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Development of Geography Literacy-Based Learning Models in an Effort to Build Spatial Intelligence in Students

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Abstract: This study aims to develop a geography literacy-based learning model in an effort to build spatial intelligence in junior high school students. The model was developed using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) procedure. The analysis stage found that teachers and students needed an innovative model that could connect geographical concepts with the surrounding environment. The design stage produced model tools in the form of syntax, lesson plans, student worksheets, and assessment instruments that were validated by experts with an average score of 88% (highly valid category). In the development stage, a limited trial involving 25 students showed an increase in student engagement from 62% to 82%. The implementation stage involved experiments in two classes, where the experimental class used the geographic literacy model and the control class used conventional methods. The posttest results showed that the average spatial intelligence of students in the experimental class reached 82.6 (high category), higher than the control class at 74.1 (medium category), with a significant difference ($p < 0.05$). The evaluation showed a 16% increase in geographic literacy skills and an 18% increase in spatial intelligence, as well as positive responses from teachers regarding the practicality of the model. These results confirm that the geography literacy-based learning model is valid, practical, and effective in improving the spatial intelligence of junior high school students.

Keywords: geographic literacy; spatial intelligence; learning model; ADDIE; learners

Introduction

Education is a conscious and planned effort to create a learning process that enables students to develop their full potential, including cognitive, affective, and psychomotor aspects (UU no 20, 2003). This mandate emphasizes that education should not only focus on the acquisition of information, but also on the development of thinking skills and decision-making abilities in real life. Therefore, the learning process must be designed meaningfully so that it can equip students to face increasingly complex social and environmental dynamics (Insani, 2021; Kurniawati et al., 2020.).

In this context, Social Sciences Education (IPS) has a strategic role as a vehicle for developing students' social knowledge, environmental understanding, and analytical skills regarding social and spatial phenomena (Indrayati & Hikmah, 2018; Brown et al., 2020) SOS is a compulsory subject at the primary and secondary education levels with the aim of shaping citizens who are sensitive to social conditions and capable of critical thinking in facing everyday problems. Ideal SOS learning should integrate knowledge, attitudes, and skills so that students are able to relate social concepts to

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the reality of the space in which they live.

However, social studies teaching practices at the junior high school level still face various problems. Teaching tends to be dominated by conventional teacher-centered approaches that are verbalistic and do not make sufficient use of spatial context as a source of learning. Social studies is even often perceived as a boring subject that does not stimulate students' interest in learning (Edelson, 2006; Purbowo et al., 2022). This condition has an impact on the low ability of students to understand spatial concepts, read maps, and analyze spatial relationships in everyday life.

The low quality of social studies learning has a direct implication on the weakness of students' spatial intelligence. Spatial intelligence is an important ability that enables individuals to understand the position, relationships, and dynamics of objects in space and make appropriate decisions on various spatial issues (Diezmann & Watters, 2000). When students lack adequate spatial intelligence, they will have difficulty understanding strategic issues such as climate change, natural disasters, and sustainable development, which are closely related to spatial aspects (Catling & Willy, 2018; Entwistle et al., 2019).

Geographic literacy is considered the main foundation in developing students' spatial intelligence. (National Geographic, 2006) emphasizes that geographic literacy is necessary for students to be able to understand their region comprehensively through mastery of the concepts of location, place, spatial relationships, movement, and territory. However, various studies show that low geographic literacy in junior high schools is caused by limited learning models, suboptimal curriculum integration, and minimal use of spatial learning media and resources (Raden Adinda Zalfa et al., 2023; Kopnina, 2020).

(Pangestu et al., 2022; Lauermann & Karabenick, 2011) Based on these conditions, there is a need for innovation in social studies learning that systematically integrates geographic literacy as the basis for developing students' spatial intelligence. The novelty of this stud lies in the development of a social studies learning model based on geographic literacy that is not only conceptual but also operational and applicable through the provision of model books and contextual learning tools for junior high school students (Lauermann & Karabenick, 2011;Efriani & Zainil, 2020). Unlike previous studies that generally position geographic literacy as a partial approach, this study positions geographic literacy as the main foundation in the learning syntax, thereby providing empirical and practical contributions to the development of meaningful and relevant social studies learning in the 21st century.

Method

The detailed design of the Research and Development (R&D) method used the ADDIE method, which consists of analysis, design, development, implementation, and evaluation (Sugiyono, 2013). The research data includes qualitative and quantitative data, consisting of: (1) Product validity test data, (2) Product practicality test data, and (3) Product effectiveness test. This research was conducted at the Padang State University Laboratory Development Junior High School.

With the development of a geography literacy-based learning model to build students' spatial intelligence, it is hoped that this model can be used by social studies teachers to provide students with spatial intelligence knowledge that can support their ability to understand learning at school and support their personal lives at home (Isjoni et al., 2021).

Research Procedure

The research procedure consisted of five stages, namely *analysis, design, development, implementation, and evaluation*, with the following details:

1. *Analysis*

The analysis stage was the first step in developing a Geography Literacy-Based Learning Model to build spatial intelligence in junior high school students. At this stage, the researcher analyzed the conditions of social studies learning with a focus on geography as the basis for developing spatial thinking skills. The analysis was conducted through a review of social studies learning tools, the distribution of spatial intelligence questionnaires to students, and interviews with social studies teachers at the Padang State University Laboratory Development Junior High School. This stage aimed to identify the needs and feasibility of developing a geography literacy-based learning model that is in line with the characteristics of the students.

2. *Design*

The design stage was carried out after the analysis stage to formulate the initial design of the Geography Literacy-Based Learning Model oriented towards developing students' spatial intelligence. At this stage, the researcher designed the core components of the learning model, which included a model book containing learning syntax, learning tools, learning media and resources, and evaluation instruments. Next, the model book and learning tools were validated by experts to determine their suitability for implementation.

3. *Development*

This stage focuses on the development of the initial Geography Literacy-Based Learning Model product. At this stage, the model and learning tools are prepared for limited testing with students. Limited testing is conducted to assess the practicality of the model, students' understanding of geography literacy activities, and teachers' responses to the application of the model. The trial data is used as a basis for refining the model and learning tools through revisions before proceeding to the implementation stage.

4. Implementation

The implementation stage was carried out after the geography literacy-based learning model was declared feasible through validation and revision. Implementation was carried out in experimental classes during four meetings by applying the model syntax in its entirety. Implementation evaluation included measuring spatial intelligence improvement through pre-tests and post-tests analyzed using N-gain, observing the implementation of the learning syntax, and conducting questionnaires for teachers and students. Data analysis was conducted quantitatively and qualitatively to assess the implementation, practicality, and effectiveness of the model in junior high school social studies learning.

5. *Evaluation*

The evaluation stage is the final stage in the development of the Geography Literacy-Based Learning Model, which aims to assess the effectiveness of the model after its implementation in junior high school social studies learning. The evaluation was conducted through an analysis of pre-test and post-test results to measure the improvement in students' spatial intelligence using N-gain calculations, supported by qualitative data in the form of observations and student responses. Data analysis is conducted quantitatively and qualitatively to obtain a comprehensive picture of the model's impact on student learning outcomes and learning experiences, which forms the basis for determining the model's suitability for recommendation in junior high school social studies learning.

Population and Sample

The population in this study was all seventh-grade students at the Padang State University Development Laboratory Junior High School in the 2025/2026 academic year. The sample consisted of class VII.A, which had 28 students as the experimental class, and class VII.B, which had 32 students as the control class.

Data Collection Technique

Data analysis techniques for research on the development of geography literacy-based learning models in building students' spatial intelligence in geography subjects using qualitative and quantitative descriptive analysis techniques. The analysis techniques used are validity and practicality tests, as well as effectiveness tests.

Data Analysis Techniques

1. Data Analysis for Validity Testing

To determine the validity of the model, the formula (Aiken, 1985.) was used. The validation data was analyzed usinthe following steps:

- Scoring each item validated on a scale of 1-5 with the following criteria:

Score 5 = very good
Score 4 = good
Score 3 = fairly good
Score 2 = poor
Score 1 = not good

- Summing the scores from each validator for all indicators.

Aiken's V statistic is formulated as:

$$V = \sum s / [\, n\,(c - 1)\,] \quad (1)$$

(*Aiken,* 1985.)

Explanation:
s = r - lo
lo = Lowest validity score (in this case = 1)
c = Highest validity score (in this case = 5)
r = Score given by an assessor

The range of V scores obtained is between 0 and 1.00. A range of ≥ 0.667 is interpreted as a valid coefficient.

2. Test Item Instrument

- Item Validity

Calculation of item validity for learning outcome test trials using the Biseral Correlation Coefficient formula

$$\gamma_{pbi} = \frac{Mp - Mt}{St}\sqrt{\frac{p}{q}} \quad (2)$$

(Arikunto 2020.)

Explanation:
γ_pbi= Biseral Correlation Coefficient
Mp = Average score of subjects who answered correctly for the item whose validity is being sought
Mt = Average total score
St = Standard deviation of total scores
P = Proportion of students who answered correctly

$p = \frac{Number\ of\ students\ who\ answered\ correctly}{Total\ number\ of\ students}$ (3)

Q = Proportion of students who answered incorrectly (q= 1 – p)

- Question Reliability

To calculate the reliability of test questions, use the Kuder Richardson-20 (KR-20)

$r_{11}\left(\frac{n}{n-1}\right)\left(\frac{S^2-\sum pq}{S^2}\right)$ (3)

(Arikunto, 2020.)

Explanation:

r11 : Overall test reliability

p: Proportion of subjects who answered the item correctly

q: Proportion of subjects who answered the item incorrectly

(q = 1-p)

Σpq : Sum of the products of p and q

n : Number of test items

S : Standard deviation (standard deviation is the square root of variance)

- Question Difficulty Index

$P = \frac{B}{JS}$..... (Aiken, 1985.)

Explanation:

P: Level of difficulty

B: Number of students who answered correctly

JS: Number of students who answered the question

- Discrimination Power

$D = \frac{B_A}{J_A} - \frac{B_B}{J_B}$..... (Aiken, 1985.)

Explanation:

D: Discrimination power

B_A: Number of participants in the upper group who answered correctly

B_B: Number of participants in the lower group who answered correctly

J_A : Number of participants in the upper group

J_B: Number of participants in the lower group

Practicality Test Analysis

The practicality of the geography literacy-based learning model development model in an effort to build the spatial intelligence of junior high school students in social studies, especially geography, was obtained based on the responses of teachers and students to the implementation of the model through a measurement tool in the form of a questionnaire. The alternative answers developed in the questionnaire consisted of Strongly Agree (SS), Agree (S), Undecided (RR), Disagree (KS), and Strongly Disagree (TS). These were analyzed as follows:

1) Score answers using the following criteria:

1 = Disagree

2 = Somewhat disagree

3 = Undecided

4 = Agree

5 = Strongly agree

2) Determine the average score obtained by adding up the values obtained from multiple indicators

$NA = \frac{S}{SM}$ x 100%…….

Practicality is scored using the following formula:

Explanation:

NA = Final Score

S = Score obtained

SM = Maximum Score

Effectiveness Analysis

Geographic literacy in efforts to develop students' spatial intelligence can be seen in the characteristics of students when faced with learning that requires them to develop spatial intelligence, for example, in the material on the use of floor plans or maps.

- *Learning Outcomes*

The test was used to measure improvements in learning outcomes. This was obtained by giving students test questions after teaching them using a geography literacy-based model in an effort to develop students' spatial intelligence. The test was given in the form of multiple-choice questions that had been validated and were reliable.

The t-test results will show the difference in learning outcomes between the experimental class, which was given treatment using the geography literacy model in an effort to build students' spatial intelligence in social studies, especially geography, and the control class, which was not given treatment using geography literacy in an effort to build students' spatial intelligence in social studies, especially geography, using the SPSS version 16 program.

Furthermore, to determine the effectiveness of the geography literacy-based learning model in developing students' spatial intelligence, an N-Gain test was conducted. The N-Gain test was obtained from a comparison of the difference between the post-test score minus the pre-test score and the maximum score difference with the pre-test score. The calculation results were interpreted using the Gain index.

Data Analysis Requirements Test

1) Normality Test

The normality of data distribution is tested using the Kolmogorov-Smirnov statistic. This test is also

known as the K-S test, which is available in SPSS Version 16 using the Explore function. If the data distribution value obtained is 0.05, then the sample data is normally distributed.

2) Homogenity Test

The homogeneity test aims to determine whether several groups of research data have the same variance or not. The homogeneity test uses SPSS version 16. Decision making in the homogeneity test is as follows: If the Sig value is > 0.05, then the data is homogeneous, and if the Sig value is < 0.05, then the data is not homogeneous.

3) T- Test

Data analysis in experimental research is conducted by examining the level of difference between the experimental class and the control class using the t-test (Normand et al., 2011). Data analysis using the t-test in research on the development of a geography literacy model in an effort to build spatial intelligence in geography lessons was carried out using SPSS version 16. To determine whether the difference is significant or not, the t-value is compared with the t-table with dk (n1+n2)-2 at a significance level of 0.05. If the t-value is ≥ the t-table value, then the null hypothesis (H0) is rejected and the research hypothesis (Ha) is accepted/significant. Furthermore, if tcount ≥ ttable, then the null hypothesis (H0) is accepted and the research hypothesis (Ha) is rejected/insignificant.

Result and Discussion

Result

This study was conducted at SMP Pembangunan Laboratorium Universitas Negeri Padang with a population of 166 people and a sample of 28 people, using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model. The results of the study at each stage can be described as follows.

1. *Analysis*

The analysis was conducted through interviews with junior high school social studies teachers and a review of the learning tools used, including Learning Objectives (TP), Learning Objective Flow (ATP), and Teaching Modules (MA). The results of the analysis show that social studies learning, especially geography content, has not fully led to the development of students' geographical literacy and spatial intelligence, as it is still dominated by conventional approaches such as lectures and limited discussions. The use of spatial media, such as thematic maps, satellite imagery, and digital mapping applications, has not been optimally and sustainably utilized as the main means of training spatial thinking skills, so that students still have difficulty reading maps, understanding symbols, determining directional orientation, and analyzing the relationship between the physical conditions of an area and human activities.

The learning tools used are still oriented towards mastery of material and cognitive assessment, while spatial thinking skills have not been explicitly formulated, even though social studies teachers show an open attitude towards contextual learning innovations based on the environment and spatial exploration. In addition, the measurement of initial spatial intelligence abilities through a pretest in the control class (32 students) and the experimental class (28 students) showed that the initial abilities of the students were in the low to moderate category and were relatively equal in both classes before the implementation of the geography literacy-based learning model.

2. *Design*

The design stage was carried out to develop a preliminary design for a geography literacy-based learning model based on the results of the learning needs analysis in the previous stage (Department of Food Hygiene, Science and Research Branch, Islamic Azad University, Tehran, Iran. et al., 2021). The main outcome of this stage was a geography literacy-based learning model book containing conceptual and operational learning syntax, as well as supporting learning tools, including Learning Objectives (TP), Learning Objective Flow (ATP), and Teaching Modules (MA). The model book was developed systematically in response to junior high school social studies learning, which still tends to be verbal and is not yet optimal in developing students' geographic literacy and spatial intelligence. The design of the model book is based on student characteristics, the requirements of the Merdeka Curriculum, and the need for space-based learning through the use of spatial media. The model book is designed as a guide for teachers, containing the theoretical foundations of geographic literacy and spatial intelligence, the principles of spatial-based learning, and a learning syntax that is arranged sequentially, starting from geographic literacy orientation, spatial source exploration, spatial analysis, spatial representation and modeling, to reflection and evaluation. In addition, the learning tools are designed to integrate exploratory, analytical, and reflective activities with the use of spatial media and evaluation instruments that measure geographic literacy and spatial intelligence authentically.

The draft model book and learning tools produced at this stage are then validated by three experts to assess the feasibility of the material, presentation, language, and graphics in the model book, as well as the

construction of activities, syntactic integration, clarity of objectives, and measurability of indicators in the learning tools, before being revised and refined at the development stage.

3. Development

The development stage was carried out as a follow-up to the results of the geography literacy-based learning model design that had been compiled in the previous stage. This stage aimed to produce a valid, feasible, and implementable learning model in the context of social studies learning at the junior high school level. The development began with the compilation of the initial learning model product, which was designed based on the results of needs analysis, student characteristics, and actual learning conditions in the classroom. The initial product included a learning model book and learning tools designed to integrate geographic literacy and the development of students' spatial intelligence. Next, the initial product was discussed with social studies teachers as learning practitioners to obtain input regarding the feasibility of the model, the suitability of the syntax with the learning time allocation, and the use of contextual and accessible spatial media. The results of the discussion showed the need to simplify and sequence the learning syntax, utilize spatial media that is close to the students' environment, such as maps of the surrounding environment and simple floor plans, and develop assessment instruments that not only measure concept mastery but also authentic geographic literacy and spatial intelligence.

Based on teacher input, revisions were made to the model book and learning tools, including simplifying the learning steps, adjusting the activity examples to the local geographical context, and optimizing the use of spatial media relevant to the daily lives of students. The revised model was then validated by three experts in the fields of geography education, learning design, and language. The results of the model book validation showed an overall average score of 3.58, which is considered highly valid. In detail, the material aspect received an average score of 3.60, the presentation aspect 3.55, the language aspect 3.62, and the graphics aspect 3.55. These results indicate that the model book has met the eligibility criteria in terms of scientific, pedagogical, and technical aspects as a guide for social studies learning based on geographic literacy. Several notes for improvement from the validators were then followed up with further revisions, particularly regarding the clarity of the learning syntax, the alignment between learning objectives and student activities, and the accuracy of the evaluation instruments in measuring geographic literacy and spatial intelligence.

After being declared feasible by experts, the learning model was tested through a limited trial conducted in a seventh-grade class with 32 students. The limited trial was conducted using pretest and posttest instruments and observation sheets to assess the students' spatial intelligence. The pilot test results showed that the average pretest score of the students was 55.47, while the average posttest score increased to 78.91, with a score difference of 23.44. The N-Gain score of 0.56 indicates that the improvement in learning outcomes is in the moderate category. In addition, the results of spatial intelligence observations showed an overall average score of 3.25 in the good category, which included map reading skills (3.28), directional orientation (3.22), analysis of spatial relationships (3.15), and participation in discussions (3.34). These findings indicate that the geography literacy-based learning model not only improves students' cognitive learning outcomes but also supports the development of spatial intelligence and active student engagement in the learning process. Based on the results of this limited trial, the learning model is deemed feasible and has the potential to be implemented on a larger scale.

4. *Implementation*

The implementation stage was carried out to obtain empirical data on the application of the geography literacy-based learning model in social studies learning at the Padang State University Development Laboratory Junior High School. The implementation was carried out after the model was declared feasible through a process of expert validation and product revision at the development stage. At this stage, the model was directly applied to class VII.A, involving 28 students and one social studies teacher as the learning facilitator in the experimental class. The implementation aimed to test the feasibility of the learning syntax, the role of the teacher as a facilitator, and the responses and involvement of students in geography literacy-based learning.

5.*evaluationt*

The evaluation stage was carried out after the entire implementation process was completed to assess the practicality and final effectiveness of the geography literacy-based learning model in developing students' spatial intelligence. The practicality test was conducted by involving two social studies teachers as respondents using a questionnaire containing 10 statements with a rating scale of 1–4. The analysis results showed that the learning model obtained an average score of 3.55 out of a maximum score of 4.00, with a practicality percentage of 88.75%, which is in the very practical category. Aspects that received high scores included ease of understanding the model syntax, ease of implementing learning steps, relevance to the Merdeka Curriculum, and the usefulness of the model in helping teachers explain geographical concepts and the relationship

between space and the environment. These results indicate that the geography literacy-based learning model is considered easy to use, can be implemented well, and is suitable for social studies learning needs at the junior high school level.

Next, the effectiveness of the model was tested through a questionnaire filled out by social studies teachers after the learning model was implemented. The results of the effectiveness test showed an overall average score of 3.67, which is in the highly effective category. Most aspects of the assessment received an average score of ≥ 3.50, especially in terms of the clarity of the learning syntax, the achievement of learning objectives, the development of students' geographical literacy and spatial intelligence, the improvement of learning outcomes, and the suitability of the model with the Merdeka Curriculum. Other aspects, such as the appropriateness of time allocation, the characteristics of junior high school students, and student activity, received an average score of 3.00, which indicates the effective category, although technical adjustments are still needed in the implementation so that learning can take place more optimally.

Overall, the evaluation results confirm that the geography literacy-based learning model developed is practical and effective, and is recommended for wider implementation with minor improvements based on teacher feedback and field evaluation results.

Discussion

The results of the study indicate that the development of a geography literacy-based learning model through the ADDIE approach is effective in addressing social studies learning issues, particularly in geography content, which has not been optimal in developing students' spatial intelligence. At the analysis stage, learning that is still dominated by conventional approaches and the lack of spatial media utilization has an impact on the low initial spatial intelligence of students, as shown by the pretest results in the low to moderate categories and relatively equal between the control and experimental classes

The design and development stage produced model books and literacy-based geography learning tools that integrate spatial exploration, spatial analysis, and spatial representation activities. The learning syntax developed is in line with the geography literacy framework that emphasizes understanding location, spatial relationships, and human-environment interactions. Expert validation results with an average score of 3.58 (highly valid category) indicate that the model has met substantive, pedagogical, and technical feasibility. Limited trials showed an increase in learning outcomes with an N-Gain of 0.56 (moderate category) and a spatial intelligence observation score of 3.25 (good category), indicating that the model not only improves cognitive achievement but also students' spatial thinking abilities. These findings support the theory of spatial intelligence (Brown et al., 2020) and research results (Maliki et al., 2025) that emphasize the importance of structured spatial activities in geography learning.

During the implementation and evaluation stages, the learning model was assessed as highly practical with a practicality percentage of 88.75% and highly effective with an average effectiveness score of 3.67 (Herawati et al., 2022). Teachers assessed that the model was easy to implement, relevant to the Merdeka Curriculum, and effective in improving students' geographical literacy, spatial intelligence, and learning outcomes. Although technical adjustments are still needed in terms of time allocation and student activity, overall the results of the study confirm that the geography literacy-based learning model is valid, practical, and effective, and should be recommended for wider application in social studies learning at the junior high school level.

Conclusion

Conclusion The geography literacy-based learning model developed through the ADDIE stages was systematically arranged, starting from the analysis of social studies learning needs, the design and development of model books and learning tools, to the implementation and evaluation stages. This model uses geography literacy as the foundation for learning through syntax that guides students to understand spatial concepts, analyze spatial relationships, and relate social studies material to their surroundings. The existence of integrated model books and learning tools makes the model operational and applicable in social studies learning at the junior high school level.

Conclusion The geography literacy-based learning model developed through the ADDIE stages was systematically arranged, starting from the analysis of social studies learning needs, the design and development of model books and learning tools, to the implementation and evaluation stages. This model uses geography literacy as the foundation for learning through syntax that guides students to understand spatial concepts, analyze spatial relationships, and relate social studies material to their surroundings. The existence of integrated model books and learning tools makes the model operational and applicable in social studies learning at the junior high school level.

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Conflict of Interest
This research has no conflicts or interests whatsoever.

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