



Students' Conceptual Difficulties in Understanding Maps and Scales: An Exploratory Descriptive Study

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Article History:

Received: Oct 30, 2025

Revised: Nov 19, 2025

Accepted: Dec 31, 2025

Online First: Jan 28, 2026

Keywords:

Conceptual Understanding,
Learning Difficulties,
Maps,
Scales.

Kata Kunci:

Kesulitan Belajar,
Pemahaman Konsep,
Peta,
Skala.

How to cite:

Fithri, R. A., Mawaddah, N. N., Azmi, N., & Ningrum, M. V. R.. (2026). Students' Conceptual Difficulties in Understanding Maps and Scales: An Exploratory Descriptive Study. *Edunesia : Jurnal Ilmiah Pendidikan*, 7(1), 623-639.

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Abstract: This study aims to describe students' conceptual difficulties in understanding maps and scales in geography learning. The study uses a qualitative approach with an exploratory descriptive model. Data were collected through in-depth interviews, classroom learning observations, and analysis of student work documents. The Research subjects consisted of ten Year 10 students from Samarinda State Senior High School 8, who were purposively selected to represent variations in academic ability and learning characteristics. The study's results showed three main categories: difficulties understanding the concept of scale, difficulties converting distance units, and difficulties interpreting and reading maps. These difficulties were influenced by the weak connection between conceptual understanding, spatial representation, and students' real experiences. The findings emphasise the need for visual-based contextual learning supported by interactive digital media. Implicitly, this study provides a basis for teachers and curriculum developers to sustainably strengthen students' spatial literacy and geospatial thinking skills. These results are relevant for further Research examining the relationship between conceptual difficulties and innovative learning strategies in the secondary school context.

Abstrak: Penelitian ini bertujuan mendeskripsikan kesulitan konseptual siswa dalam memahami peta dan skala pada pembelajaran geografi. Penelitian menggunakan pendekatan kualitatif dengan model deskriptif eksploratif. Data dikumpulkan melalui wawancara mendalam, observasi pembelajaran di kelas, dan analisis dokumen hasil kerja siswa. Subjek penelitian terdiri atas sepuluh siswa kelas X SMA Negeri 8 Samarinda yang dipilih secara purposif untuk mewakili variasi kemampuan akademik dan karakter belajar. Hasil penelitian menunjukkan tiga kategori utama, yaitu kesulitan memahami konsep skala, kesulitan mengonversi satuan jarak, serta kesulitan menafsirkan dan membaca peta. Kesulitan ini dipengaruhi lemahnya keterkaitan antara pemahaman konseptual, representasi spasial, dan pengalaman nyata siswa. Temuan menegaskan perlunya pembelajaran kontekstual berbasis visual dengan dukungan media digital interaktif. Secara implikatif, penelitian ini memberikan dasar bagi guru dan pengembang kurikulum untuk memperkuat literasi spasial serta kemampuan berpikir geospasial siswa secara berkelanjutan. Hasil ini relevan rujukan penelitian lanjutan yang menelaah hubungan kesulitan konseptual dengan strategi pembelajaran inovatif di konteks sekolah menengah.

A. Introduction

Understanding spatial concepts such as maps and scale is a fundamental competency in geography education in the era of globalisation and the development of information technology. Maps serve as abstract representations of real space. At the same time, scale allows students to understand the proportional relationship between distances on a map and actual distances, enabling them to analyse geospatial phenomena, including population distribution and disaster mitigation, such as floods and earthquakes (Bednarz, 2023).

However, this process is not as simple as it involves visual abstraction and cognitive transformation from theoretical concepts to practical interpretation. Various international studies show that students across countries still experience conceptual difficulties with maps and scales. These difficulties arise mainly from low spatial representation skills, such as mental rotation and symbol interpretation, leading students to fail to understand the relationship between real space and cartographic representations (Vosniadou, 2020; Beitlová, 2020). In fact, most secondary school students struggle to distinguish between different types of scales and fail to understand spatial proportions as a dynamic concept (Bienert, 2024).

At the global level, weak spatial abilities are associated with lower student performance in map interpretation and spatial phenomenon analysis tasks. This exacerbates their inability to understand contemporary environmental problems that require understanding of local and global-scale relationships (Skarstein & Wolff, 2020). In addition, low spatial literacy also impacts geospatial-based decision-making skills in the context of environmental change (Nurjanah et al., 2025; Wulandari, 2023).

In Indonesia, this issue is evident as well. Data from the Ministry of Education, Culture, Research, and Technology show that only about 45% of Year 10 students can interpret map scales correctly. In comparison, the error rate in reading maps reaches 60% in geography learning assessments (Kemdikbudristek, 2023). Geography teachers report that students often confuse numerical scales with graphic scales, leading to errors in distance calculations and a weak understanding of basic spatial concepts (Hanus et al., 2021).

Cognitive and learning environment factors exacerbate this situation. Students often view maps as static images rather than as dynamic, representative models of space, thereby failing to understand scale as a proportional relationship (Vosniadou, 2020). Limited access to spatial technology, especially in non-urban areas, further exacerbates difficulties in understanding the concepts of projection and map distortion (Sejati et al., 2023). This condition became even more complex during the COVID-19 pandemic as students lost the opportunity to interact directly with physical maps in the classroom (Nirwansyah, 2022).

From a theoretical perspective, these conceptual difficulties stem from a mismatch between students' visual perceptions and the conceptual structures underlying spatial representation (Bienert, 2024). Other studies also show that around 70% of secondary school students experience obstacles in mental rotation tasks directly related to understanding map scale and orientation (Ishikawa & Newcombe, 2021). In addition, internal factors such as

low learning motivation and external factors such as a dense curriculum contribute to misunderstandings of spatial concepts (Khuluqi et al., 2025).

In addition to students, misconceptions were also found among prospective teachers and geography teachers. Conceptual errors among teachers can be transmitted to students if they are not identified and corrected through appropriate diagnostic approaches (Havelková & Hanus, 2022; Schulman & Demantowsky, 2022). Research in an international context also shows that without a reflective approach, maps can reinforce spatial stereotypes and systematic misconceptions about certain regions (Bendl et al., 2024; Bowden, 2021). Errors in interpreting symbols and scales were also found among students in various multilingual contexts (Nyoni et al., 2019; Maganga & Srivastava, 2025).

Although various studies have discussed the difficulties of understanding maps and scales, most continue to focus on developing technology-based solutions, such as augmented reality and interactive digital media (Pratama et al., 2025). On the other hand, these studies are generally quantitative and test-oriented, thereby failing to explore students' conceptual roots and subjective experiences.

Furthermore, Research on geographical thinking and causal diagrams is still dominated by Western and European contexts and has not considered the cultural and contextual factors of Southeast Asia, particularly Indonesia (Cox et al., 2020; Humble, 2023). The phenomenological perspective of students as the main subjects of learning is also rarely explored in depth (Schulman & Demantowsky, 2022). This is the main gap that underlies this study.

The novelty of this study lies in the use of an exploratory, descriptive, qualitative approach to examine students' conceptual difficulties through their direct learning experience narratives. This study not only identifies the types of difficulties but also maps the relationships among conceptual misunderstandings, local cultural experiences, and the geographical context of Samarinda, an area prone to flooding and urban expansion (Skarstein & Wolff, 2020). Furthermore, this study integrates cultural perspectives and local conditions into the analysis of students' spatial difficulties, a move that has rarely been made in previous studies, which tend to be general and Western-centric (Bienert, 2024).

This study makes several important contributions. Theoretically, it enriches the study of conceptual difficulties in learning maps and scales by examining them from the perspective of students' spatial thinking (Bednarz, 2023). In practice, the results of this study can serve as a basis for geography teachers to develop learning strategies and diagnostic tools to detect misconceptions early (Khuluqi et al., 2025). Contextually, this study presents an Indonesian local perspective to the global literature on spatial representation theory and geospatial literacy (Bienert, 2024).

This study was conducted at Samarinda State Senior High School 8, which represents secondary schools in developing urban areas with real environmental challenges such as seasonal flooding and residential expansion. This environment makes maps and scales highly relevant to students' daily lives. This study aims to explore the conceptual difficulties Grade X students have in understanding maps and scale, identify the main misconceptions,

their causes, and their implications for geography learning. The results of this study are expected to support the strengthening of students' spatial literacy and the development of more contextually and reflectively oriented geography learning (Bednarz, 2023; Khuluqi et al., 2025).

Based on the identified research gap, this study is guided by the following research questions: how students experience and construct conceptual understanding of map scales, what forms of difficulties arise in converting map distances to actual distances, and how students interpret symbols, legends, and spatial information when reading maps in geography learning.

B. Method

This study used a qualitative, exploratory-descriptive approach to examine in depth the conceptual difficulties students encountered in understanding maps and scales in Grade X Geography lessons. The study was conducted at SMA Negeri 8 Kota Samarinda, which implemented the Merdeka Curriculum and actively used maps in teaching. This location was chosen based on preliminary observations indicating students' difficulties understanding the relationship between distance on a map and actual distance in the field. The Research subjects consisted of 10 Grade X students who were selected purposively based on having received Material on maps and scale but experiencing difficulties with questions requiring comparison and symbol interpretation. Geography teachers were also involved as supporting informants to enrich the contextual data.

Data collection was conducted through semi-structured in-depth interviews, classroom observations, and document analysis of student worksheets, assignment results, and teaching materials. The researcher acted as a moderate participatory observer, involved in the learning process while conducting active observation. The Research instruments included interview guides, observation sheets, and field notes, developed based on conceptual understanding indicators from Bloom's Taxonomy. Data validity was maintained through source triangulation (students and teachers) and technique triangulation (interviews, observations, and documentation).

Table 1. Conceptual Understanding Indicators for Map and Scale Material

Number	Conceptual Understanding Aspects	Operational Indicators	Data Format
1	Understanding the concept of scale	Students can explain the meaning of map scale in their own words.	Interview
2	Scale Conversion	Students can convert numerical scales to line scales and vice versa.	Interviews & assignment documents
3	Calculation of actual distance	Students can accurately calculate the actual distance from the distance on the map.	Practice documents
4	Map symbol interpretation	Students can identify and explain the meanings of symbols on maps.	Observation & Interviews

Number	Conceptual Understanding Aspects	Operational Indicators	Data Format
5	Understanding spatial relationships	Students can explain the relationships between objects on a map (direction, distance, relative location).	Observation & Interviews
6	Application of concepts in real-world contexts	Students can relate the use of scales and maps to everyday life.	Interview

The data were analysed using Miles and Huberman's qualitative analysis model through the stages of data reduction, data presentation, and conclusion drawing and verification. The reduction process involved sorting relevant data on the types of conceptual difficulties students experienced, while the data were presented in the form of narratives and category matrices. The Research lasted for three months, covering the stages of preparation, preliminary study, instrument development, data collection, analysis, and reporting of results. This design was developed to produce a comprehensive picture of the forms of students' conceptual difficulties, their causes, and alternative learning strategies that can be applied to improve understanding of maps and scales.

The validity of the data in this study was maintained through several techniques, namely source triangulation, technique triangulation, and member checking. Source triangulation was conducted by comparing data from students and geography teachers on the learning process and the difficulties students experienced. Triangulation was carried out by comparing the results of interviews, classroom observations, and document analysis to ensure the consistency of findings. In addition, the researcher also conducted member checks by reconfirming the interpretation results with several respondents to ensure that the data obtained was in line with their experiences and understanding. Validity was also strengthened through peer debriefing with the supervising lecturer to assess the feasibility of the analysis results and categories of findings.



Figure 1. Research Design Flow

C. Result

The data in this study were obtained through three main techniques, namely observation, interviews, and document analysis. Observations were conducted in two classes, namely X-3 and X-6. In classes X-3 and X-6, the researcher conducted direct instruction in the first and second meetings, while in the third meeting, the Geography teacher led the learning activities. The purpose of these observations was to observe differences in teaching practices, student engagement, and the effectiveness of the teaching tools used.

Interviews were conducted with a geography teacher who acted as a mentor during the activity, and classes X-3 and X-6 were selected, each with five students as representatives, making a total of ten students. These interviews aimed to explore their perceptions and experiences regarding the learning process implemented. In addition, document analysis was conducted on the Learning Module, student worksheets, and formative assessment results to reinforce the findings from the observations and interviews. All collected data were then analysed qualitatively through the stages of data reduction, data presentation, conclusion drawing, and verification.

Based on interviews, some students expressed confusion in converting scale units, especially from numerical to graphic scales. Some students also misinterpreted that a large scale means a large area, when in fact it actually means a map with a high level of detail and narrow coverage. In the first two sessions taught by the researcher, students were more active in discussions and attempted to relate the concept of scale to their surroundings (e.g., the distance from home to school). However, in the third session, when the lesson continued with the geography teacher, student activity tended to be passive, focusing on practising questions.

Based on observations and analysis of students' worksheets, it was found that many students still made mistakes in identifying map symbols, especially topographical symbols, and the use of colours. Most students relied on memorization rather than contextual understanding, making it difficult to interpret the meaning of symbols when their shapes differed from the examples given in the book. Interviews with geography teachers revealed that limited time and resources (such as topographic maps, globes, or simple GIS software) were major obstacles to in-depth exploration of the concept of maps. Teachers tended to focus on theory and scale-conversion exercises rather than on exploratory activities based on real maps.

In this study, data analysis was conducted in three stages: open coding, categorising, and theming. In the open coding stage, data from interviews, observations, and student documents were broken down into units of meaning such as 'scale is considered a map measurement', 'inverse scale formula', or 'not using a legend'. Similar codes were then combined in the categorising stage into three main categories according to the RQ: difficulty in understanding the scale, difficulty in converting distance, and difficulty in interpreting map symbols. Furthermore, the theming stage identified major themes regarding patterns in students' conceptual difficulties with understanding maps and scales. Each category was constructed from a combination of data sources: interviews (RQ1–RQ3), observations (RQ1 and RQ3), and analysis of student worksheets (RQ2 and RQ3).

Most students' difficulties in understanding the concept of scale were the main cause of errors in the next category. A lack of understanding that scale is a comparison of map distance to reality led students to make mistakes when converting units, for example, multiplying map distance by the scale value or directly assuming that 1 cm = 1 km. These conversion errors then lead to misinterpretation of information on the map, especially when students try to read distances or understand the relationships between symbols. As a result,

these three categories of difficulty form a sequential pattern in which basic misconceptions about scale trigger mathematical errors, ultimately leading to a failure to understand the map as a whole.

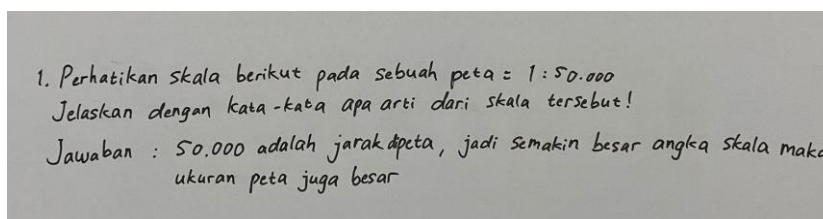
Table 2. Student Difficulty Categories

Number	Difficulty Category	Description of Difficulties	Example of student statements
1	Difficulty understanding the concept of scale	Students do not yet understand that a scale shows the ratio between distances on a map and in the real world.	"I think the scale is the length of the map."
2	Difficulty converting distance units	The students are confused about converting distance from centimetres to kilometres.	"I still often get confused about how to convert cm to km and vice versa."
3	Difficulty interpreting or reading maps	Students lack an understanding of the meanings of symbols, colours, signs, directions, and the information contained in maps.	"I thought blue always meant the sea, without paying attention to the legend."

Result for RQ1: Understanding the Concept of Scale

In response to the first Research question, the interview results showed that 8 out of 10 students did not understand that a scale is the ratio between the distance on the map and the actual distance on the Earth's surface. Students stated: "I think scale is the length of the map", "Scale is the number in the corner of the map, but I do not know what it does", "If the scale is large, it means the map is also large." These findings indicate that students tend to interpret the scale as the map's physical size rather than as a proportional comparison between two distances.

From the observation results, when students were asked to explain the meaning of a scale of 1:50,000, five students wrote '50,000 cm = map distance' and said that the larger the scale number, the larger the map size. This shows that there was a mistake in interpreting the scale number as a physical measurement. Moreover, during the distance-measuring activity, three students drew a ruler line directly on the map without connecting it to the units in the legend, then calculated the distance based solely on the ruler's length. This shows that students did not understand that a scale is a comparison of two distances.



1. Perhatikan skala berikut pada sebuah peta = 1:50.000
 Jelaskan dengan kata-kata apa arti dari skala tersebut!
 Jawaban : 50.000 adalah jarak dipeta, jadi semakin besar angka skala maka ukuran peta juga besar

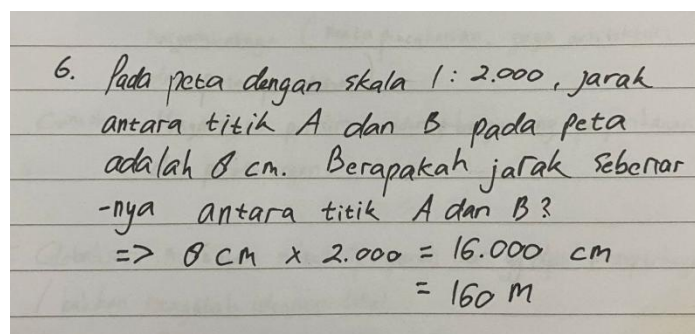
Figure 2. Student Answers to Questions on Understanding the Concept of Scale

This pattern of error is a misinterpretation of scale as the map's physical size. In some cases, students wrote '1:50,000 = 50,000 cm is the distance on the map', demonstrating an error pattern in which scale is understood as the physical length of the map, rather than a proportional comparison. This pattern was consistent when some students drew larger maps and said, 'because the scale is large.' This shows that students failed to see scale as a ratio, rather than a measure.

Result for RQ2: Converting Distance Units

In the second Research question, based on document analysis (worksheets and formative assessment results), it was found that 7 out of 10 students made mistakes in the unit conversion process, particularly between centimetres and kilometres and vice versa. Some mistakes found included students assuming that 1 cm on the map was always equal to 1 km in the field, without considering the scale. Students made mistakes when converting units (for example, converting cm to km without first converting to metres). One student said, "I am still confused about how to convert cm to km; I often make mistakes." This difficulty occurred in both classes (X-3 and X-6) and was consistent across students' work.

From the observations, when calculating the actual distance from point A to B, four students multiplied the map distance by the scale value instead of dividing it, resulting in calculations that were 10 times larger. On the worksheet, two students wrote '1 cm = 1 km' even though the map scale was 1:25,000, and continued to use that value for all the questions. One student wrote the final distance result in 'cm' even though they were asked to convert it to kilometres. This shows that students are still incorrect in their conversion calculation procedures, do not pay attention to scale information, and are confused about unit conversion.



6. Pada peta dengan skala 1:2.000, jarak antara titik A dan B pada peta adalah 8 cm. Berapakah jarak sebenarnya antara titik A dan B?
=> 8 cm x 2.000 = 16.000 cm
= 160 m

Figure 3. Student Answers to Scale Conversion Questions

This error pattern involves multiplying distance by scale rather than dividing it. An example of this pattern occurs when students are given a distance of 8 cm on a map with a scale of 1:2,000. Four students immediately calculate '8 cm \times 2,000 = 16,000 cm', resulting in a real distance that is 10 times too large. This pattern shows that students apply the opposite calculation rule, i.e., multiplying instead of dividing, without understanding the principle of proportionality.

Result for RQ3: Interpreting and Reading Map Symbols and Information

In the third Research question, which concerned students' inability to interpret symbols, colours, and descriptions on maps, 6 out of 10 students did not understand the meaning of symbols and colours because they did not use the legend as a reference. Some of the students' statements were: "I think blue always means sea, without paying attention to the legend", "I think green means mountain", "I have never seen the legend, so I do not know the meaning of the symbols", "I still find it difficult to distinguish between each legend or symbol because they look almost the same". These findings indicate that students do not yet understand the function of symbols and legends as tools for spatial representation.

From the observations, when asked to find the location of rivers on the map, two students pointed to thick black lines that were administrative boundaries because they thought all curved lines on the map were rivers. Three students marked the green area as 'mountainous region' because they thought that green always referred to highlands, without referring to the legend. One student tried to identify residential areas but pointed to small yellow circles because they thought the colour matched the residential symbols on the previous map. The students did not open the legend and continued to compare symbols solely by shape and colour, even though they thought the symbols were similar.

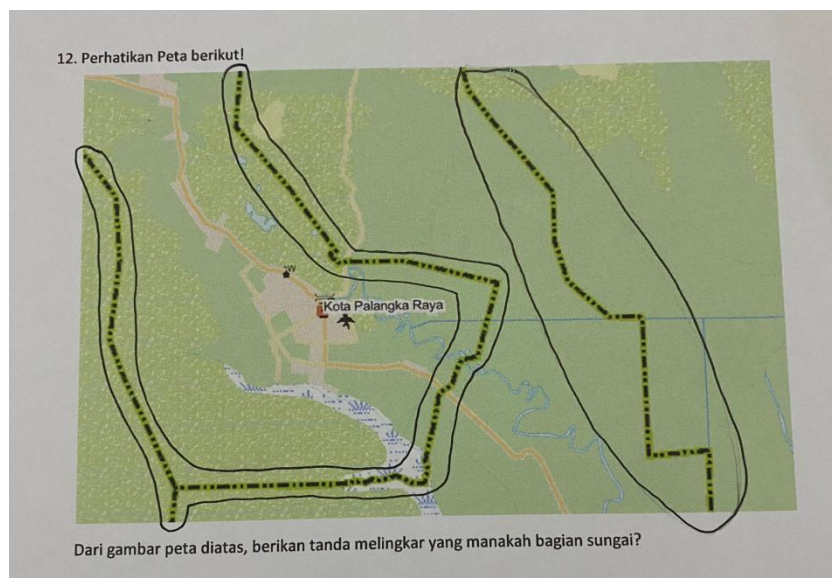


Figure 4. Student Answers to Questions on Understanding Map Legends

This pattern of error is an overgeneralisation of map symbols, where two students pointed to thick black lines as rivers because they assumed that 'all curved lines are rivers.' Another example, 'These symbols are all similar, so I think they are the same,' shows a pattern of error in the form of overgeneralisation, interpreting symbols based on visual similarities rather than the legend. This pattern demonstrates a low level of understanding of symbolic representation.

Table 3. Variations in Interview Quotes Based on Student Ability

Research Question	Group	Quotation
1	Low Ability	'I think the scale is the length of the map.'
	Moderate Ability	'The scale is the number in the corner of the map, but I do not know what it does.'
	High Ability	'I know the scale compares distances, but sometimes I am confused about how to use it.'
	Teacher	'Many students only see the scale number as part of the map's appearance, not as a comparison of distances.'
2	Low Ability	'I think 1 cm on the map is equal to 1 km in the field.'
	Moderate Ability	'I immediately convert from cm to km, sometimes forgetting to convert to metres first.'
	High Ability	'I can calculate, but I am still confused about when to divide or multiply by the scale.'
	Teacher	'Students often convert units without looking at the scale value, so the results are not proportional.'
3	Low Ability	'I think blue always means sea.'
	Moderate Ability	'I have never seen a legend, so I do not know what the symbols mean.'
	High Ability	'I can read some symbols, but the colours on thematic maps are often different, which makes me unsure.'
	Teacher	'Students rarely use legends as a reference, especially when reading thematic maps.'

Comparison between Two Classes (X-3 and X-6)

The results showed differences in difficulty patterns between students in classes X-3 and X-6. In class X-3, four out of five students appeared more active when the researcher was teaching and attempted to calculate the scale, albeit incorrectly, including writing the scale formula backwards. Their participation was higher, but basic conceptual errors persisted among most students.

Meanwhile, X-6 students showed different tendencies: five students asked more questions during discussions, but three of them had particular difficulty reading symbols and legends, for example, equating administrative boundaries with rivers or misinterpreting colours. In addition, four students still multiplied the map distance by the scale value. This comparison shows that X-3 is stronger in the initial exploration of the concept of scale, while X-6 experiences more visual-spatial difficulties in map symbolisation.

The results of the study summarised three main categories of conceptual difficulties experienced by students, namely a lack of understanding of the concept of scale (experienced by 7 out of 10 students), errors in converting units of distance (6 out of 10 students), and difficulties in interpreting symbols and map legends (8 out of 10 students).

These findings were obtained through triangulation of interviews, classroom observations, and analysis of student worksheets. The pattern of errors was consistent: misconceptions about scale led to numerical conversion errors, which in turn led to inaccurate map reading.

These results indicate that map comprehension skills do not stand alone; they develop gradually and are interrelated, so geography learning should emphasize integrating scale concepts, proportional calculations, and symbolic interpretation.

D. Discussion

Based on the results of in-depth interviews, classroom observations, and analysis of student documents, three main categories of conceptual difficulties were identified, namely difficulties in understanding the concept of scale as a comparison of distance, difficulties in converting units of distance from maps to the real world, and difficulties in interpreting symbols and information on maps. These three difficulties do not stand alone, but are interrelated and form a conceptual hierarchy that affects students' overall spatial literacy skills.

In the 'Difficulty understanding the concept of scale' in-depth interview results, most students understood scale as 'the size of a map', rather than as a comparison of distance between the map and actual conditions. Classroom observation results also showed fundamental errors, such as students writing scale formulas in the wrong direction. Some students assumed that a scale of 1:10 meant that the distance on the map was greater than in real life. These findings indicate that misconceptions about scale do not stem solely from mathematical ability, but more fundamentally from the absence of a bridge between mathematical concepts (comparison/ratio) and spatial representation (the relationship between maps and the real world). In other words, students understand scale symbolically but not conceptually-spatially.

'Difficulties in converting units of distance' arise when students are asked to calculate actual distances based on map scales. Based on an analysis of students' work, several main patterns of errors were found, such as students assuming that 1 cm on the map is always equal to 1 km in the field, students not paying attention to the scale value when converting units, and students being confused about whether to multiply or divide. These findings show that numerical misconceptions underlie spatial difficulties. However, conversion errors do not stem solely from weak mathematical abilities; they also arise from a lack of spatial awareness of the relationship between maps and actual geographical conditions. Thus, the ability to convert units can be understood as a conceptual bridge between understanding scale and interpreting maps.

The 'difficulty in interpreting and reading maps' is demonstrated by the low level of visual spatial literacy among students. From interviews with students, the following statement emerged: 'It is easier to memorise symbols than to understand their meaning.' Observations show that many students do not use legends when reading thematic maps; instead, they interpret symbols based on visual intuition rather than symbolic function. These findings indicate that students read maps visually and literally, rather than

symbolically and conceptually. This difficulty is exacerbated by the minimal use of real maps and interactive media, as well as a lack of spatial interpretation exercises in learning.

This study reinforces [Græsli & Lien \(2024\)](#) findings that procedural map learning hinders students' proportional understanding and extends it by showing that teachers' emphasis on the use of formulas without conceptual meaning exacerbates misconceptions about scale. In line with [Biernet \(2024\)](#), this study's results confirm that a weak understanding of linear units impairs proportional thinking, and that adding a spatial dimension reveals that numerical errors directly affect the understanding of map-geographical reality relations. Furthermore, supporting the findings of [Szigeti-Pap et al \(2023\)](#) and [Beitlová et al \(2020\)](#) regarding the limitations of visual-spatial experience as a cause of map-reading errors, this study shows that these error patterns have been established since secondary school, not only among university students or adult map users. Thus, this study confirms that weak spatial literacy is not a problem that arises later, but is rooted in the early stages of geography learning.

This study offers a new theoretical contribution through the development of a conceptual model of the Hierarchy of Map Comprehension Difficulties and Scale, which consists of three levels: difficulty in understanding the concept of scale (basic), difficulty in converting distance units (transitional), and difficulty in interpreting symbols and map information (complex). This model confirms that failure at the basic level will have a direct impact on the next level and that students' spatial literacy develops gradually, not separately. Thus, this study not only confirms previous theories but also modifies the explanatory structure of conceptual difficulties in geography learning, particularly in the context of Indonesian education, and provides a basis for developing learning strategies and curricula that systematically integrate mathematical, conceptual, and visual-spatial aspects.

E. Implication

The results of this study reinforce the understanding that effective geography learning requires integration between conceptual mastery and spatial representation. Students' difficulties in understanding maps and scales indicate that spatial literacy is not merely a technical skill of reading symbols, but rather a conceptual ability to connect spatial representations with geographical reality. These findings expand the geospatial framework by emphasising that conceptual understanding is the main foundation for developing spatial reasoning, particularly in the context of geography learning in Indonesia.

In practical terms, this study emphasises the need for learning strategies that are more contextual, exploratory, and based on direct experience. Teachers need to integrate the use of digital mapping media and distance-measurement activities in the surrounding environment so that the concepts of scale, distance, and space are understood not only abstractly but also contextually. This approach is important to reduce conceptual difficulties while improving students' geospatial thinking skills in a more meaningful way.

The findings of this study also have social and policy implications, particularly in strengthening spatial literacy as a 21st-century competency. Understanding maps and scales

is not only relevant to geography learning but also important in everyday life, such as location-based decision-making and spatial analysis. Therefore, the results of this study support the need for more explicit integration of spatial literacy into the curriculum and for strengthening geospatial Material in cross-level learning.

As an implementation, teachers can design environment-based learning projects, such as mapping the route from home to school using digital applications (e.g., Google Maps or simple QGIS), then converting the digital distance into a scale map created by students. Through this activity, students not only understand the concept of scale theoretically, but also relate it directly to real spatial experiences, thereby strengthening their conceptual understanding and geospatial thinking skills.

The limited scope of subjects and school contexts in this study limits the generalisability of the results. Hence, the findings are better understood as an in-depth description of a specific local context and cannot yet represent students' conditions more broadly. Therefore, further Research is recommended to use a longitudinal design to observe the development of students' conceptual understanding and spatial abilities over a long period of time, as well as an experimental approach to directly test the effectiveness of learning interventions (such as interactive geospatial media or project-based learning) in reducing students' conceptual difficulties more measurably.

F. Limitation and Suggestion for Further Research

This study has several limitations that need to be considered. The scope of the subjects is still limited to several students in one school with a specific learning context, so the findings cannot be generalized widely. The data collected through in-depth interviews, classroom observations, and document analysis are qualitative in nature, so the results of the study emphasise depth of understanding rather than breadth of representation. In addition, this study has not examined in detail the cognitive and affective factors that may contribute to students' conceptual difficulties in understanding maps and scales.

For further Research, it is recommended that the participant pool be expanded to include individuals from diverse school backgrounds and regions to obtain a more comprehensive understanding. A mixed-methods approach can be used to combine the strengths of qualitative and quantitative data to map the relationships among conceptual understanding, spatial abilities, and learning outcomes. In addition, further Research could focus on developing interactive geospatial technology-based learning models or media and project-based learning designed to address students' conceptual difficulties more effectively.

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learning interventions (such as interactive geospatial media or project-based learning) in reducing students' conceptual difficulties more measurably.

G. Conclusion

This study answers the Research question by showing that students' conceptual difficulties in understanding maps and scales stem primarily from a weak connection between conceptual knowledge, symbolic representation, and real spatial context. Based on analysis of interviews, observations, and documents, it was found that students were not yet able to construct a complete spatial meaning when relating scale, units of distance, and map representations to geographical reality. Thus, the Research objective—to reveal the form and causes of students' conceptual difficulties—has been achieved, while also emphasising the importance of learning that fosters geospatial thinking skills as the foundation of map and scale literacy.

Theoretically and practically, these findings contribute to strengthening the conceptual framework of geography learning, which places spatial meaning construction at the core of students' geospatial literacy, while also providing implementable directions for teachers and curriculum developers to integrate real-world context-based approaches and interactive digital media. This Research not only enriches the study of conceptual difficulties in map and scale materials but also provides a conceptual basis for the development of more meaningful, integrated geography learning relevant to the spatial literacy needs of the 21st century.

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