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The implementation of Geography learning with spatial representation using the discrepancy evaluation model

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ABSTRACT

This study aims to evaluate the learning process of geography with spatial representation in high school using the Discrepancy Evaluation Model (DEM) from Provus. Evaluation goes through five stages: design, installation, process, and product, as well as implementation comparison. Respondents were five teachers and 208 students from SMA 1 Srandakan, MAN 2 Yogyakarta, and SMA 1 Pundong in Yogyakarta. The evaluation was carried out in February-July 2021. The focus of the evaluation includes (1) learning design, (2) learning tools, (3) learning implementation, (4) learning outcomes, geographic critical thinking, and (5) implementing learning comparisons. Data were collected through document studies, observations, tests, and questionnaires. Descriptive analysis was used to measure gaps in each stage and efforts to improve them, while experimental quantitative analysis was used to compare learning. The DEM results describe gap variations in stages 1-4. However, in collaborative improvement efforts at stages 1-3, there is an increase in spatial critical thinking skills. The test results at stage 5, learning geography with spatial representations, are more effective for improving students' spatial critical thinking skills than textbook-oriented learning and media images. Recommendations on the results of the evaluation at all stages for organizing geography learning with spatial representation: (1) strengthening understanding and mentoring of the concept of spatial representation and learning design, (2) monitoring and periodic testing of geography learning with spatial representation to improve critical thinking skills in geography.

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INTRODUCTION

The purpose of education is to help every generation to be ready for tomorrow, so it requires a strong base of knowledge and skills that are adaptive to change (Beneker & van der Schee, 2015). They further conveyed that geography education is a vehicle for knowledge and skills that sees the environment comprehensively through spatial thinking. Besides, Yuniandita and Mukminan (2020) illustrate that the outcome of students' geography skills is highly dependent on the professionalism of teachers and learning components. Mohan et al, (2015) stated that geography is a complex discipline with a focus on the characteristics, relationships, and spatial patterns of human and natural activities. Regarding this, a couple of key perspectives for understanding and studying geography include spatial and ecological perspectives (Heffron, 2012). Supporting the ideas of these experts, the integration of spatial in geography benefits the students to achieve the learning objectives (Jo & Bednarz, 2014).

The ability of spatial thinking provides a geographical perspective on the relationship between the human interaction system and the dynamics of the physical environment and the com-

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munity environment which is seen from the aspect of spatial integration and interdependence of space both between places and between scales that can be realized in real and abstract forms (and or representations) both visually, verbal, mathematical, digital, and in (cognitive) mindset (Madl et al., 2016; Newcombe & Shipley, 2015; Human Resources Development Centre of the Ministry of Education and Culture, 2016). This spatial representation can encourage students to express their ideas or knowledge ideas with flexibility, skill, and habit of thinking to use tools, and provide reasons to solve problems and make decisions they are facing (Fiantika, 2017).

Spatial representation is a curriculum mandate that should be the basis for implementing High School Geography learning (Human Resource Development Centre of the Ministry of Education and Culture, 2016). This representation shows a spatial understanding of the standard intellectual structure that formulates geographic studies from the point of view of the relationship between human and environmental interaction systems in three dimensions, namely the physical (natural) environment, the social environment, and spatial integration and spatial interdependence both between places and between scales. The general conception of geography editorially shows differences, but many similarities are found, among others, in the study of places and the relationships between people and their environments. Geographers explore both the physical properties of Earth's surface and the human societies spread across it. They also examine how human culture interacts with the natural environment and the way that locations and places can have an impact on people.

Dempsey (2021) states that Geography can be broadly categorized into three main focus areas: Physical geography – the study of the natural environment, Human geography – the study of human populations, and environmental geography – the study of how people are affected by and change the natural environment. In accordance with this statement, Haggett (2001) and Bednarz (1994) state that "geography is an integrative discipline that brings together the physical and human dimensions of the world in the study of people, places, and environments", definition this implies that geography seeks to study nature, people in an integrative manner and the interrelationships between people, places, and the environment.

The perspective of spatial representation in geography can be realized in real or abstract forms (and or representations) both visually, verbally, mathematically, digitally, and in (cognitive) mindsets. Experts provide boundaries that intersect with spatial representation in the geography curriculum which is a form of spatial critical thinking perspective in studying geography (Lee & Bednarz, 2012; Jo & Bednarz, 2009; Gersmehl & Gersmehl, 2007; Metoyer & Bednarz, 2017; Golledge et. al, 2008; Goodchild & Janelle, 2010). Bonnet (2008) states that the study shows the existence of an integrated spatial relationship between physical phenomena (environment) and humans (society). The five spatial representations have a constructive conception which is supported by the concept of space, representational tools, and reasoning processes. Pereira et al. (2013) described that spatial representation in geography is a key concept for understanding spatial phenomena and their interactions that influence perceptions of knowledge and technological applications. Learning geography in the curriculum applies some or all the concepts of spatial representation. This representation is designed through learning tools including Learning Implementation Plans, media, learning resources, Student Worksheets, and assessment instruments. The implementation of geography learning containing spatial representation as a curriculum mandate should have been carried out in every school. The output of this geography learning can support students to have competence in three domains according to the Regulation of the Minister of Education and Culture number 20 of 2016 concerning graduate competency standards. Geographic critical thinking as cognitive competence, geographic awareness (affective), and geographic skills (psychomotor/skill). These aspects are abilities shown by students as a profile of learning outcomes.

One of the three domains is spatial critical thinking, according to Costa (2001) concludes that knowledge gained from geography can analyze the differences and uniqueness of each phenomenon. The aspect of critical thinking knowledge because of learning geography containing

spatial representation is based on the results of the assessment of geographic knowledge in the curriculum. There are three aspects of knowledge in Regulation of the Minister of Education and Culture Number 24 of 2016 for geography subjects, namely: (1) The level of understanding, applying, and analyzing factual, conceptual, procedural, and metacognitive knowledge on the object of geography study. (2) Ability to solve problems related to the object of geographic study. (3) Creativity in creating and proposing ideas to improve the condition of the physical environment and social environment as resources.

Lee and Bednarz (2012) stated that geographic ability can be demonstrated by understanding spatial representation as a collection of cognitive abilities consisting of spatial knowledge concepts, the use of representational tools, and reasoning processes. According to Golledge et al (2008), spatial representation is a vehicle that can be in the form of technology or supporting capabilities related to geospatial and its relevance to solving problems in everyday life. Lee and Bednarz (2012) added that the concept of spatial ability is defined as spatial perception, visualization, and orientation which is seen as a narrow concept of spatial thinking. Logan et al. (2010) stated that geospatial abilities can be fostered by the process of interpreting spatial pattern characteristics which require an understanding of spatial representation.

The results of the preliminary study in 2020 proposed that the conception of spatial representation is still a contradiction in terms both conceptually and practically (Nursa'ban et al., 2020). The content of the spatial representation in learning has not been designed measurably, both in the Learning Implementation Plan and in the implementation of learning. The study obtained an illustration that teachers still had difficulty developing geography learning designs with spatial representation content. In fact, in the field, they have included several aspects of spatial representation in learning, but the placement and activities are not yet appropriate in every stage of learning. This shows that the conceptual understanding of the definitions, indicators, and attributes of the spatial representation of teachers as practitioners still requires.

This evaluation study seeks to analyze the degree of conformity or discrepancy between the standard geography curriculum and the actual appearance of activities in each stage of high school geography learning with Spatial Representation, including learning design, learning tools, learning implementation, and learning outcomes related to critical thinking skills and geographic awareness. as well as the accuracy of the implementation of learning in the field. The results of this gap evaluation research, according to Provus (1969) can portray reality with the ideal standards that have been compiled. The results description is then used as material for improving, managing, or even terminating the program at its stages. Said et al. (2019) describe how Provus DEM can evaluate the implementation of national policies such as Minister of Health Regulations which are equivalent to learning policies.

This research can practically provide solutions to any problems or difficulties found in the learning process of geography with spatial representations. By using the theoretical benefits approach of a science according to Suriasumantri (2010), theoretically the study is an explanation of geography learning conditions containing spatial representations in high school geography learning, besides being a controller of geography, which teaches critical thinking skills through spatial abilities. The third benefit, these results can also theoretically predict the development of geography learning with spatial representations in the future.

METHOD

Evaluation Design

This study uses the discrepancy evaluation model (DEM) design (Provus, 1969). The main purpose of the discrepancy evaluation model is to change and improve programs starting from the early stages of planning, installation, and making initial predictions about the success or failure of a program. This evaluation model provides opportunities for improvement at each stage, which also acts as an evaluation tool. Researchers can examine more deeply the constraints, bar-

riers, or gaps that occur at each stage. The focus of the evaluation of this study is regarding two main dimensions, namely the learning process and learning outcomes of geography containing spatial representations which are packaged into five aspects of the evaluation focus, namely: (1) learning design, (2) learning tools, (3) learning implementation, (4) learning outcomes related to abilities. geographical critical thinking, and (5) the accuracy of the implementation of learning in the field.

The three key elements of this evaluation model are standards, performance, and differences that indicate gaps. The process of comparing performance with standards occurs at all stages of evaluation except at stage 5. At this stage, a comparison is made between the geography learning objectives of hospital content and their implementation in the field. To obtain these data, experimental theory testing was carried out. A brief description of the evaluation aspect formulation through DEM implementation in this study is presented in Table 1.

Table 1. Stages of Evaluation Research Using a Discrepancy Evaluation Model in Geography Learning with Spatial Representation

Evaluation Stage	Definition/Concept	Evaluation Aspect	Evaluation Technique
Design	Learning design setup	1. Learning stages 2. Spatial Representation Integration 3. Notes on the role of teachers, students, facilities, models, and classroom climate, as well as student self-regulation	Interview and document study
Installation	Setting the Learning Tool Plan (RPP)	Accommodates: Spatial representation, and Learning design	Interview, observation, and document study
Process	Application/Implementation of Hospital-charged Geography Learning	1. Teacher Performance 2. Learning Tools 3. Learning model 4. Class Climate 5. Student self-regulation	Observation and document study
Product	Critical thinking skills and geographic awareness	Geographic critical thinking	Tests and questionnaires
Comparison	Comparison between the objectives of learning geography in hospitals and their implementation in the field.	Learning objectives (according to lesson plans) Evaluation results (observations)	Document studies and experimental testing

Research Settings

This research was conducted at three schools that represent the middle level of the school based on the input grades of their students in Yogyakarta, namely SMAN 1 Srandakan, MAN 2 Yogyakarta, and SMAN 1 Pundong. The research was carried out from February 1 to July 31, 2021. The subjects or respondents of this study were five teachers and 208 students of class XI social sciences.

Data Collection Techniques and Instruments

Data collection techniques in this study followed the evaluation stages of the discrepancy model, namely: tests, questionnaires, observation sheets, document studies, and interviews. The test is used to see learning outcomes in the form of geographic spatial critical thinking. Questionnaires are used to obtain information related to learning implementation procedures. Observation sheets are used to photograph the implementation of learning, and document studies are used to confirm and clarify aspects of learning tools.

Content and construct validation for research instruments was carried out by experts, namely lecturers with expertise in evaluation and learning geography. The validation instrument

utilizes a five-scale response with categories ranging from 1 (very inappropriate) to 5 (very appropriate). The item validity was determined by a recommendation from the panellist using the Aiken index formula as presented in Formula (1) (Aiken, 1996). A valid category occurred with a score of >0.6.

$$V = \frac{\sum n_i (r - l_0}{N(c-1)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Evidence of validity occurs regarding the criteria of 'goodness of fit, to the value of t>1.96, or the standardized loading factors >0.3 (Igbaria et al., 1997; Hair et al., 2019). The value of the compatibility criteria for the assessment instrument refers to namely: the Root Mean Square Error of Approximation (RMSEA) <0.08, Probability Chi-squares > 0.05, and GFI > 0.90 (Garson, 2016; Hooper et al., 2008; Hair et al., 2019).

Data Analysis Technique

The evaluation criteria in this study relate to two main dimensions, namely the learning process and learning outcomes of geography containing spatial representations which are packaged into five aspects of evaluation focus as presented in Table 2. In general, all criteria are based on the provisions of learning standards in the curriculum related to geographic critical thinking skills through spatial representation. The data analysis technique is descriptive by changing the average score into a qualitative value according to the assessment criteria by Azwar (2015) as presented in Table 3.

Table 2. Evaluation Standard Criteria

No.	Stages	Standard	External
1.	Learning design	Standard Competence Graduate, Standard Content and Process standards	Syllabus
2.	Device learning	Process Standard	Device learning: RPP, teaching materials, LKPD, Instruments evaluation
3.	Implementation learning	standards and Standards Evaluation supported the theory	Learning supported by : 1. Teacher performance is good 2. Adequate Learning Facilities _ 3. The right learning model 4. Climate conducive class _ 5. Regulation self good student _
4.	Study results	Standard Evaluation	Ability students on aspects Think critically about geography
5.	Accuracy implementation	Theory testing in a way experimental	Effectiveness results in learning geography through the representation of spatial

Table 3. Scoring Range and Qualitative Category

Score Range	Category
X > Mi + 1.5 SBi	Excellent
Mi + 0.5 SBi > X Mi + 1.5 SBi	Very Good
Mi – 0.5 SBi >X Mi + 0.5 SBi	Good
Mi – 1.5 SBi > X Mi- 0.5 SBi	Fair
>X≤ Mi – 1.5 SBi	Poor

Source: Azwar (2008)
Notes: X : Average score
Mi : Average ideal = ½ (ideal maximum score + ideal minimum score)
SBi : Standard deviation = 1/6 (ideal maximum score – ideal minimum score)
Ideal maximum score = indicator x highest score
Ideal minimum score = indicator x lowest score

FINDINGS AND DISCUSSION

Implementation of Learning Geography Containing a Spatial Representation

Based on the discrepancy evaluation model design, five stages were used to describe the results of this study. Each stage of the evaluation is presented through a description of the standards that are expected to be shown by the goals (goals) of each stage as performance standards, and in the end, draws justification through the gaps (problems) that occur at each stage. Furthermore, recommendations are given according to the results of the problem diagnosis at each stage.

According to the characteristics of DEM, namely providing recommendations or solutions at each stage, then at the end of each stage after justifying the problem, researchers and respondents, namely teachers and students, collaborate to solve any problems encountered. The operational form of this collaboration is to discuss plans and follow up on the recommendations given. Therefore, at the end of each stage of this evaluation model, an understanding of the ideal conditions can be made for teachers and students in the field.

Geography Learning Design with Spatial Representation

The conception of geography learning that contains spatial representation in this study is a geography learning process by applying some or all of the concepts of spatial representation based on the 2013 geography curriculum which includes visual, verbal, digital, mathematical, and cognitive representations of learning devices. Spatial representation in geography learning in the 2013 curriculum has 15 factors which are divided into five dimensions (Nursa'ban et al., 2020) as shown in Table 4.

Table 4. Dimensions and Factors of Spatial Representation in Geography Learning

No.	Spatial Representation Variables	Indicators/Factors
1.	Visual Representation	1. Displaying material objects through maps/graphs/diagrams/images/globes/photos 2. Explaining material details through rock comparator/nature box/earth layering/miniature/embossed map/props/mockup 3. Presenting visual media as an object of observation
2.	Verbal Representation	4. Define earth phenomena/phenomena/concepts with standard terms in geography/spatial features: volcanism processes, demography, GIS geosphere, etc. 5. Presenting narrative examples of symptoms/phenomena through geographic concepts (location, distance, affordability, morphology, agglomeration, usability values, patterns, etc.) 6. Use of verbal symbols (intonation, gesture) to describe geographic phenomena/phenomena
3.	Mathematical Representation	7. Converting geographic phenomena into numeric symbols 8. Explaining geography material using number data 9. Geographical phenomena/phenomena are symbolized by spatial structures 10. Analyzing geographic phenomena/phenomena through diagrams/graphs 11. Presenting spatial information through the conception of area, height, slope, etc.
4.	Digital Representation	12. Use of digital media in analyzing geographical phenomena (calculating population data, delineation of areas on maps, use of measuring instruments, etc.) 13. Utilization of applications for geographic phenomenon analysis 14. GIS technology helps obtain new spatial information
5.	Cognitive Representation	15. Deciphering information through *spatial critical thinking*

Source: Nursa'ban et al. (2020, p.29)

The learning outcomes of geography containing spatial representations are focused on spatial critical thinking skills that place the knowledge obtained from geography, namely being able to analyze the differences and uniqueness of each phenomenon (Costa, 2001; Hopkin, 2011; Gardner et al., 2018). The aspect of critical thinking knowledge as a result of learning geography containing spatial representation is based on the results of the assessment of geographic knowledge in the 2013 curriculum listed in the Regulation of the Minister of Education and Culture Number 24 of 2016. An overview of geographical critical thinking skills is presented in Table 5.

Table 5. Dimensions and Factors of Geographical Critical Thinking because of Learning Geography

No.	Variables	Indicators
1.	The level of critical thinking in understanding the geographical concepts and perspectives of spatial thinking	1. understanding the concepts of geography practically in the everyday life 2. showing the absolute location of a geographical object easily 3. determining the distance between locations of each geographical object 4. using a geographical approach to explain the characteristics of locations 5. identifying the similarities or differences between a certain location and others 6. Understanding the theoretical mitigation efforts for natural disasters. 7. designing a concept map of geographical material studied 8. describing inter-regional interactions based on their advantages and disadvantages 9. understanding a geographical material using maps, charts, diagrams, or other relevant media 10. explaining the influence of a region on others 11. understanding the concept of a "region"
2.	The ability to use the geographic concepts and perspectives of spatial thinking	12. identifying the physical or social characteristics of a region
3.	The creativity to make and propose ideas to describe the geographical conditions of the environment.	13. describing the geographical patterns in an area based on the characteristics of the condition 14. describing the relationship between the height of a place and the population density 15. understanding the scientific approach through an inquiry process to understand geographical problems

Sources : Nursa'ban et al. (2020)

This spatial representation-laden learning is a geography learning process by applying some or all of the concepts of spatial representation. The representation is integrated into the content of the learning implementation plan, especially learning teaching materials.

At this design stage, the evaluation studies carried out are related to (1) understanding and accuracy of the stages of systematic learning, and (2) integration of indicator content from each aspect of spatial representation with material content and learning activities. The focus of this evaluation is the goal and standard in seeing the achievement of the design stage.

Understanding and Accuracy of The Stages of Systematic Learning

Through the Focus Group Discussion (FGD) process, evaluating the understanding and accuracy of the stages of systematic learning containing spatial representations, it was obtained that more than half of the teachers still had difficulty understanding the concept of spatial representation in the curriculum. Furthermore, the teachers have not been able to know the procedures for the systematic stages of learning geography containing spatial representations. The teachers are more focused on analyzing the knowledge competency material in the curriculum. Meanwhile, the learning process follows the general learning systematics such as opening, core, and closing activities, however, neglects the aspect of spatial representation.

Following up on these findings, researchers and teachers discussed with each other to analyze the concepts and procedures of spatial representation as requested in the curriculum, sup-

ported by relevant theories. Factors and dimensions of spatial representation of geography learning in the 2013 curriculum have 15 factors divided into five dimensions (Nursa'ban et al., 2020) to be discussed. The results of the discussion obtained an overview of the increase in teacher understanding related to spatial representation concepts and procedures. A brief description of the understanding and systematics of the teachers' spatial representation is presented in Figure 1.

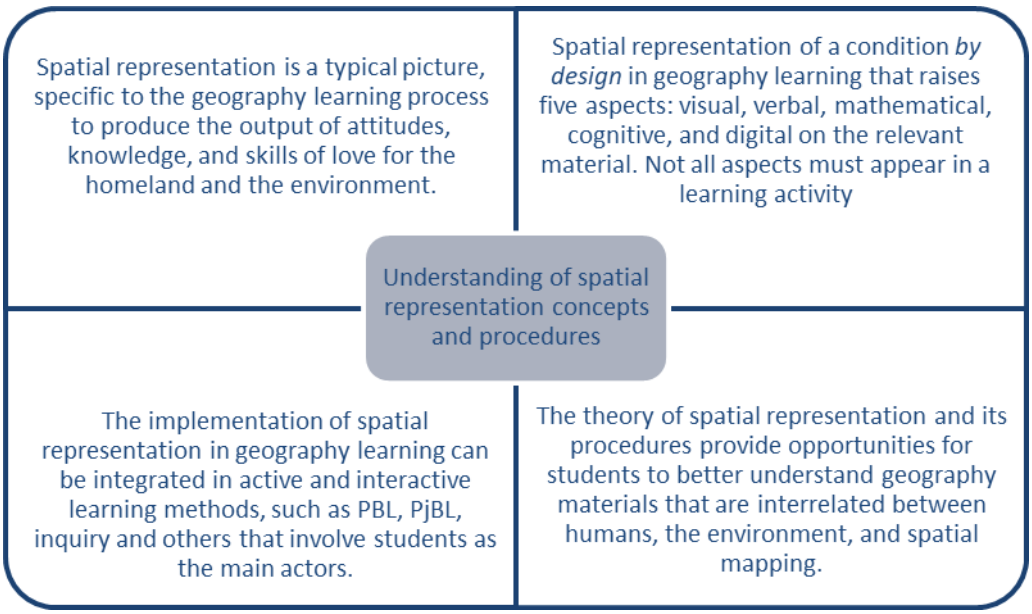


Figure 1. Justification of Teachers' Understanding of Spatial Representation Concepts and Procedures

Integration of Spatial Representation Factors with Learning Materials

The ideal condition as a standard in this activity is that teachers can theoretically integrate spatial representation factors as a learning base with the material content of each planned knowledge base competency (Nursa'ban & Abe, 2019). Integrating spatial representation content with learning materials in the Lesson Plan is a major problem encountered in the field. The previous teachers did not understand how to integrate it.

Table 6. Description of Disaster Mitigation Material with Spatial Representation

No.	Aspects of Spatial Representation	Activity Material Content Spatial Representation	Output
1.	Visual	Identify pictures of natural and non-natural disasters	Students can describe and categorize the types of disasters
2.	Verbal	Identify the characteristics of natural disasters	Students can identify the characteristics of each natural disaster and explain the terms within the scope of the disaster
3.	Mathematical	Describe the formula for disaster risk Risk = $\frac{Hazard\ x\ Kerentanan}{Kapasitas}$ R = $\frac{H\ x\ V}{C}$	Students can explain the relationship between indicators in knowing disaster risk in an area
4.	Digital	Finding the location of a disaster through the *google earth application*	Students can show the location of a disaster through the *Google Earth application*
5.	Cognitive	Analyzing news about a recent natural disaster in an area	Students can provide analysis based on the latest information about natural disasters

At this stage, the researchers and teachers conducted discussions and workshops on mapping the content of spatial representations using matrices. Spatial representation factors use the results of the development of Nursa'ban et al. (2020). The results of the discussion have implications for the teacher's understanding of designing learning, especially in including indicators of spatial representation with the theme of the material being taught. An overview of the results of mapping the spatial representation of one of the learning materials, namely Disaster Mitigation, is presented in Table 6.

Table 6 presents an illustration of how teachers have been able to place each spatial representation activity in the material according to the characteristics of its aspect. The conception of active student learning is emphasized in learning so that the evaluation results illustrate that the device has placed students as subjects in learning changes. The teachers asked to be given direction regarding the development of integration between the content of spatial representation and geography material. The findings of the researchers related to the difficulties in this development as a recommendation as a result of the evaluation justification in the form of fulfilling the teacher's request in designing and planning learning tools. Collaboratively, researchers and teachers identify supporting tools for learning such as lesson plans, media, teaching materials, assessment instruments, and Student Worksheets. Identify each learning device so that it contains indicators of spatial representation based on curriculum requests.

Geography Learning Installation with Spatial Representation

This stage evaluates the object of determining the Learning Device Plan as a standard/goal. Does the lesson plan that has been made accommodate the spatial representation of the content and is designed through the right learning systematics, including activities: introduction, core, and closing? This activity was done through a process of interview, observation, and document study.

The justification for the evaluation of this stage is to produce information that the installation or preparation of the lesson plans that have previously been carried out by the teachers have not described the learning process containing spatial representations. At this stage, it is recommended to conduct FGDs and workshops on the preparation of lesson plans containing spatial representations. Following up on the problems encountered, a workshop on the preparation of Learning Implementation Plan containing spatial representation was carried out.

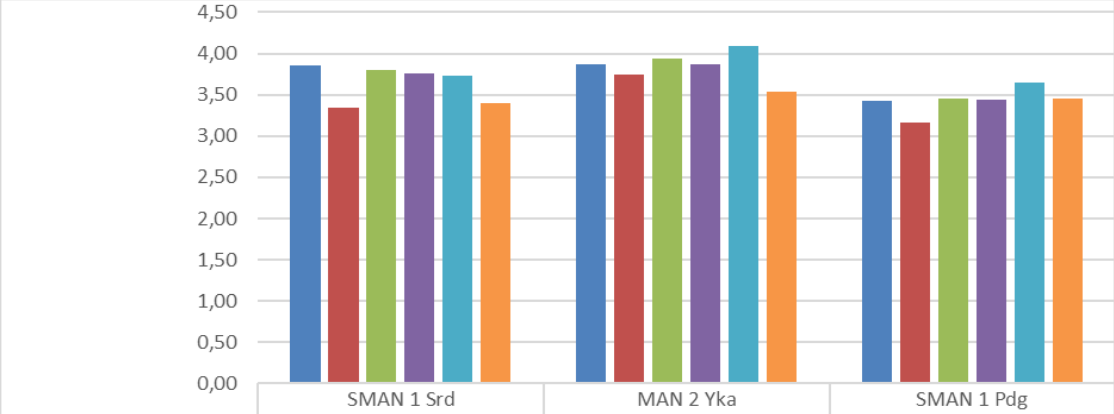
Table 7. Summary of Preparation (Installation) Containing Lesson Plan Material for Disaster Mitigation Using the Inquiry Method

No.	RPP Components	Description
1.	Identity	Presenting information on learning settings (School, subject name, class/semester, subject matter, time allocation.
2.	Learning Competencies and Learning Indicators	Mapping the content of spatial representation with basic competencies and learning indicators. Each spatial representation activity is based on the developed learning indicators.
3.	Learning objectives	Describing the results and activities carried out during learning based on a review of the ABCD concept (audience, behavior, condition, and degree). This goal can be presented in the form of a narrative or numbering.
4.	Learning tools, media, resources, and models	Presenting the need for tools, media, resources, and learning models. The learning model was agreed to use inquiry learning.
5.	Learning steps	Presenting a systematic description of learning in each stage of inquiry learning. Each of these stages describes the activities of teachers and students as learning subjects. This section also presents the content of the relevant spatial representation according to the activities and materials taken at each stage of the inquiry. This inquiry learning stage is repeated at every planned meeting.
6.	Assessment of learning outcomes	Presenting instrument information and assessment substance in each area to be measured (attitudes, knowledge, and skills). The connection with this research is knowing the learning outcomes in the form of geographical critical thinking skills, so a test instrument is prepared based on the dimension indicators and critical thinking factors from Nursa'ban et al. (2020).

The initial step of the workshop is to provide an understanding of the concept of spatial representation and the components of lesson plans as integration material. The researcher and the teacher designed the lesson by developing a Learning Implementation Plan document using the basic competencies of disaster mitigation studies in class XI. The indicators developed are: (1) analyzing the types and characteristics of disasters, (2) explaining the disaster management cycle, and (3) the distribution of areas prone to natural disasters in Indonesia. Furthermore, the preparation of the learning device design was carried out starting with describing the learning material. The description of Class XI Disaster Mitigation materials containing spatial representations is presented in Table 6. After mapping the material, then a learning design containing spatial representation is developed through the Learning Implementation Plan document as an activity at the design stage and the development of other tools. The installation of the learning device plan is briefly presented in Table 7.

The Process of Implementation of Learning Geography with Spatial Representation

This stage refers to the evaluation of the learning process involving spatial representations through justifying the implementation of the pre-prepared learning plans. The object of evaluation includes teacher performance, support for learning facilities including media, method accuracy, classroom atmosphere, and student self-regulation in learning. The description of the evaluation results based on the peer teacher and student questionnaires as well observation results are in Figure 2.



	SMAN 1 Srd	MAN 2 Yka	SMAN 1 Pdg
Teacher Performance	3,85	3,87	3,43
Learning Tools	3,35	3,74	3,17
Learning materials	3,81	3,94	3,46
Learning methods	3,76	3,86	3,44
Class climate	3,73	4,10	3,65
Self Regulation	3,40	3,53	3,45

Figure 2. Graph of Test Assessment Results Try the Geography Learning Process Containing a Spatial Representation

Figure 2 shows the average results of the assessments of peer teachers, students, and researchers through observations of the geography learning process containing spatial representation in the three pilot schools. Aspects of teacher performance obtained an average assessment result in the range of 3.43 – 3.87. This figure illustrates that the teacher's performance in learning Geography is in the "good" category. This category is estimated because the geography teachers in the three schools can understand the operational planning of the lessons that have been made. On the other hand, it is estimated that these teachers are active in following the development of Geography learning through curriculum training. However, it was noted that some of the school's students stated that teachers rarely used maps in learning. Teachers tend to give only concepts and not optimally provide case examples in the material presented.

The average assessment of geography learning facilities containing spatial representations as a whole is in the "good" category. The results of the assessment in the two pilot schools were in the "enough" category. The assessors said that learning had not utilized maps, diagrams, graphs, globes, or aerial photographs to analyze the material being studied. The tools and materials for Geographic Information Systems (GIS) and remote sensing at the two schools are not yet owned. Meanwhile, MAN Yogyakarta has equipment and materials for GIS and remote sensing interpretation. Teachers and students said that the learning tools were used for some relevant geography materials.

The aspect of material load leads to critical thinking skills assessed in three test schools try in the "good" category. This shows that the geography materials delivered in each of these schools contained elements of critical thinking well. The trial respondents assessed that the three schools had carried out learning that showed the inquiry stage as a method that was used well.

The classroom climate felt by students and teachers during the learning process was in the "good and very good" category. However, it was noted that at the time of learning there was sometimes an unpleasant atmosphere. Rules during learning are sometimes broken by students together. Student respondents in all schools rated their self-regulation during learning in the "good" category. Students follow the lesson well and focus on the ongoing process of meeting the needs for geographic knowledge.

Geography Learning Product with Spatial Representation

Following the research objectives, the focus of the evaluation at this stage is to see the test results of the geography learning design containing spatial representation, namely the aspect of spatial critical thinking skills. This ability is directly related to the level of students' understanding of the substance of the material given. This understanding is measured through a test using 15 indicators of critical thinking skills from Nursa'ban et al. (2020). The average acquisition of students' critical thinking skills is presented in Figure 3.

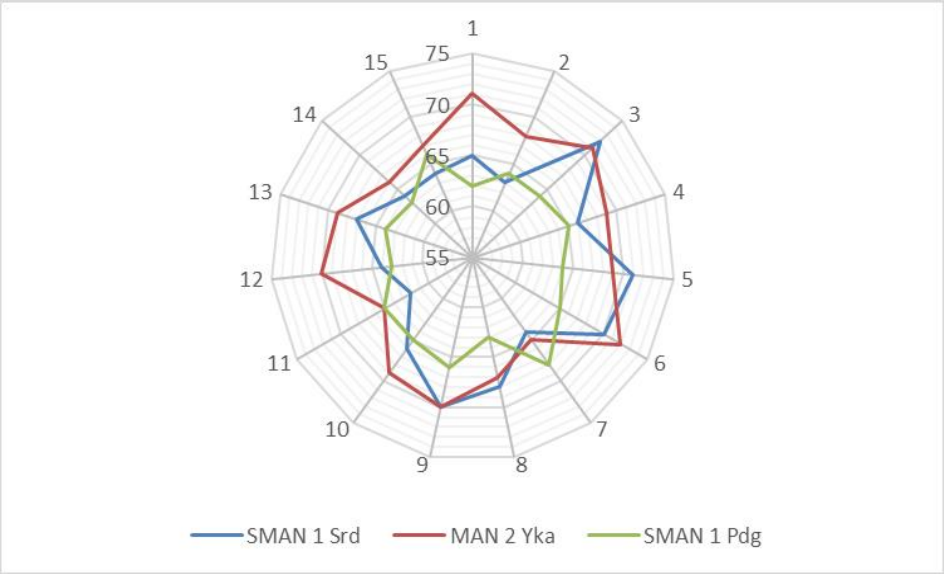


Figure 3. The Average Result of the Test of Understanding Students' Critical Thinking Skills After Studying Geography for Disaster Mitigation Materials

Figure 3 presents data on the average level of student ability on each indicator of critical thinking through geography learning with spatial representation as a whole in the three pilot schools. In general, it is described that students' critical thinking skills are in the range of 64.46 to 68.53. The ability of students at MAN 2 Yogyakarta seems to dominate the other two pilot schools. The results of the observations of researchers in the field as presented in the data in

Figure 3 that the school has advantages in teacher performance, more complete learning facilities, and a more competitive and conducive classroom climate. This is assumed because this school is located in the center of Yogyakarta city which is close to public facilities and policy centers.

When viewed from the average of one-hundredth of each dimension of the concept, sequentially obtained an average of 66.78 for the level of critical thinking in understanding the geographical concepts and perspectives of spatial thinking on disaster mitigation materials. The ability to use the geography concepts and perspectives of spatial thinking obtained an average of 65.67, while the average for the creativity to make and propose ideas to describe the geographical conditions of the environment is 65.55.

The description of these results shows that the student's critical thinking skills in the knowledge of geography in all pilot schools are in the "good" category. The results of the assessment indicate that the level of critical thinking in understanding, applying, and analyzing factual, conceptual, procedural, and metacognitive knowledge on the object of geographic study is good. In addition, students have good abilities in overcoming problems related to the object of geography study. Students are creative in creating and proposing ideas to update the condition of the physical environment and social environment as resources.

Comparison of Learning Geography with Spatial Representation

The study of this stage is conducting experiments to see the effect of learning geography with spatial representation on critical thinking skills. Causality analysis was used to see changes in the effect on the experimental class, namely the students of class XI IPS 1 SMAN 1 Srandakan, and the control class, namely students of class XI IPS 3 in SMAN 1 Lendah. After experimenting, the students' learning outcomes can be compared between the experimental class that applies spatial representation learning and the control class that applies textbook-oriented learning.

The effect of increasing students' spatial critical thinking skills is obtained through the gain score analysis of the difference between the results of the Posttest and Pretest. The results of calculations using the gain formula in the pretest and postest of experimental class are presented in Table 8.

Table 8. Descriptive Statistics

Paired Sample Statistics					
		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pairs 1	*PRE-TEST*	66.33	30	12.521	2.286
	POS-TEST	84.17	30	10.007	1.827

Based on the output in Table 8, it is known that the average value of the pre-test is 66.33 and the average value of the post-test is 84.17. The difference between the two is 17.84. This shows that there is an increase in spatial critical thinking skills as a result of student learning in geography learning disaster mitigation materials containing spatial representation.

Table 9. Test Results for Improving Learning Outcomes

Paired Samples Test									
		Paired Differences							
		Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**		**t**	**df**	**Sig. (2-tailed)**
					Lower	**Upper**			
Pairs 1	*PRE-TEST - POST-TEST*	-17.833	10.882	1.987	-21.897	-13.770	-8.976	29	.000

Based on the output of the test results for increasing learning outcomes in the experimental class in Table 9, the Sig value was obtained. (2-tailed) 0.000 < 0.05), then H 0 is rejected. This means that it can be concluded that there is an increase in the spatial critical thinking ability of the experimental class from the pre-test to the post-test. The effect of learning geography with spatial representation is to improve students' spatial critical thinking skills compared to using textbook-oriented learning and picture media.

The focus of the study at each stage of this evaluation was to obtain an overview of the difficulties or weaknesses and the solutions provided during the development of a comprehensive geography lesson containing spatial representation at the pilot school. The results of the comparison of difficulties and solutions as a feature of the discrepancy evaluation model research can be a reference in the development of geography learning with spatial representation in other schools, especially with similar characteristics.

Identification of difficulties in developing learning geography with spatial representation is carried out at each stage of the activity of the Discrepancy Evaluation Model (DEM). Each of these stages has described a process from beginning to implementation so that it can be a coherent guideline. The difficult data in this study was carried out through a focus group discussion (FGD) on a panel basis between the researcher and the subject of the geography teacher. Notes on the substance of the FGD results are presented in Table 9 describes the difficulties of developing geography learning with Spatial Representation (RS) based on the stages of the DEM component described in the five stages. Efforts to solve problems at each stage are concluded based on the findings as shown in Table 10.

Table 10. Synthesis of Difficulties in Developing Geography Learning with Spatial Representation Based on DEM Stages

Difficulty Aspect				
Design	***Installation***	***Process***	***Product***	***Comparison***
Preparation of the design of the geography learning device containing the RS	- Don't understand the RS indicator - Integration of RS indicators and materials	- Indicators of achievement of learning design - Learning achievement instrument containing RS	- Achievement measure of hospital-loaded geography learning on geographic critical thinking	- Identify differences, especially the advantages and disadvantages of hospital-charged geography learning on critical thinking skills
Efforts to solve problems				
- Identify supporting tools for learning such as (Lesson Plan /RPP, media, teaching materials, assessment instruments, and LKPD - Each learning device contains hospital indicators based on the 2013 curriculum including Visual verbal, mathematical, digital, and cognitive	- Provide an overview of the concept of the hospital in the 2013 curriculum for geography subjects - includes the integration of hospitals into learning activities and materials	- the learning process is observed through a checklist of the achievement of hospital implementation in the activities and learning materials provided	- critical thinking skills are obtained through the RS. charged material test - prepared RS. charged material test	- an experiment to see the effect of hospital-loaded geography learning on critical thinking skills

Source: Online panel method guided discussion

CONCLUSION

The Discrepancy Evaluation Model results describe gap variations in stages 1-4. However, in collaborative improvement efforts at stages 1-3, there is an increase in spatial critical thinking skills. The test results at stage 5, learning geography with spatial representations is more effective for improving students' spatial critical thinking skills than using textbook-oriented learning and media images. Recommendations on the results of the evaluation at all stages for organizing geography learning with spatial representation: (1) strengthening understanding and mentoring of the concept of spatial representation and learning design, (2) monitoring and periodic testing of geography learning with spatial representation to improve critical thinking skills in geography.

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