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Development Of Geography Learning Modules Using A Field Work-Based Deep Learning Approach To Enhance Students' Spatial Thinking Skills

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Abstract

Spatial thinking skills are an essential competency in Geography education, helping students understand the location, orientation, distribution, and relationships among geographical phenomena. This research aims to develop a Geography learning module using a deep learning approach based on field work to enhance the spatial thinking skills of grade X students at high schools in North Gorontalo Regency. The research method employed is Research and Development, adapting the Borg and Gall model. The results indicate that the developed module meets very high feasibility criteria, with material expert validation at 96.25% and media expert validation at 97% (categorized as highly valid). The practicality test results from teachers' responses averaged 92.48%, and students' responses reached 87.97%, both in the highly practical category. The effectiveness test involving 129 grade X students in four schools in North Gorontalo Regency showed an increase in average pretest scores from 61.10 to 86.81 on the posttest, with N-Gain scores in the medium to high category (0.65 to 0.70). These findings are supported by theoretical alignment and empirical evidence for the implementation of deep learning policies. Overall, the field work-based Geography learning module with a deep learning approach has proven to be valid, highly practical, and effective in improving the spatial thinking skills of grade X students.

Keywords: Learning Module, Deep Learning, Field Work, Spatial Thinking, Geography.

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INTRODUCTION

Geography learning in senior high school plays an important role in helping students understand geospheric phenomena and the relationship between human activity and the environment. Geography learning not only emphasizes mastery of theoretical material, but also trains students to understand location, distribution, patterns, and interregional relationships comprehensively. One of the essential skills that needs to be developed in Geography learning is spatial thinking ability. According to Jirana et al.., (2024)), spatial thinking includes an understanding of concepts of space, the use of tools of representation such as maps, and the processes of spatial reasoning. This ability helps students read and interpret maps, recognize patterns of distribution of geographical phenomena, analyze spatial relationships, and find solutions to spatial problems. In line with this, according to Akmal et al. (2023) and Bednarz (2023), spatial thinking is the main foundation of geographic literacy that enables students to interpret the real world from a spatial perspective. Furthermore, Gersmehl & Gersmehl (2022) state that spatial skills involve higher-order cognition that helps students connect spatial data to the reality of their surrounding environment.

The condition of Geography learning at SMA Negeri 6 Gorontalo Utara shows that the spatial thinking ability of Grade X students still needs improvement. Based on initial observations of 26 students, as many as 18 students had difficulty reading and interpreting maps, determining direction and relative location, as well as analyzing spatial relationships. This number is equivalent to 69.23% of all observed students. Difficulties were also found in understanding map symbols, determining absolute and relative locations, analyzing distance and direction, and identifying patterns of geographic phenomena distribution. This condition indicates that some students still experience difficulties in connecting the concepts studied with spatial information and geographic phenomena in their surroundings.

One crucial aspect that needs to be addressed to resolve this issue is the delivery of classroom teaching. Geography teaching, which has traditionally been largely teacher-centred and reliant on textual teaching materials, tends to limit pupils' opportunities to observe and analyse geographical phenomena directly. Yet the nature of geography is closely linked to real-world phenomena on the Earth's surface. Pupils require empirical learning experiences that enable them to observe geographical features, collect field data, interpret environmental conditions, and link these observations to the concepts being studied. Therefore, the learning

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process needs to be designed in an interactive and contextual manner so that pupils can play a more active role in developing their understanding and optimising their spatial thinking skills.

In addition to learning strategies, the availability of systematic and contextual self-study materials also plays a vital role. Based on the issues identified in this study, there is a need for Geography learning modules capable of guiding pupils to carry out learning activities in a focused manner. These modules should contain essential content, activity guidelines, worksheets, observation procedures, analytical tasks and assessment tools that are aligned with the learning objectives. With the provision of such systematic modules, it is hoped that pupils will not only understand concepts in the abstract but will also be able to apply them to analyse real-world geographical phenomena.

One highly relevant alternative solution is the development of fieldwork-based geography learning modules using a deep learning approach. Fieldwork is a learning model involving direct observation of geographical objects or phenomena in a real-world environment. Through these activities, pupils can identify locations, observe regional characteristics, record spatial data, recognise patterns of distribution, and analyse spatial interactions. These activities provide students with a golden opportunity to link theoretical material to real-world environmental conditions. Consequently, fieldwork has proven to be an effective primary means of supporting contextual geography learning and strengthening students' spatial thinking skills.

The implementation of such fieldwork needs to be supported by a robust pedagogical framework, namely the Deep Learning approach. In modern education, the Deep Learning approach emphasises three main pillars: mindful learning, meaningful learning and joyful learning. Through this approach, pupils are encouraged to truly understand the essence of the learning objectives, integrate new knowledge with prior experience, engage actively in field investigations, and reflect deeply on their learning process. The integration of the Deep Learning approach with fieldwork activities is expected to guide pupils towards a comprehensive understanding of geographical concepts, enabling them to transform their field findings into meaningful and practical knowledge.

The development of this module focuses on the subject of 'Basic Concepts of Geography', given that this subject forms the fundamental basis for various spatial aspects, such as location, distance, accessibility, patterns, morphology, agglomeration, interaction and interdependence, utility, area differentiation, and spatial relationships. All these essential concepts can be explored to the full through direct observation of the environment surrounding the school. In the module

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developed, the sequence of activities is systematically designed across three main stages, namely: (1) pre-fieldwork activities, in which pupils study the basic concepts and prepare their observation tools; (2) fieldwork, during which pupils engage directly in observing geographical features and collecting empirical data; and (3) post-fieldwork, during which pupils analyse their findings, relate them to geographical concepts, and formulate scientific conclusions.

From both a regulatory and empirical perspective, the development of this module is also in line with the direction of national education policy, particularly in implementing the mandate of Ministry of Education and Culture Regulation No. 13 of 2025 regarding the strengthening of the deep learning approach in educational institutions. Based on the above, there is a pressing need to develop a fieldwork-based Geography learning module using a deep learning approach that has been tested for validity, practicality and effectiveness. Therefore, this study aims to produce a valid and practical learning module, as well as to test its effectiveness in improving the spatial thinking skills of Year 10 pupils at State Senior Secondary School 6, North Gorontalo.

METHOD

The validity of the fieldwork-based learning modules was analysed using a descriptive quantitative approach applied to the assessment data provided by subject-matter and media experts. The validity percentage was calculated using the following formula:

$$Va = \frac{TSe}{TSh} \times 100$$

Where Va is the validation sheet; Tse is the total empirical score; and TSh is the highest total score on the validation sheet. The validity criteria are as shown in Table 1

Table 1: Validation Criteria

Validation Criteria	Validation Level
85,01% - 100,00%	Highly Valid
70,01% - 85,00%	Valid
50,01% - 70,00%	Fairly Valid
01,00% - 50,00%	Not Valid

Sumber Akbar, (2022)

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The level of practicality of fieldwork-based geography learning modules using a deep learning approach was measured using a questionnaire completed by teachers and pupils, and was then analysed using quantitative descriptive statistics by calculating the percentage score using the following formula:

$$P = \frac{\Sigma the\ score\ achieved}{\Sigma score\ maxsimum}\ x\ 100\%$$

Where Σ Score Obtained is the cumulative total score of the respondents' (teachers/pupils) answers; Σ Maximum Score is the highest total score; and 100 per cent is the constant used to convert fractions into percentages. The results of these calculations are then interpreted in accordance with the practical criteria set out in Table 2.

Table 2: Percentage Criteria for the Pupil and Teacher Questionnaires

Percentage	Criteria
80%<skor≤100%	Very Good
60%<skor≤80%	Good
40%<skor≤60%	Fair
20%<skor≤40%	Poor

The effectiveness of fieldwork-based learning modules using a deep learning approach is measured by the extent to which learners' spatial thinking skills improve between the pre-test and post-test. Spatial thinking scores are first converted into percentages using the following formula:

$$P = \frac{\Sigma the\ score\ achieved}{\Sigma score\ maxsimum}\ x\ 100\%$$

Where Σ Score Obtained is the cumulative total score of the respondents' (teachers/pupils) answers; Σ Maximum Score is the highest total score; and 100 per cent is the constant multiplier used to convert fractions into percentages.

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RESULTS AND DISCUSSION

This study aims to produce a fieldwork-based geography learning module utilising a deep learning approach to enhance pupils' spatial thinking skills. The development of this product follows the research and development (R&D) steps outlined by Borg and Gall.

Validation carried out by subject matter and media experts consistently classified the fieldwork-based geography learning module incorporating a deep learning approach as 'highly valid'. The results of both expert validations are presented in Table 5.

Validator	Percentage	Category
Subject matter expert	96.25%	Highly valid
Media expert	97%	Highly valid
Average	96.63%	Highly valid

The fieldwork-based geography learning module using a deep learning approach developed in this study was found to be highly valid based on the assessments of both validators. The subject matter expert awarded a score of 96.25 per cent, covering the aspects of content suitability, accuracy of material, relevance of issues, learning activities and critical thinking skills, whilst the media expert awarded a score of 97 per cent, assessed on the aspects of graphical suitability, presentation suitability, linguistic suitability and ease of use. With an overall average of 96.625 per cent, this product falls into the 'highly valid' category. Both sets of results indicate that the geography learning module has met the suitability criteria and is aligned with the principles of deep learning and fieldwork syntax. The high validity score reflects the fact that this module was deliberately designed to meet the instructional needs of geography learning on the topic of Regional Development. The material included is not merely focused on conceptual mastery; rather, it actively guides students to analyse problems, engage in discussions, and reflect on their learning experiences. The sequence of activities is systematically organised in accordance with the instructional stages of deep learning and the fieldwork syntax, thereby ensuring more structured and meaningful learning progress. These findings are consistent with the theoretical framework proposed by Plomp & Nieveen (2013), which states that the validity of an instructional product is based on two dimensions: content validity (the alignment of content with objectives) and construct validity (coherence amongst components). This coherence is clearly evident in the consistency between the learning objectives, materials, activities and assessment, all of which

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are geared towards developing pupils' spatial thinking skills. This is also supported by Kosasih (2021), who states that high-quality learning modules must integrate content, structure, language and visual presentation in a cohesive manner in order to function effectively within the learning process. Furthermore, these high validity scores are consistent with the findings of Rohmah & Murtini (2025), who reported that deep learning-based learning media tend to achieve high validity ratings due to their capacity to integrate active and contextual learning experiences.

The Practicality of Fieldwork-Based Geography Teaching Modules Using a Deep Learning Approach

The practicality of these fieldwork-based geography learning modules, which utilise a deep learning approach and were developed to enhance pupils' spatial thinking skills, was assessed through two trial phases: a limited trial and a wider trial, both of which involved teachers and pupils as the direct users of the product.

During the limited trial conducted at State Senior Secondary School No. 6, North Gorontalo, the responses from teachers and pupils indicated that the module was 'very practical'. Teachers' responses during the limited trial yielded an average rating of 93.5 per cent, with the language and implementation aspects receiving very good ratings. This indicates that the instructions in the learning module are very easy to understand and that the steps for the fieldwork activities can be effectively applied both in the classroom and in the field. Meanwhile, student feedback during the pilot study at this school reached 86.5 per cent, also falling into the 'highly practical' category, with the learning activities dimension receiving a high percentage.

Furthermore, to test the level of practicality more broadly and in greater depth, the field trial was extended to several schools, namely State Senior Secondary School No. 1 North Gorontalo, State Senior Secondary School No. 5 North Gorontalo, State Senior Secondary School No. 6 North Gorontalo, and State Senior Secondary School No. 7 North Gorontalo. A summary of the overall practicality test results from teachers and pupils is presented in Table 6 below:

Table 6: Results of pupils' and teachers' responses to the teaching module

	The Aspect with the Highest Score	Average Percentage	Category
Teacher's Response	Language & Implementation (100 per cent)	92,48%	Very Practical

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Pupil's Response	Learning Activities (87.3 per cent)	87,97%	Very Practical

During the large-scale trial conducted at four schools in North Gorontalo Regency, the consolidated results regarding the practicality of the fieldwork-based geography learning modules using a deep learning approach are presented in Table 7. As shown in the table, the practicality ratings consistently fell within the 'very practical' category across all research locations.

The percentage of practicality rated by teachers ranged from 90.8 per cent to 94.2 per cent, with the highest rating achieved by State Senior Secondary School No. 7, North Gorontalo, at 94.2 per cent, and the lowest at State Senior Secondary School No. 5, North Gorontalo, at 90.8 per cent. This indicates that teachers were able to integrate fieldwork syntax and deep learning principles very effectively into their classroom lesson plans. Meanwhile, pupils' responses to the modules in this large-scale trial ranged from 86.5 per cent to 89.4 per cent, with State Secondary School 7, North Gorontalo, recording the highest score of 89.4 per cent and State Secondary School 6, North Gorontalo, recording 86.5 per cent. These results confirm that the modules developed are practical, engaging and capable of facilitating pupils' active involvement in the spatial learning process across schools with diverse characteristics.

The Effectiveness of Deep Learning-Based Teaching Modules.

The effectiveness of the learning modules was measured based on the improvement in pupils' critical thinking scores from the pre-test to the post-test in both pilot phases.

School	Number of Pupils	Pre-test Average	Post-test Average	NGain Average	Category
SMA Negeri 1 Gorontalo Utara	33	54,70	86,21	0,70	High
SMA 7 Gorontalo Utara	37	63,78	87,03	0,65	Medium
SMA 5 N Gorontalo Utara	32	62,81	87,28	0,66	Medium

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SMA N 6 Gorontalo Utara	26	63,15	86,73	0,67	Medium

The effectiveness of the fieldwork-based geography learning module using a deep learning approach was tested by comparing pupils' spatial reasoning scores before and after learning across all trial stages, including both the limited and large-scale trials. All schools participating in this study showed an increase in average scores following the implementation of the fieldwork-based geography learning module using a deep learning approach.

In the pilot study conducted at State Senior Secondary School No. 6, North Gorontalo, students' average scores increased substantially from 63.15 in the pre-test to 86.73 in the post-test, resulting in an average N-Gain value of 0.67, which falls within the 'moderate' category.

Furthermore, during the large-scale trial covering four schools in North Gorontalo Regency, a comprehensive summary of the effectiveness results is presented in Table 8. Based on the large-scale trial data, State Senior Secondary School No. 1, North Gorontalo, recorded the highest N-Gain of 0.70 (high category), whilst State Senior Secondary School No. 7, North Gorontalo, recorded an N-Gain of 0.65 (moderate category). Overall, in the North Gorontalo region, improvements in spatial reasoning skills occurred consistently across all research locations, with no schools falling into the low category.

Collectively, these findings confirm that fieldwork-based geography learning modules employing a deep learning approach are effective in enhancing the spatial thinking skills of upper secondary school pupils. The improvements observed reflect the capacity of the sequence of fieldwork activities and the stages of deep learning to guide pupils towards a deeper conceptual understanding. The structured learning stages—comprising understanding, application and reflection—provide students with the opportunity to analyse spatial information, link geographical concepts to real-world phenomena in their local area, and formulate solutions to the spatial problems under study.

This process encourages pupils to move beyond mere theoretical understanding and to develop more critical and reflective thinking skills. Furthermore, the integration of fieldwork activities provides an active learning experience through direct observation, investigation and the processing of geographical data. These activities help students develop indicators of spatial thinking, such as spatial analysis, evaluation of distribution patterns, inference, and spatial decision-making throughout the learning process.

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The findings of this study are consistent with Brenya (2024), who explains that a deep learning approach is capable of creating more meaningful learning experiences through students' active engagement in the instructional process. Yuan et al. (2024) similarly emphasise that deep learning-based instruction encourages students to develop reflective and applied understanding, resulting in more substantial knowledge acquisition. Furthermore, the results of this study reinforce the findings of Rahaningmas et al. (2025), which indicate that the deep learning approach is effective in enhancing students' higher-order thinking skills.

From a policy perspective, the findings of this study provide empirical evidence supporting the implementation of Ministry of Education, Culture, Research and Technology Regulation No. 13 of 2025. The deep learning approach mandated by this regulation has proven to be effectively operationalised in classroom and field-based learning practices through appropriately designed modules—not merely as a slogan in curriculum documents, but as a practice in geography teaching that yields measurable improvements in spatial thinking skills.

CONCLUSION

Based on the results of the research and discussion regarding the development of a geography learning module using a fieldwork-based deep learning approach to enhance pupils' spatial thinking skills in North Gorontalo Regency, the following conclusions can be drawn:

1. Module Suitability (Validity): The learning modules developed meet the suitability criteria with a very high level of validity. Based on the validity test results, media experts assigned a score of 97 per cent, categorising the module as 'Highly Valid', whilst subject matter experts assigned a score of 96.25 per cent, also categorising it as 'Highly Valid'. Overall, these validation results indicate that the geography module developed is highly suitable for trialling in learning activities.
2. Practicality of the Modules: The learning modules have proven to be highly practical for use in the learning process. This is demonstrated by the results of an analysis of feedback from direct users—both teachers and pupils—gathered during a limited pilot phase (at State Senior Secondary School No. 6, North Gorontalo) and a wider pilot across various schools in North Gorontalo Regency. Assessments of practicality consistently fell within the 'Very Practical' category, indicating that the modules' instructions, content and structure are easy to understand and can be effectively implemented both in the classroom and in the field.

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3. Effectiveness of the Module: The fieldwork-based geography learning module, which employs a deep learning approach, has proven effective in enhancing pupils' spatial thinking skills in North Gorontalo Regency. This is evidenced by an increase in pupils' average scores from the pre-test to the post-test across all pilot sites, with N-Gain scores falling within the moderate to high categories, as well as a significant and consistent improvement in learning outcomes in the region.

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