitive structures.

The topic constitutes the first major theme in Indonesian geography taught in Grade 11, with instructional time varying across schools (ranging from 9 to 20 class hours). The topic is intended to enable students to understand the significance of Indonesia's conditions and position in the world and to support the development of geographical reasoning (Nurbidawati, 2019). Textbooks provide detailed explanations of Indonesia's astronomical, geological, and geographical location, along with the various influences associated with each. They also include information on national policies and development programmes aimed at strengthening Indonesia's position as an archipelagic nation.

Understanding Indonesia's territorial conditions and its strategic position as a global maritime axis (*poros maritim dunia*) was explicitly incorporated into the 2013 curriculum, alongside the 2014-2024 national development

agenda aimed at positioning Indonesia as a maritime axis. The subject of the global maritime axis was later removed from the official curriculum following the 2020 revision and replaced by the topic "Indonesia's Strategic Position and Natural Resource Potential" (*Posisi Strategis Indonesia dan Potensi Sumber Daya Alam*) (Handoyo, 2021). Nevertheless, textbook chapters and instructional materials continue to include descriptions of the national maritime axis policy, and this content remains incorporated into classroom teaching practices.

This study investigates the breadth and structure of teachers' geographical knowledge and conceptual associations regarding Indonesia's Strategic Maritime Position through the use of the Word Association Task.

2. Theoretical framework

2.1 Scope of geographical inquiry

The subject of geographical inquiry encompasses the Earth as the spatial setting of human life.

Consequently, structuring the discipline becomes essential for simplifying complex realities and enabling focused observation.

Understanding the intricate nature of geographical relationships requires broad and well-organised knowledge (Gregg and Leinhardt, 1994) as well as synoptic capacity, which refers to the ability to integrate disparate elements into a coherent whole (Brooks, 2006).

Pattison (1964) identifies four major traditions within geographical scholarship, namely the earth science tradition, the area studies or regional tradition, the human and environmental tradition, and the spatial tradition. Morrill (1974, pp. xi-xii) further outlines three approaches to geographical analysis:

a. investigations of the unique characteristics of a place or region;
b. studies that reveal the relationship between humans and their environment;
c. analyses of spatial behaviour that systematically examines locational patterns and spatial interactions that constitute spatial organisation.

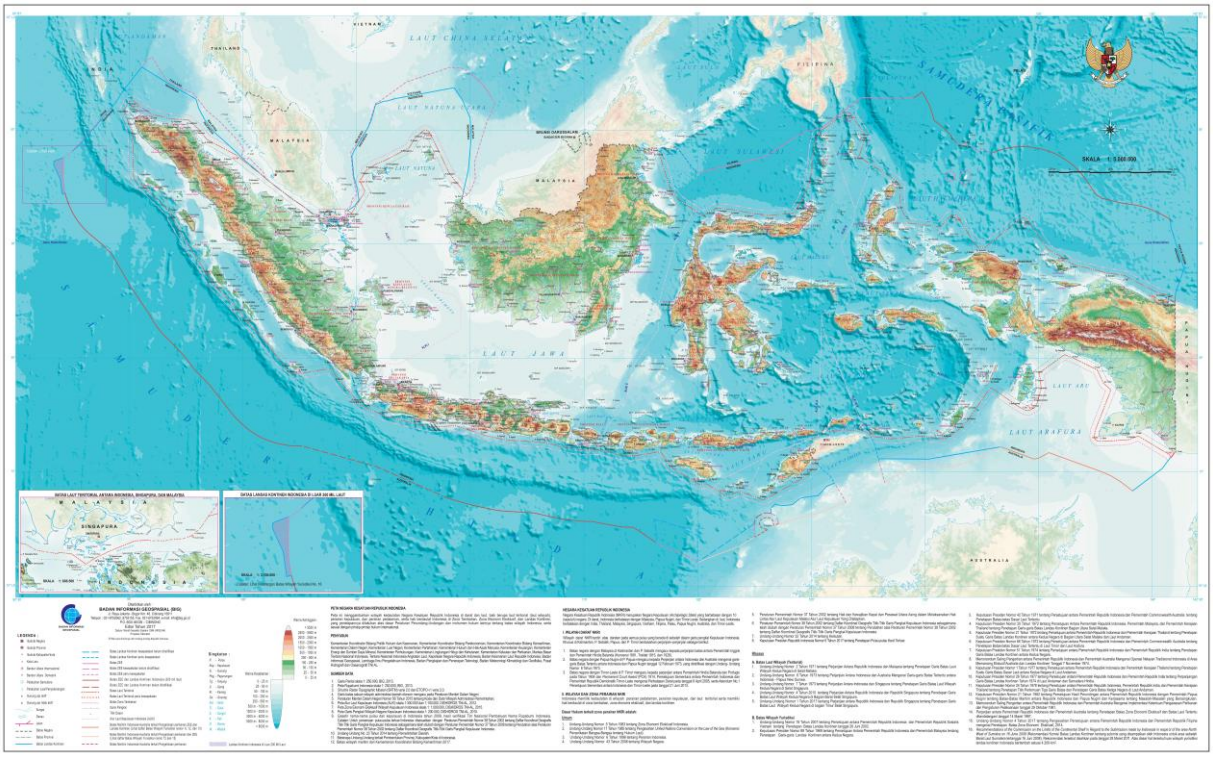

Figure 1. Map of Indonesia. Source: Indonesia Geospatial Information Agency (https://www.geografi.org/2024/08/indonesia-letak-astronomis-geografis.html).

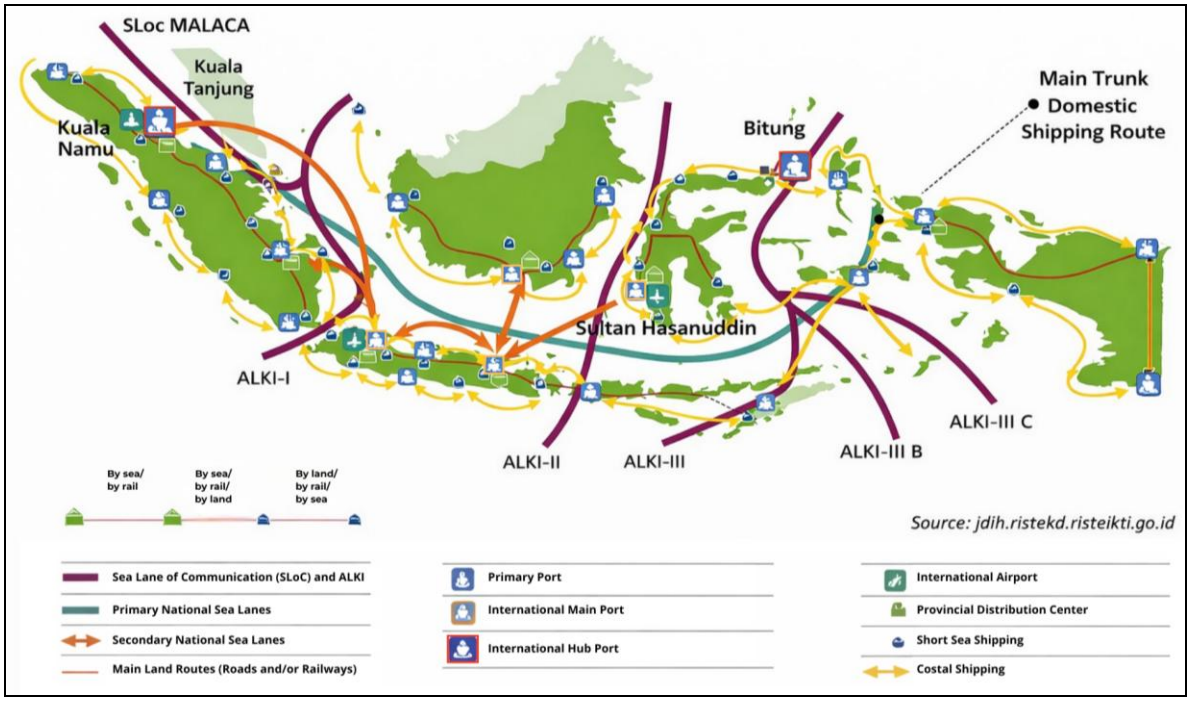

Figure 2. Shipping routes in Indonesian Archipelagic Sea Lanes (ALKI).
Source: Directorate General of Sea Transportation, Ministry of Transportation, Republic of Indonesia, 2019.

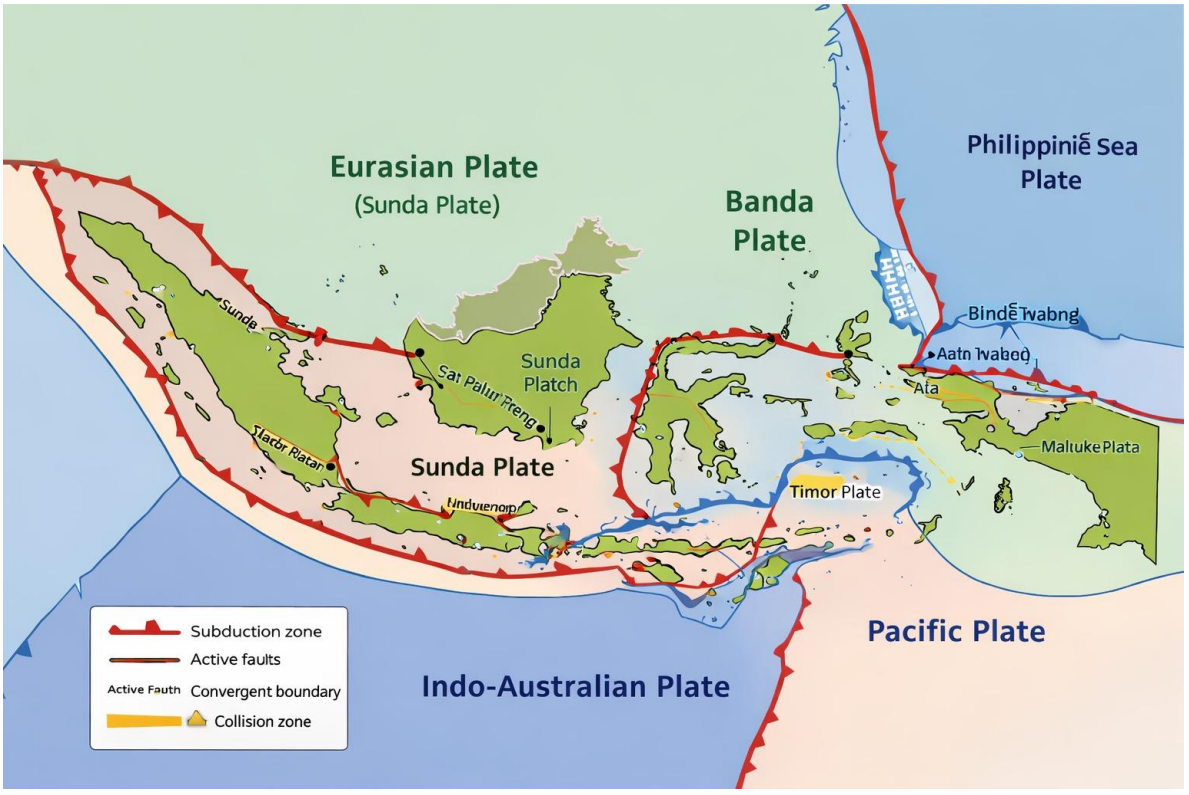

Figure 3. Major tectonic plates and boundaries around Indonesia.
Source: adapted from tectonic maps of the Geological Agency of Indonesia.

The geographical approach that emphasises spatial organisation within the spatial tradition continues scholarly efforts to understand how humans use space efficiently. Spatial organisation is conceptualised as abstract properties of space, such as distance, accessibility, agglomeration, size, shape and the relative location of parts within a whole. This organisation is shaped by human spatial behaviour that follows principles such as maximising locational utility, maximising spatial interaction, and the clustering of economic activities. Within this conceptualisation, emphasis is placed on abstract spatial relationships rather than physical and environmental conditions. This distinction provides the foundation for distinguishing between first nature geography and second nature geography (Redding, 2009). First nature geography concerns locational fundamentals rooted in physical conditions, whereas second nature geography involves relational and abstract spatial attributes that describe how places are connected through land use and human activities.

The spatial organisation of a region can therefore be conceptualised as an economic space characterised by dynamic interconnections among economic activities. Chadwick (1978, pp. 83-113) identifies three types of economic space: simple markets, nets of areas, and systems of regions. In this view, regions emerge as interconnected systems through input flows from resource producing areas to centres of production and output flows from production to points of consumption across regional, national, and global scales (Figure 4). Economic space comprises multiple spatial dimensions, including real or physical space, abstract economic space, and potential space shaped by intervening opportunities.

Spatial and ecological perspectives represent two principal geographical lenses for understanding the world (Heffron et al., 2012). The spatial perspective focuses on aspects of "*whereness*," including location and the interactions and interconnections across space. The ecological perspective, by contrast, concerns the connections and relationships between humans and ecosystems, in which human actions modify the natural environment and physical systems influence human systems. A comprehensive geographical perspective integrates both spatial and ecological perspectives, together with additional dimensions such as historical, economic and cultural ones, enabling the interpretation of real-world phenomena. Gersmehl (2014, pp. 137-39) distinguishes these two perspectives as a distinction between situations and sites or connections and conditions. The spatial perspective emphasises the analysis of patterns, linkages and distributions within spatial situations, whereas the ecological perspective emphasises the description of the attributes and conditions of sites. A distinctive feature of geographical thinking is viewing phenomena holistically through these dual perspectives. Accordingly, geographical analysis operates "like two blades of scissors," requiring the simultaneous integration of both perspectives.

Another important aspect of geography, given its wide-ranging subject of study, is its vulnerability to moving into topics outside the discipline. Geography draws upon concepts from other fields but does so with the purpose of understanding spatial patterns and relationships. Standish (2021, p. 143) cautions that "without disciplinary concepts to guide us, geographers risk straying into other subjects or non-educational aims."

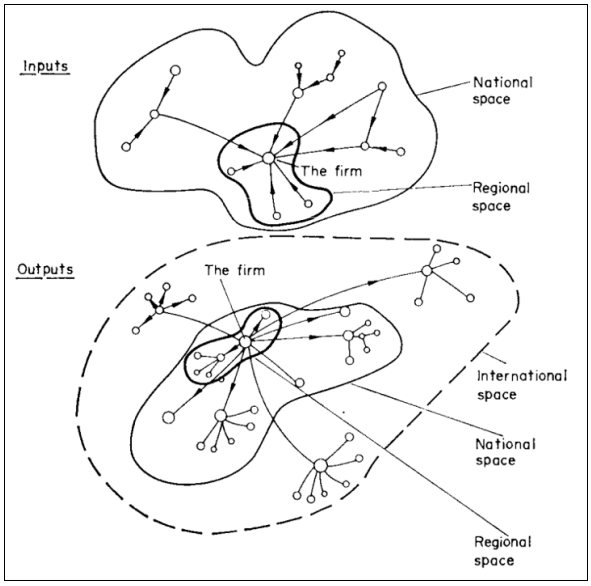

Figure 4. Model of economic space.
Source: Chadwick (1978, p. 100).

2.2 Word association task method

The Word Association Task (WAT) method is used to uncover cognitive structures, specifically the conceptual networks embedded within an individual's semantic memory. In WAT, a stimulus word triggers spreading activation, whereby related concepts are activated and expressed spontaneously as responses (Collins and Loftus, 1975). The underlying assumption is that "the order of the response retrieval from long term memory reflects at least a significant part of the structure within and between concepts" (Bahar et al., 1999). Patterns of association therefore illustrate the organisation of knowledge and the interconnections among concepts stored in long-term memory (De Deyne and Storms, 2008). The method has been widely used to identify conceptual categories and relationships, as well as to detect misconceptions among teachers and students (Avci, 2021; Elif and Muhlis, 2015; Kaya and Aladağ, 2018).

3. Geographical reasoning framework for the topic

Content in textbooks published by both governmental and private publishers is typically organised into sub-sections on astronomical, geological, and geographical location and their associated influences. These sections are followed by sub-sections describing national policies and programmes associated with the maritime axis agenda. However, the conceptual links among these components are not always made explicit. For this reason, the geographical reasoning structure of the topic needs to be clearly articulated. Astronomical, geological, and geographical location are understood as the geographical setting, referring to the physical and human conditions that shape place characteristics and encompass both physical and sociocultural dimensions. These settings give rise to geographical consequences, both positive and negative, while maritime axis policies and programmes may be understood as geographical implications or responses.

The geographical reasoning framework for the topic is structured in Figure 5.

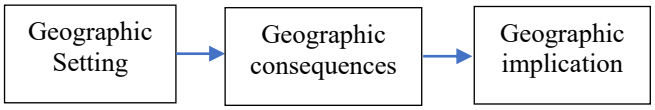

Figure 5. Geographical reasoning framework of Indonesia's strategic position.

According to Morrill's (1974) categorisation of geographical approaches, geographical settings form part of the study of the unique characteristics of regions, while geographical consequences elaborate on these characteristics and contribute to the study of relationships between humans and the environment. Geographical implications are aligned with the conceptualisation of abstract space and potential space in relation to locational patterns and spatial interactions. The broad range of approaches needed to understand this topic provides an important opportunity to develop synoptic geographical understanding and reasoning.

Nevertheless, several concerns require attention. Geographical phenomena must be examined comprehensively as an integration of physical and human dimensions, and the geographical consequences of Indonesia's location should be considered simultaneously from both positive and negative perspectives**.** While Indonesia is endowed with abundant natural resources, it also faces challenges such as geological hazards and difficulties in connecting and integrating its extensive territory**.** Coherent geographical reasoning therefore requires activating schemas that incorporate both opportunities and constraints**.**

Geographical understanding is also prone to drifting into non-geographical concepts. The wide scope of the topic makes it vulnerable to losing focus on core geographical ideas. Textbooks tend to present information about government policies and programmes in descriptive form and frequently employ non-geographical terms such as "maritime cultural development", "maintaining and managing marine resources", and "strengthening maritime sovereignty". This results in a missing link in constructing geographical reasoning about Indonesia's strategic position, as the causal connections between geographical consequences and geographical implications are not

analytically articulated. Spatially connected elements that should be framed as components of Indonesia's economic space receive limited analytical attention.

Given the scope of the topic, it is necessary to examine whether teachers possess a sufficiently rich understanding of it. Their conceptual focus may range from factual descriptions, including astronomical location or maritime features, to a more integrated understanding of socio environmental consequences and spatial interaction networks within regional economic space. This framework therefore provides the basis for examining the breadth and organisation of teachers' cognitive structures in relation to the topic.

4. Method

4.1 Research design

This study adopts an exploratory qualitative design using the Word Association Task (WAT) to uncover teachers' cognitive structures. It aims to determine: a) whether teachers possess a complete and systematic understanding of the geographical setting, geographical consequences and geographical implications of the topic; b) the extent to which they activate mental schemas in a balanced manner when conceptualising Indonesia's geographical setting across its physical and human dimensions; c) whether they hold an integrated perception of both positive and negative consequences of the geographical setting; d) whether they possess mental schemas that organise the conceptual relationships underlying the implications of Indonesia's spatial organisation as a maritime nation; and e) whether they have a sufficiently clear and distinct understanding of the spatial and ecological perspectives as analytical lenses for interpreting the topic.

The free association technique was employed, in which a single stimulus word elicits multiple response words. It was used to capture knowledge structures, identify subthemes, and examine the diversity of associations. Responses were collected within a flexible time frame to allow participants to express associations comprehensively across all aspects of the topic.

The first stimulus was: "What ideas come to mind that reflect your understanding of the various aspects of 'Indonesia's Strategic Maritime Position'?" Teachers provided ten responses as single words, followed by a written description of their understanding of the key idea of the topic.

The second and third stimuli were: "What ideas come to mind when considering the spatial perspective of Indonesia's strategic maritime position?" and "What ideas come to mind when considering the ecological perspective of Indonesia's strategic position?" For each stimulus, teachers provided seven responses and subsequently wrote their own definitions of the spatial and ecological perspectives.

4.2 Research participants

The participants consisted of 35 geography teachers from two municipalities in West Sumatra Province, Indonesia. This number represents nearly the entire population of geography teachers in these municipalities. All participants were secondary school geography teachers who had previously taught the subject.

4.3 Data collection

Teachers were asked to list words that came to mind in response to each stimulus prompt. Three stimuli were administered, with an allotted time of 15 minutes for the first and 10 minutes each for the second and third. All responses were written manually by participants during the data-collection sessions.

4.4 Data analysis

The analysis involved several steps:

a. Developing a coding and categorisation scheme, initially separating responses into geographical setting (physical and human), geographical consequences (positive and negative), and geographical implications. Additional subcategories were derived from the data. All data were processed using Microsoft Excel (Microsoft Corporation).

b. Classifying teachers based on the coverage of their reasoning, specifically whether they addressed all categories or only some.

c. Conducting a detailed analysis of response tendencies within each category.

d. Examining teachers' conceptualisations of the spatial and ecological perspective as applied to the topic.

e. Conducting content analysis of teachers' written descriptions of the stimulus terms.

4.5 Validation and interpretation

A critical stage in data analysis involved assigning categories to the word-association responses. Free association carries the risk of generating highly diverse response terms; therefore, normalisation (standardisation) was carried out for words with similar meanings. Coding and categorisation were conducted collaboratively by the principal researcher and two additional team members. Inter-coder agreement was established through an initial set of coding decisions, followed by discussions among the coders to resolve differences and reach consensus.

5. Results

5.1 Word association responses on the idea of Indonesia's strategic position

The word association responses were organised into four categories and nine subcategories (Table 1).

- The geographical setting category consisted of three subcategories. The locational attributes subcategory contained 95 words produced by 35 teachers, generating nearly three associative words on average (2.7 words per teacher). The physical and marine characteristics subcategory contained 38 words produced by 21 teachers, and the socio-cultural characteristics subcategory contained 8 words produced by 8 teachers.
- Geographical consequences comprised two subcategories: positive consequences (42 words by 27 teachers) and negative consequences (17 words by 13 teachers).
- Geographical implications consisted of four subcategories: maritime development policies (6 words by 6 teachers), infrastructure development (15 words by 12 teachers), environmental management (3 words by 3 teachers), and social development (7 words by 4 teachers).
- Maritime-specific terms were categorised as an independent category. They are part of commonly used terminology in national maritime policy. Terms such as the Indonesian Archipelagic Sea Lanes (ALKI), the Exclusive Economic Zone (EEZ), inter-island shipping routes of Indonesia, and global maritime trade routes were classified as surface-level associations, representing factual recall. This category was relatively large (65 words) and was produced nearly twice as frequently (1.9 words per teacher).
- Only a small number of geographically relevant words (6) fell within the subcategory General Terms for Maritime Development Policy. Most words in this category (30) were non-geographical in nature, including expressions such as "marine resource management," "maritime law," "maritime resilience," "upholding maritime sovereignty," and "Indonesian defence and security."

With the inclusion of terms such as "cultural acculturation" under socio-cultural characteristics and "human resource development" under geographical implications, a total of 54 non-geographical words were identified across categories and were subsequently excluded from the analysis.

5.2 Coverage of word association categories

A total of 16 teachers (45 percent) produced complete word associations across all categories (Table 2). Only one teacher provided responses that were complete across all subcategories. The remaining teachers demonstrated incomplete associative responses, particularly with respect to the dual dimensions of geographical phenomena, either by addressing only physical aspects without reference to human dimensions or by identifying only positive consequences without considering negative ones.

Category	Total	Subcategories and number of word associations	Example words	Number of participants	Average
Geographical Setting	141 (41%)	Location and Position (95)	geographic location; astronomical location; strategic location; geological location; location between two continents; location in the ring of fire.	35	2.7
		Physical and Marine Characteristics (38)	landform characteristics; climatic characteristics; marine ecosystems.	21	1.8
		Socio-Cultural Characteristics (8)	population distribution; cultural diversity.	8	1.0
Maritime-Specific Terms	65 (19%)		Indonesian Archipelagic Sea Lanes; Exclusive Economic Zone; continental shelf; global trade routes; time-zone divisions.	35	1.9
Geographical Consequences	59 (16%)	Positive Consequences (42)	marine natural-resource wealth; biodiversity richness; advantages of geographical location; utilisation of marine natural resources; potential for marine tourism.	27	1.5
		Negative Consequences (17)	geological disaster hazards; tsunami hazards; climate impacts; negative impacts of maritime activities; inequality in community welfare.	13	1.2
Geographical Implications	31 (9%)	General Terms for Maritime Development Policy (6)	maritime potential development; implications of trade activities; maritime security.	6	1.0
		Infrastructure Development (15)	development of marine transportation; port infrastructure development; shipbuilding industry development; fisheries industry development; development of trade routes; maritime infrastructure development.	12	1.3
		Environmental Management (3)	sustainability; coral-reef conservation; environmental mitigation.	3	1.0
		Social Development (7)	coastal-community empowerment; coastal-area development; equitable welfare distribution.	4	1.8
Total geographical words: 296 (85%)				169	1.8
Total non-geographical words: 54 (15%)			marine resource management; maritime law; maritime resilience; enforcement of maritime sovereignty; national defence and security; cultural acculturation; human-resource development	42	1.3

Table 1. Teachers' responses in geographical terms.
Note. The proportion values were calculated by dividing the number of word associations by the number of participants, representing the average number of word associations produced per participant within each category.

No.	Geographical setting		Maritime terms	Geographical consequences		Geographical implications		Number of participants
	1	*2*	*3*	*4*	*5*	*6*	*7*	
Complete								16 (45%)
1	◉	◉	◉		◉	◉	◉	1
2	◉	◉	◉	◉		◉	◉	3
3	◉		◉		◉	◉	◉	1
4	◉		◉	◉		◉	◉	3
5	◉		◉	◉		◉		3
6	◉		◉	◉			◉	2
7	◉		◉		◉	◉		2
8	◉		◉		◉		◉	1
Incomplete								19 (55%)
9	◉	◉	◉			◉	◉	1
10	◉		◉			◉	◉	1
11	◉		◉				◉	1
12	◉	◉	◉	◉				3
13	◉		◉	◉				10
14	◉		◉		◉			2
15	◉		◉					1
							Total	35 (100%)

Table 2. Coverage of categories based on word associations.
Note. 1. Physical setting (location and position, and physical and marine characteristics); 2. Socio-cultural setting; 3. Maritime-specific terms; 4. Only positive or only negative geographical consequences; 5. Both positive and negative geographical consequences; 6. Implications expressed using general terms for maritime-development policies; 7. Implications expressed in spatially specific terms (infrastructure, environmental, and social).

No.	Associative responses in geographical setting	Number of participants	%
1	Physical geographical setting only	27	77
2	Socio-cultural geographical setting only	–	–
3	Both physical and socio-cultural settings	8	23
Total		35	100

Table 3. One-sided and dual-sided responses.

By contrast, 19 teachers (55 percent) omitted one or two categories from their responses. Four teachers did not provide any associations related to geographical consequences, and 16 teachers did not extend their responses to include geographical implications. One teacher produced associations only within the geographical setting and factual maritime conditions category.

The geographical consequences associated with natural resource endowment represent the counterpart of natural hazard risks that arise from the same geological processes. Ideally, associations reflecting both dimensions would be expected to occur simultaneously. However, most teachers (24) produced associations limited to either the positive or negative dimensions of consequences, whereas only a small number (7) provided associations that reflected an integrated understanding of both positive and negative geographical consequences.

In terms of the coverage of dual aspect geographical phenomena, only a small number

of teachers (8) demonstrated thinking that incorporated both the physical and socio-cultural dimensions of the geographical setting, whereas the majority (27) focused exclusively on the physical aspect (Table 3).

Table 4 presents the associative responses related to infrastructure development. From the perspective of regions as economic spaces, infrastructure implications highlight the importance of integrated infrastructure development. However, only a small number of teachers (12) identified spatial implications related to infrastructure development. Even within this small group, their associations appear fragmented, suggesting that they do not possess a well-structured understanding of the interconnections among spatial implications of development. Among these responses, most teachers (8) referred to "marine transportation development," sometimes in combination with "port infrastructure development," whereas others generated associations such as "fisheries industry development" and "shipbuilding industry development." Other responses were expressed using more generic expressions, such as "maritime infrastructure development" and "maritime economic potential."

The pattern of associative responses related to "marine transportation development" was linked to expressions such as "strategic position," "global trade routes," "characteristics of an archipelagic state," "vast seas," and "natural resource wealth." However, none of the responses reflected a more complex understanding of spatial networks, in which transportation development, conceptualised as a flow, is specifically connected to activity nodes such as port locations, natural resource sites, industrial centres and market centres.

5.3 Participants' written statements on the main idea of Indonesia's strategic position

The written descriptions provided by teachers indicate that, for most of them, the idea of Indonesia's strategic position was primarily associated with a favourable location situated along global trade routes and endowed with abundant maritime natural resources. Only a small number of teachers (5) articulated ideas related to the broader objectives of this strategic position, such as developing a maritime-based industrial economy or improving community welfare. This finding is consistent with the preceding results, which showed that teachers' associations were more strongly concentrated in the categories of geographical setting and geographical consequences.

5.4 Teachers' understanding of the spatial and ecological perspectives

What distinguishes geographical thinking from other forms of knowledge is its use of disciplinary perspectives to examine phenomena, namely the spatial, ecological and regional complex, with the latter representing an integration of the first two (Oktafiana et al., 2023, p. 229). The spatial and ecological perspectives operate in conjunction in the interpretation of geographical phenomena; however, a clear distinction between them must be maintained to ensure that each functions effectively as an analytical lens for comprehensive understanding.

In the spatial perspective stimulus (Table 5), teachers' associative responses involving abstract spatial concepts such as spatial patterns and spatial relationships amounted to only 53 words (29 percent), produced by 24 teachers. Words referring to geographical settings and maritime specific terminology, although technically classifiable as spatial concepts (25 percent), largely appeared to reflect the recall of isolated facts rather than an understanding of spatial relationships. This suggests that teachers tended to interpret phenomena within the spatial perspective as fragmented facts rather than within a framework of interactions and connectivity.

A substantial proportion of the associations within the spatial perspective consisted of non-spatial concepts (46 percent), including place characteristics (for example, marine characteristics, ecosystem characteristics, and ecological diversity) and environmental management issues (for example, marine environment management, disaster mitigation, and sustainability in development).

Word association	Words associated in other categories	Number of participants
Marine transportation development	vast seas; archipelagic state; global trade routes	6
Marine transportation development and port infrastructure	marine-water characteristics; vast seas; global trade routes; maritime potential	2
Shipbuilding industry development	distribution of ship building industries	1
Fisheries industry development	fisheries potential	1
Maritime infrastructure development	maritime economic potential; marine natural-resource wealth	2

Table 4. Associative responses related to infrastructure development.

Main category	Subcategory	Number of words	(%)	Example words	Number of participants
Spatial Concepts	Spatial patterns, distribution, and spatial relationships	53	29	regional connectivity; transportation access for regional development; interregional interaction; port distribution; port service reach; island connectivity; inter-island economic equity; patterns of marine movement.	24
	Location-based associations	26	14	geographical location; astronomical location; geological location; strategic location; Indonesia's crossroads position; location between two oceans; location between two continents; location in the ring of fire.	19
Maritime-specific Terms		20	11	Indonesian Archipelagic Sea Lanes; Exclusive Economic Zone; continental shelf; territorial sea; marine navigation; sea-lane routes; international trade.	13
Non-Spatial Concepts	Place characteristics	56	31	marine characteristics; coastal characteristics; regional characteristics; marine ecosystems; landform characteristics; ecological diversity; regional differences; climate.	26
	Environmental-management issues	27	15	marine-environment management; physical impacts of development; resource conservation; environmental restoration; environmental governance; sustainability; disaster mitigation; coastal-community empowerment.	18
Total		245	100		

Table 5. Word associations from the spatial perspective.

Main category	Number of words	(%)	Example words	Number of participants
Natural phenomena	23	10	ecosystems; climate change; biodiversity; natural processes; ecology; geosphere; oceanography.	18
Environmental impacts and their mitigation	71	30	environmental impacts; conservation; development impacts; restoration; environmental preservation.	32
Resource use	74	32	development of economic activities; development of facilities and infrastructure; natural-resource development; site development.	34
Physical constraints in development	6	3	characteristics of ocean waves; shallow waters; ocean currents; tsunami threats; sedimentation.	5
Maritime policy	36	15	sustainability; maritime policy; maritime cooperation; institutional development; law enforcement.	19
Social conditions (population and settlement)	24	10	socio-cultural conditions; community development; community welfare; settlement patterns.	23
Total	234	100		

Table 6. Word associations from the ecological perspective.
Note. Eleven word associations were left blank.

In the ecological perspective stimulus (Table 6), the largest proportions of teachers' associative responses referred to resource use (32 percent), environmental impacts and their mitigation (30 percent), and maritime policy (15 percent). This pattern suggests that teachers tended to follow a sequence of reasoning, beginning with the exploitation of natural resources, followed by the resulting environmental impacts, and culminating in policies intended to address these impacts.

Teachers' understanding of the ecological perspective generally reflected the idea of human environment interactions. However, these interactions were predominantly conceptualised as unidirectional, from humans to the environment. Only a very small number of associative responses indicated the reverse relationship, in which environmental conditions constrain or shape human actions.

Teachers' written definitions of the spatial perspective show that fewer than half (16) related it to the idea of "whereness," which concerns location, patterns, distribution, and relationships in space. The remaining teachers associated it with ideas such as "geospheric phenomena," "phenomena on the surface of the Earth," "understanding places," "natural conditions," "studying similarities and differences across space," and "diversity on the surface of the Earth." Based on expert definitions (Gersmehl, 2014; Heffron et al., 2012), these ideas are more appropriately associated with the broader geographical perspective, and in some cases with the ecological perspective, than with the spatial perspective. This suggests that many teachers did not have a clear understanding of the spatial perspective.

Teachers shared a common view that the environmental or ecological perspective refers to interactions between humans and the environment. However, almost all teachers conceptualise human and environment interaction in a one-way manner as the impact of human activities on the environment, rather than recognising the reciprocal influence of environmental systems on human actions.

These findings concerning teachers' understanding of the two geographical perspectives and their tendency toward one directional linear thinking are consistent with the

patterns observed in the word association responses on Indonesia's strategic position, as shown by the limited number of responses involving abstract spatial concepts and the tendency to express geographical consequences in a one-sided manner.

6. Discussion

6.1 Teachers' mastery of geographical knowledge

The limited number of teachers' associative responses related to geographical implications indicates limited engagement with geographical knowledge in the spatial tradition, or with spatial organisation, in which spatial phenomena are understood as outcomes of human efforts to organise space efficiently and are interpreted through abstract spatial concepts. Geography teachers' attention is more strongly oriented toward first nature geography, situated within the earth science tradition and the area studies tradition which focuses on the characteristics of regions rather than second nature geography, situated within the spatial tradition, which examines spatial behaviour and organisation. Nir (1990, p. 1, 3) characterises this orientation as an "inventory of topographical objects," which needs to be transformed into "an attempt to understand the interconnections and interrelations that make the area a mutual association."

The concentration of associative responses within this inventory-based category of geographical settings, combined with the scarcity of responses related to geographical implications, indicates that teachers' geographical knowledge remains largely confined to the description of surface-level physical characteristics. National Research Council (2000, p. 237) indicates that this issue reflects the absence of well-organised knowledge structures that enable more advanced reasoning.

Although some teachers referred to the implications of Indonesia's strategic characteristics, their mental representations were not sufficiently comprehensive to conceptualise Indonesia's archipelagic space as an economic space in which a system of relationships links various forms of economic investment. Associations involving input flows from natural resource extraction areas to production centres, as well as output flows through distribution networks and supporting infrastructure, were largely absent from teachers' associative responses.

Abstract spatial concepts function as an entry point for representing, explaining, and predicting patterns and interactions within an economic space. However, teachers demonstrated a limited vocabulary for expressing such concepts. This limitation indicates that knowledge of spatial representation remains a general weakness among teachers. Findings from numerous studies in Indonesia (among others, Dewi et al., 2025; Nursa'ban and Mukminan, 2023; Somantri and Hamidah, 2024) and in other countries (for example, Bondarenko, 2025; Larangeira and Van Der Merwe, 2016) corroborate these findings.

6.2 Blurred distinctions between the spatial and ecological perspectives

A conceptual ambiguity was identified in teachers' understanding of the differences between spatial and ecological perspectives. Nearly half of the associative responses in the spatial perspective stimulus were instead associated with the ecological perspective. This indicates weaknesses in teachers' spatial knowledge, not only in terms of limited spatial vocabulary but also in their insufficient understanding of what constitutes a spatial perspective.

In geography, the two-way relationship between humans and the environment is described in terms of "how human actions modify the physical environment" and "how physical systems affect human systems" (Heffron et al., 2012). These propositions tend to be taken as self-evident and unproblematic. Harden (2012) observed a tendency among geographers to move away from considering the ways in which people, cultures, and societies are influenced by environmental factors. Consistent with this observation, although teachers stated that geography examines interactions between humans and the environment, their associative responses regarding the ecological perspective

were predominantly one-sided, focusing on the impacts of human activities on the environment rather than on the ways in which physical systems shape human systems. This suggests that understanding interaction as a reciprocal relationship requires greater emphasis in geography education.

6.3 Limited attention to the uniqueness of geographical reasoning

Two major themes emerged from the associative responses, highlighting the distinctive nature of geographical reasoning in capturing phenomena comprehensively. First, geographical information is stored in parallel and simultaneous neural networks (Gersmehl and Gersmehl, 2007). Consequently, geographical thinking must be intentionally trained to activate these networks in a complementary manner. An emphasis on observing and reasoning across complementary geographical dimensions simultaneously, including physical and human phenomena, positive and negative geographical consequences, as well as reciprocal relationships between humans and the environment, represents an important dimension of geographical thinking that warrants attention.

Second, geographical understanding is prone to drifting into non-geographical concepts. The large number of non-geographical associations indicates that teachers' mental representations of the topic include concepts that are not genuinely geographical. This is related to conceptualisations of maritime axis policies presented in various textbooks, which are not sufficiently selective in determining which concepts are geographically relevant. This lack of disciplinary focus contributes to conceptual drift and undermines a clear and coherent understanding of geographic phenomena.

7. Conclusion

The findings of this study reveal several recurring themes in teachers' cognitive structures based on their word associations. First, their knowledge is primarily concentrated on first-nature geography, expressed through descriptive and inventory-based approaches. Second, their reasoning tends to be one-sided and follows simple, linear patterns. Third, their limited spatial vocabulary and misconceptions about spatial concepts diverge from disciplinary definitions. Fourth, the distinctions between spatial and ecological perspectives remain blurred. Finally, teachers' cognition shows a tendency to drift toward non-geographical concepts. As a consequence, teachers demonstrate a limited integrated understanding of the implications of Indonesia's strategic position as an economic space.

This study indicates that teachers' cognitive structures for understanding geographical phenomena as comprehensive and dynamic across multiple dimensions represent a critical weakness that requires attention in geography teacher education. Geographical concepts are not consistently functioning as coherent organising frameworks for interpreting the complexity of phenomena, as reflected particularly when teachers engage in topics related to applied geography. Teachers' reliance on textbooks that insufficiently articulate the relationships among elements of complex phenomena across multiple dimensions further reinforces this condition.

8. Limitation

The use of the Word Association Task was intended to capture teachers' cognitive structures, yet several considerations must be acknowledged. Given the limited dataset, generalisations should be made cautiously. Moreover, spontaneous associative responses elicited by a broad stimulus, such as the first stimulus, carry the risk that not all relevant schemas are activated. For example, negative geographical consequences were infrequently represented in response to the first stimulus but emerged in a more balanced manner alongside positive consequences when the second and third stimuli provided more specific prompts. Despite these limitations, spontaneous associations remain valuable indicators of the knowledge schemas that teachers readily activate when responding to everyday geographical phenomena in the absence of explicit cues to guide their attention.

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References

1. Avci F., "Determination of cognitive structures and misconceptions of pre-service science teachers' regarding the concept of energy", *Adıyaman Üniversitesi Eğitim Bilimleri Dergisi*, 11, 1, 2021, pp. 9-25.
2. Bahar M., Johnstone A.H. and Sutcliffe R.G., "Investigation of students' cognitive structure in elementary genetics through word association tests", *Journal of Biological Education*, 33, 3, 1999, pp. 134-141.
3. Bondarenko O.V., "Teaching geography with GIS: a systematic review, 2010-2024", *Science Education Quarterly*, 2, 1, 2025, pp. 24-40.
4. Brooks C., "Geographical knowledge and teaching geography", *International* Research *in Geographical and Environmental Education*, 15, 4, 2006, pp. 353-369.
5. Chadwick G.F., *A Systems View of Planning: Towards a Theory of The Urban and Regional Planning Process*, (2nd ed.), Elsevier Science, 1978.
6. Collins A.M. and Loftus E.F., "A spreading-activation theory of semantic processing", *Psychological Review*, 82, 6, 1975, pp. 407-428.
7. Cox M., Elen J. and Steegen A., "Fostering students geographic systems thinking by enriching causal diagrams with scale. Results of an intervention study", *International Research in Geographical and Environmental Education*, 29, 2, 2019, pp. 112-128.
8. De Deyne S. and Storms G., "Word associations: network and semantic properties", *Behavior Research Methods*, 40, 1, 2008, pp. 213-231.
9. Dewi S., Amin S., Sumarmi S., Bashith A., Angriani P., Benardi A.I. and Kurniawan M.A., "Improving spatial thinking skills through problem-based hybrid learning in social science education for Islamic students", *Jambura Geo Education Journal*, 6, 2, 2025, pp. 191-205.
10. Elif O.Y. and Muhlis O., "Determination of secondary school students cognitive structure, and misconception in ecological concepts through word association test", *Educational Research and Reviews*, 10, 5, 2015, pp. 660-674.
11. Gersmehl P., *Teaching Geography* (Third edition), New York, The Guilford Press, 2014.
12. Gersmehl P.J., Gersmehl C.A., "Spatial thinking by young children: neurologic evidence for early development and 'educability.'", *Journal of Geography*, 106, 5, 2007, pp. 181-191.
13. Gong Q., Brooks C. and Duan Y., "A teacher's role in making a given knowledge curriculum into a powerful knowledge curriculum", *Geography*, 106, 1, 2021, pp. 39-48.
14. Gregg M. and Leinhardt G., "Mapping out geography: an example of epistemology and education", *Review of Educational Research*, 64, 2, 1994, pp. 311-361.
15. Handoyo B., *Geografi untuk SMA/MA Kelas XI* (1st ed.), Jakarta, Pusat Perbukuan, Badan Standar, Kurikulum, dan Asesmen Pendidikan – Kemdikbud Ristek, 2021.
16. Harden C.P., "Framing and reframing questions of human–environment interactions", *Annals of the Association of American Geographers*, 102, 4, 2012, pp. 737-747.
17. Heffron S.G. and Downs R.M. (Eds.), American Geographical Society of New York, *Geography for Life: National Geography Standards: Geography Education National Implementation Project (GENIP)* (2nd ed), National Council for Geographic Education, 2012.
18. Kaya B. and Aladağ C., "Determining the cognitive structures of geography teacher candidates related to energy resources", *Review of International Geographical Education Online (RIGEO)*, 8, 2, 2018, pp. 350-370.
19. KBBI Daring, "Strategis", Kamus Besar Bahasa Indonesia Daring, https://kbbi.kemdikbud.go.id/entri/strategis.

20. Krajňáková L., Hanuš M. and Trahorsch P., "Pre-service geography teachers' conceptual understanding of contours on maps: implications for teacher training in cartography", *Journal of Geography in Higher Education*, 49, 3, 2024, pp. 313-331.
21. Larangeira R. and Van Der Merwe C. D., "Map literacy and spatial cognition challenges for student geography teachers in South Africa", *Perspectives in Education*, 34, 2, 2016, pp. 120-138.
22. Martin F., "Knowledge bases for effective teaching: beginning teachers' development as teachers of primary geography", *International Research in Geographical and Environmental Education*, 17, 1, 2008, pp. 13-39.
23. Mitchell J.T., "Wicked from the Start: Educational Impediments to Teaching about Climate Change (and How Geography Education Can Help)", *Education Sciences*, 13, 12, 2023, p. 1174.
24. Morrill R.L., *The Spatial Organization of Society* (2nd ed.), North Scituate, Duxbury Press, 1974.
25. National Research Council, *How People Learn: Brain, Mind, Experience, and School: Expanded Edition*, Washington DC, National Academies Press, 2000.
26. Nir D., *Region as a Socio-environmental System (Vol. 16)*, Dordrecht, Springer Netherlands, 1990.
27. Nurbidawati, *Posisi Strategis Indonesia sebagai Poros Maritim Dunia* (e-Modul), Jakarta, Direktorat Pembinaan SMA – Kementerian Pendidikan dan Kebudayaan, 2019.
28. Nursa'ban M. and Mukminan M., "The implementation of geography learning with spatial representation using the discrepancy evaluation model", *REID (Research and Evaluation in Education)*, 9, 1, 2023, pp. 49-64.
29. Oktafiana S., Jaya E.F. and Satria M.R., *Ilmu Pengetahuan Sosial untuk SMA/MA kelas X* (Edisi Revisi), Jakarta, Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi, 2023.
30. Pattison W.D., "The four traditions of geography", *Journal of Geography*, 63, 5, 1964, pp. 211-216.
31. Puttick S., "An analysis of individual and departmental geographical stories, and their role in sustaining teachers", *International Research in Geographical and Environmental Education*, 25, 2, 2016, pp. 134-150.
32. Puttick S., Paramore J. and Gee N., "A critical account of what 'geography' means to primary trainee teachers in England", *International Research in Geographical and Environmental Education*, 27, 2, 2017, pp. 165-178.
33. Redding S.J., *Economic geography: a review of the theoretical and empirical literature* (CEP Discussion Paper No 904), Centre for Economic Performance, London School of Economics, 2009, https://cep.lse.ac.uk/_new/publications/abstract.asp?index=3262.
34. Somantri L. and Hamidah S., "Effects of webGIS-based spatial intelligence training on geography teacher's spatial skills", *Jurnal Pendidikan Geografi: Kajian, Teori, Dan Praktek Dalam Bidang Pendidikan Dan Ilmu Geografi*, 28, 1, 2024, pp. 75-83.
35. Standish A., "Geography", in Sehgal Cuthbert A. and Standish A. (Eds.), *What Should Schools Teach?: Disciplines, Subjects and the Pursuit of Truth* (2nd ed., pp. 137-153), London, UCL Press, 2021.
36. Van der Schee J., "Thinking through geography in times of the COVID-19 pandemic", *J-READING (Journal of Research and Didactics in Geography)*, 2, 9, 2020, pp. 21-30.
37. Virranmäki E., Valta-Hulkkonen K. and Rusanen J., "Powerful knowledge and the significance of teaching geography for in-service upper secondary teachers – a case study from Northern Finland", *International Research in Geographical and Environmental Education*, 28, 2, 2019, pp. 103-117.

