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Geographical Inquiry: Learning Model to Empower Students' Spatial Citizenship in Higher Education

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ABSTRACT

This research was initiated by the lack of spatial citizenship in geography learning from secondary to tertiary levels, even though this is crucial for becoming citizens with a spatial perspective. This study aims to develop an effective geography learning model to improve students' spatial citizenship. This study used the design-based research methods, which has four stages: analysis of practical problems, design development, implementation, evaluation, and reflection. The research subjects were 250 students of Geography Education at Sebelas Maret University for needs analysis and 27 for product effectiveness testing. Data collection techniques were classroom observation, in-depth interviews, tests, expert judgment, and focus group discussions, testing the effectiveness using a one-group pretest-post test design. The data analysis technique at the practical problem analysis stage was a constant comparative method. The geographical inquiry model is efficacious in improving students' spatial citizenship skills. Calculation of the paired sample t-test shows the value of Sig. (2-tailed) <0.05, so there are differences in learning outcomes using the geographical inquiry model in improving spatial citizenship skills. This geographic inquiry model effectively provides essential steps in conducting geographic inquiries to solve problems using geospatial data sources. This study concludes that if geographical inquiry is applied appropriately and comprehensively in geography education at the university level, it will provide students with the skills to become good citizens from a spatial perspective. For further research, it is hoped that applying the geographical inquiry model with a deep learning approach to geography learning can be studied.

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1. Introduction

The development of students' spatial insight and knowledge is needed to be able to think innovatively, respond to the dynamics of change, and create alternative solutions to various social problems that occur in society. Previous research by Sinton (2017) explained that critical thinking in geographical studies should be combined with spatial concepts. Spatial citizenship is essential to mastering geography in higher education. Spatial citizenship is a means of optimizing the use of geographic information in everyday life. Students can understand this geographic information, provided that they can read maps. One study stated that the capability to read maps in Indonesia, which is a part of spatial citizenship, is still not optimally mastered. This statement was proven by the delivery of learning using map-reading skills that are not yet applicable and have not been used on the right platform (Segara et al., 2018).

The gap is that many students in the Geography Education Study Program still do not maximize spatial perspectives in solving problems that arise in society. The limitation of this research is that it can only be applied to geography learning; it cannot be generalized to other learning areas. This study was conducted to provide students with skills to become good citizens from a spatial perspective in everyday life. Spatial citizenship appears as a reaction to the need to partner with the community, which needs to be introduced to the students. Moreover, as one of the 35 disaster-prone countries worldwide, Indonesia requires high social sensitivity from all citizens. One of the efforts to learn geography in Indonesia is to improve spatial citizenship, making students good citizens from a geographic perspective. Relationships between people aware of their identity as social beings must be introduced to the competence of geography learning in Indonesia. Social sensitivity and interdependence between communities in this social space are essential for teaching geography. These insights relate to social, political, cultural, and economic issues. Spatial thinking in geography learning is indirectly applied to various daily activities (Duarte et al., 2022). In diverse cultures, spatial citizenship skills must be developed to improve community participation. Previous research by Schulze et al. (2015) explained that students can achieve this by improving their communication skills through maps because spatial communication through map symbols is integral to spatial citizenship.

Instruction in higher education must be well-designed, and the challenges of 21st-century learning technology advancement must be considered by implementing hybrid learning in the lecture process. The problems in education are very complex and cannot be solved effectively using the old paradigm. Instruction in this digital age requires a new paradigm to develop the power of thinking, compile concepts, and create intelligent actions to solve problems. Geographic education in the 21st century will require students to think critically to prepare themselves for dynamic changes in the world in the future (Silviariza et al., 2020). Scientific thinking carried out by these students is challenging. Seriousness is also required to pay attention to student factors, educator factors, time, assessment forms, learning environments, and various learning resources (Handayani et al., 2024). Scientific thinking skills in geography learning are needed to solve problems from a spatial perspective and can be applied to online and face-to-face learning. Hybrid learning is a compelling message-delivery model because it is flexible, synchronous, and asynchronous.

Efforts to improve spatial citizenship are more effective in flexible geography learning. Hybrid or blended learning applications prioritize flexibility and interaction (Putra et al., 2021). Spatial thinking is a key asset in geography education (Tomaszewski et al., 2020; von Reumont and Budke, 2021). Technology and information in the 21st century have developed at a breakneck pace, thus requiring students to actively participate in improving their communication and collaboration skills. Information and communication technology progress is currently perceived as a hallmark of 21st-century learning, significantly influencing people's lives in various fields. In geography education, a new paradigm is needed to solve increasingly complex learning problems by creating innovative geography learning models to meet the demands of the times. This new paradigm combines geographical inquiry with hybrid learning. Teaching critical spatial thinking in higher education empowers graduates to engage with spatial data effectively (Bearman et al., 2016). Constructivist theory is essential to problem-based learning because the scope of the study is broad and philosophical (Wahelo et al., 2025). Constructivist theory is beneficial for understanding learning problems and contributes significantly to updating daily learning practices. As a form of constructivist theory application, community-based learning is a pedagogical technique designed to bring students out of the classroom and into their communities (Rock, 2022).

Innovation in the geography learning model in the 21st century has an important aspect that needs to be a top priority: how an educator develops students' spatial citizenship skills as the primary learning goal. In essence, every person can use logical thinking, because it is the nature of a human being. Thinking ability has different characteristics from that of humans, from simple memories to more complex stages that require deep reflection (Krause et al., 2021). Geography Education students, a younger generation of future change agents, must have spatial citizenship skills, emphasizing a spatial point of view to form superior human resources, social sensitivity, and quality to overcome societal problems. Spatial citizenship in the study of geography is the ability of a person's social participation to be a responsible citizen using a spatial perspective that can influence one's perception, action, and development of ideas in learning (Euikyung E. Shin, 2019). 21st-century learning skills, such as critical thinking, creativity, communication, and collaboration, are highly relevant for developing spatial skills in geography education. Spatial skills—the ability to understand, analyze, and interpret locations, patterns, and spatial relationships between geospheric phenomena and are at the core of geography as a discipline. In the context of geography education, critical thinking is essential for evaluating spatial data, such as maps, satellite imagery, and digital geographic information. Creativity plays a role in visualizing spatial solutions to real-world problems such as urban planning, disaster mitigation, or climate change. Communication and collaboration skills enable students to work in teams, present spatial analysis results, and use information and communication technology to communicate geographical findings effectively. Integrating 21st-century skills in developing spatial abilities promotes more contextual, interactive, and meaningful geographical learning. This enhances understanding of spatial concepts and equips students with the competencies needed to address global challenges and make data-driven decisions in the future (Prihadi, Singgih., Sajidan., Siswandari., Sugiyanto., 2023)

Regarding spatial citizenship ability, the results of research in Europe explain the need to develop a learning process based on spatial citizenship for students in higher education. The spatial citizenship learning development program at the higher education level is equipped with counseling, observation, reflection, and evaluation services. The learning process based on spatial citizenship has been continuously (Schulze et al., 2015). Spatial citizenship must be considered and improved because this ability supports students in developing skills, practices, and perspectives by utilizing geospatial technology and spatial thinking (Euikyung E. Shin, 2019).

Mastery of spatial citizenship skills is required, given the importance of global interaction and communication between citizens and communities in overcoming problems in everyday life (Kenyon, 2019). As part of society, students must be able to participate in solving national and global issues through geography

education and research. The globalization age is not the right time for students to study only for high grades and graduate with a bachelor's degree. Along with developing a highly dynamic age with various problems, students must be able to think innovatively from a geographical point of view to overcome societal problems by optimizing geospatial information technology.

Geospatial information technology is not sufficient for students in geography education programs to master geographical knowledge. They must also master geographical attitudes and skills, based on their geographical and scientific thinking skills. A study focusing on media use in geography learning explained how to practice geography learning using geospatial information technology. To implement this learning, it is necessary to have geography learning training utilizing geospatial information technology and the technical development of geography learning technology for educators. In the current development of geography learning, geography education research on geospatial information technology is still inadequate; therefore, its contribution to improving the quality of learning has not been optimized (Langran and Baker, 2016).

The mastery of spatial citizenship is perceived to be very important for students, so spatial thinking skills are needed to design and choose questions that integrate spatial thinking aspects and increase the level of question complexity related to spatial concepts. Students are expected to search for, understand, assess, and manage geographic information critically and creatively, thus delivering practical knowledge for personal life and the interests of society (Kim and Bednarz, 2013). Geography Education students are responsible for solving the problems occurring in the community, given the varying conditions of Indonesia's geographical area. The settlement process is complex; thus, it began with a quality geography learning process by prioritizing spatial citizenship skills.

Geography learning in universities is strategic in providing innovations for encouraging geography education students as prospective teachers to transmit spatial citizenship skills from a spatial perspective to their students. Students must be pioneers in maintaining their physical and social environment. Higher-order thinking skills, including critical and creative thinking, are essential for students to meet future market demands when working (Lee, 2020). Based on this statement, when applied to learning geography, scientific thinking skills from a spatial perspective will support spatial citizenship skills and help students face globalization's challenges, so they are not left behind in other countries at the international level. Geographic learning should emphasize students learning to participate in a living space, including formulating, negotiating, and communicating activities. Previous research by Prihadi, Singgih., Sajidan., Siswandari., Sugiyanto (2023) explained that geography learning, oriented towards increasing spatial citizenship, will give students the ability to build community in a participatory and interactive way; have a broad view of the diversity of ideas, values, and behaviors; build negotiations related to space utilization and community empowerment; and use geospatial information technology to solve problems in society. Research conducted by Krause et al.(2022) stated that geography learning will be of high quality if assignments are designed that use higher-order thinking skills.

Previous research conducted by (Wijayanto et al., 2023) stated that high-quality geography learning is supported by e-module technology and the application of problem-based learning based on higher-order thinking skills. A weakness of this study is that it does not address spatial thinking or spatial citizenship. Furthermore, von Reumont and Budke (2021) stated that spatial thinking is a skill that must be considered in geography learning, and it would be interesting if it were used by students through comics. This study focused on spatial thinking but still has the weakness of not addressing spatial citizenship. Research conducted by Putra et al.(2021) found that geography learning must produce an understanding of spatial thinking through project-based learning and the STEM approach. Previous studies have shown that spatial thinking skills play a central role in helping students develop higher-order thinking skills, particularly in the context of spatial problem-solving in geography, mathematics, and education. Spatial thinking involves the ability to understand, interpret, and manipulate spatial representations such as maps, diagrams, satellite images, and geometric shapes, which form the foundation for analytical, evaluative, and creative thinking processes. Spatial thinking is an essential foundation for the development of higher-order thinking skills in higher education. Previous research suggests the need for a more systematic integration between strengthening spatial abilities and learning strategies oriented towards spatial problem-solving to prepare students to face complex challenges in the global and data-driven era.

Based on the research question related to how students' initial abilities are in mastering spatial citizenship, a preliminary study was conducted in the Geography Education Study Program at Sebelas Maret University, regarding students' spatial citizenship. It was found that 1) the ability to read maps, orientation, and navigation to describe an opinion in 19.51% of students got a low score; 2) the ability to ask simple questions in developing hypotheses from spatial representations in 54.88% of students got a low score; 3) the ability to select data and present it in the form of visualization in 37.80% of students got a low score; 4) the ability to produce their data and ideas from an event/phenomenon in 48.78% of students had a low score; and 5) the

ability to use social networks/ the internet to access data or present data results in 13.41% having a low score. The spatial citizenship abilities of Geography Education students have not been optimized because the average value of their spatial citizenship skills remains low, thus requiring an alternative solution for implementing the learning model. Through these empirical considerations, it is necessary to develop a geographical inquiry model with geographic characteristics to improve students' spatial citizenship skills. The geographic inquiry model developed is novel. The novelty of this study is that the geography-learning model focuses only on achieving spatial abilities. In contrast, the geographical inquiry model focuses on responsibility and social skills, so that students can become good citizens from a spatial perspective.

2. Method

This study is based on a pragmatic paradigm that emphasizes the practical usefulness of research results in the educational context. This paradigm allows the use of mixed methods (quantitative and qualitative) to holistically address various aspects of spatial-based learning model development, from field requirements to the effectiveness of the model in improving students' spatial skills and higher-order thinking. This section explains how the research was conducted, the research design, data collection techniques, and instrument development. It provides sufficient details of the methods, including ethical conduct and data analysis techniques. The method used in this research was a development research methodology using Design-based Research (DBR) design. The objective of this study was to develop a geographical inquiry model. Data were collected qualitatively and quantitatively; therefore, Design-Based Research became an intermediary for educational theory and its forms of application (Purwanto et al., 2024). Design-based Research was conducted collaboratively between researchers and practitioners or model teachers in systematic repetition, according to design and evaluation, to solve problems in the field of education. Design-based Research focuses on practical innovations in learning (Ford, C., McNally, D. and Ford, 2017). The innovation was the development of a learning model to improve students' spatial citizenship. Spatial citizenship has five indicators: reading maps, asking simple questions to develop hypotheses, selecting and visualizing data, producing data and ideas, and using social networks (Solari et al., 2015). Spatial citizenship was used as an essential variable to improve because current students are less aware that geography, maps, and spatial analysis are significant in overcoming societal problems (Euikyung E. Shin, 2019). A unique strategy through geoformation and geomedia is needed to achieve spatial citizenship. Spatial citizenship is part of a geographic study that interprets space and communicates students' views. Spatial citizenship considers the importance of spatial concepts, the constructive understanding of spatial representation, and geographic media (Shin and Bednarz, 2019).

This research considered some aspects, namely the issue of low spatial citizenship skills of students in the Geography Education Study Program, Sebelas Maret University, implementation of the learning models carried out by lecturers that have not been optimized in equipping spatial citizenship skills, lecturers as practitioners in this study who have an essential role in collaborating with researchers in solving research problems, the use of a learning model that is process-oriented and perceived beneficial by students in the classroom and community, and the development of learning models carried out in several stages to produce learning models that can overcome the problems that improve students' abilities and student spatial citizenship. This is because design-based research collaborates theory, design, and practice to produce innovative products (Prihadi, Singgih., Sajidan., Siswandari., Sugiyanto., 2021).

The procedure used in this study had four stages: 1) analyzing practical problems, 2) developing alternative solutions based on design principles and innovative technology, 3) conducting tests and improving the formulated solution, and 4) reflection based on design principles and product development model determination. In stages 2 and 3 of the DBR approach (Prihadi, Singgih., Sajidan., Siswandari., Sugiyanto., 2021). The researcher made modifications by combining the two stages.

After adopting the two models, the research procedure was conducted in several stages: 1) analysis of practical problems, 2) development, design, and implementation, 3) evaluation, and 4) reflection based on design principles and product development model determination, as shown in Figure 1.

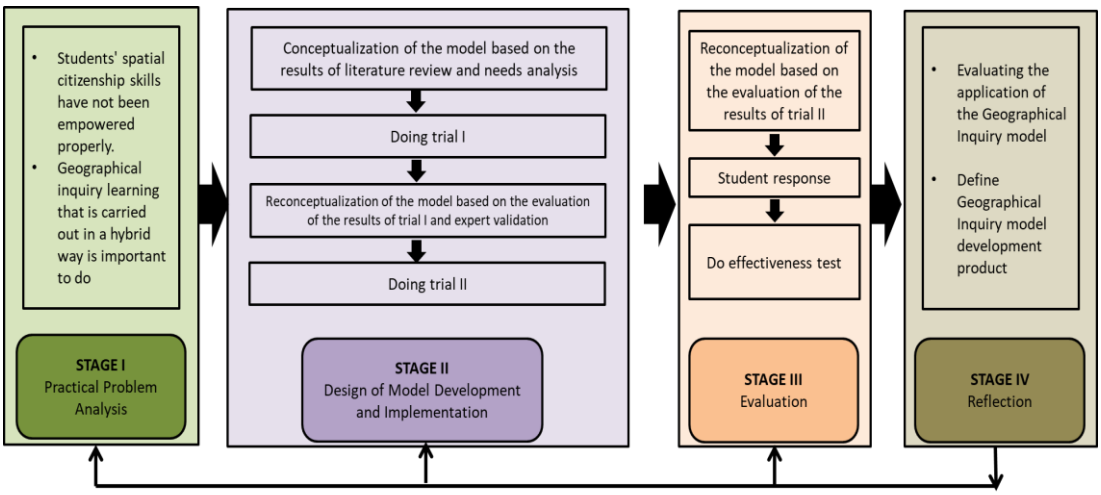

Figure 1.
Development Procedure of the Geographical Inquiry Model

2.1 Analysis of practical problem

The first stage was a practical problem analysis to examine the learning models often used by lecturers in the Geography Education Study Program at Sebelas Maret University, and the types of online learning platforms. The second stage was an analysis of the needs of lecturers and students to determine the need for an effective geography-learning model to improve spatial citizenship skills. This practical problem analysis phase was carried out at the beginning of the study to serve as a basis for developing an initial prototype model as an alternative solution to real problems occurring in the field (Prihadi, Singgih., Sajidan., Siswandari., Sugiyanto., 2021). The method used in the practical problem analysis stage is qualitative. The research subjects in the practical problem analysis stage were administrators of the Study Program, lecturers, and students. Data collection techniques include guided written reflection, in-depth interviews, classroom observations, and document analysis. The data analysis technique in the practical problem analysis stage is a constant comparative method.

In the practical problem analysis stage, the researcher conducted a document analysis to examine the applicable curriculum in the Geography Education Study Program at Sebelas Maret University, and viewed the semester learning plan as a lecture guide. The researcher made observations to passively participate in the class to determine the conditions of online and face-to-face student learning. The guided written reflection activity was conducted by researchers directly with lecturers in the Geography Education Study Program. The results of the guided written reflection activities were used as a guide for conducting interviews with the lecturers and students. At the end of the practical problem analysis activity, researchers, study program administrators, lecturers, and student representatives held focus group discussions. To facilitate data collection, the researchers prepared observation sheets, interview guidelines, reflection sheets, and focus group discussion guides.

2.2 Development and Implementation design

The design phase was conducted to develop a geographical inquiry model based on actual conditions and supporting theory. Researchers have carried out development and implementation to overcome the problem in the field, namely, students' low spatial citizenship skills, which require improvement. The method used in the design development stage was a literature study and consultation of a prototype model with several competent experts. Data from expert judgments were analyzed using a constant comparative method and descriptive statistical analysis. At this stage of development and implementation design, the researcher technically prepared a prototype of the geographical inquiry model, conducted expert judgment, tested the prototype, and improved the learning model prototype. In preparing the geographical inquiry model prototype, I was equipped with a model application guidebook, semester learning plans, assessment instruments, and learning modules. In implementing expert judgment, researchers involve experts in assessing the feasibility of the developed learning model product. This study included learning model experts, material experts, linguists, and learning evaluation experts.

2.3 Product evaluation

The product evaluation stage optimized the application of the geographical inquiry model to improve students' spatial citizenship skills in geography learning. The focus of the research at this stage was to examine whether the geographical inquiry model had a positive impact on increasing students' spatial citizenship skills in geography learning. The method used in the learning model effectiveness test stage was action research, including four steps, namely 1) design, 2) implementation (enactment), 3) reflection and evaluation (reflection and evaluation), and 4) improvement (redesign) (Akker, Jan van den, Brenda Banan, Anthomy E.Kelly, Nienke Nieveen, 2013).

The research subjects were students and lecturers in the first semester of the Geography Education Study Program. The trial sample at the evaluation stage comprised 32 Sebelas Maret University Geography Education Study Program students in the first semester of Class B 2023. The class for the trial was determined using a purposive sampling technique, so the researcher chose Class B 2023 because all students in that class had relatively similar spatial thinking abilities. Testing the application of the geographical inquiry model to the effectiveness test was conducted using a quasi-experimental design with a one-group pretest-posttest design. Researchers used a one-group pretest-posttest design, namely, experimental research carried out only on one group with relatively the same abilities, so a homogeneity test was not carried out. Data collection techniques included observation of the implementation of syntax, pretest, posttest, performance assessment according to the geographical inquiry model target, filling out student response questionnaires, project documentation, and interviews with supporting lecturers. The data from the model effectiveness tests were analyzed quantitatively and qualitatively. A t-test was conducted for one data group to determine its effectiveness because only one class was used in this study.

The process of observing geographical inquiry syntax implementation was analyzed quantitatively and qualitatively. The results of student performance were analyzed descriptively and qualitatively. The results of the student response questionnaire were analyzed descriptively and quantitatively. The researchers conducted a qualitative analysis of the interview results. The data from the effectiveness test results of the model were further analyzed through quantitative and qualitative methods. Qualitative data in this activity included photo documentation, videos, observations, and interviews during the learning activities. Student activities were observed to obtain data on spatial citizenship skills and to improve the quality of lectures using the geographical inquiry model. Quantitative data were obtained by testing the students. Students' spatial citizenship abilities in learning and responses to the geographical inquiry model were analyzed qualitatively and quantitatively. Qualitative data were analyzed by collecting, reducing, presenting, drawing conclusions, and verifying the results. Quantitative and qualitative data analyses were conducted by the researcher because quantitative analysis was needed to process data from the questionnaire, while qualitative analysis was needed to process data from the interviews. The researcher also performed triangulation by comparing the results of the interviews, tests, and questionnaires to obtain comprehensive conclusions.

2.4 Reflection and determination of the final product

The reflection stage was conducted to thoroughly evaluate the feasibility and effectiveness of the geographical inquiry model for making final improvements and products. The reflection stage was a focus group discussion involving lecturers who became collaborators, administrators of the Geography Education Study Program at Sebelas Maret University, and experts. The result of the focus group discussion was used as material to improve the learning model developed and determined as the final product. The Geographical Inquiry learning model has strong relevance to geography content in higher education because both are rooted in understanding spatial phenomena. Geographical Inquiry is a learning approach that emphasizes the process of questioning, exploring, analyzing, and concluding spatial information through active inquiry activities. In the context of geography education in higher education, this approach aligns with learning objectives that require students not only to master concepts, but also to think critically, analytically, and solution-oriented about real-world spatial issues.

3. Results and discussion

Supporting the findings of E. Shin (2019), which state that spatial citizenship is important for application in learning because the quality conditions are still low, researchers analyzed at the college level, and it was found that the understanding of spatial citizenship in students of the Geography Education Study Program was still low. Spatial citizenship is an important factor in the quality of geographic learning outcomes. The ability to read maps, ask scientific questions, select and visualize data, produce data and ideas, and use social networking deserves to be understood by students as an ability that must be mastered. Regarding students'

initial spatial citizenship skills, the researchers collected information from all 250 active students in the Geography Education Study Program at Sebelas Maret University: 79 students from the 2020 class, 84 from the 2021 class, and 87 from the 2022 class. This is shown in Figure 2.

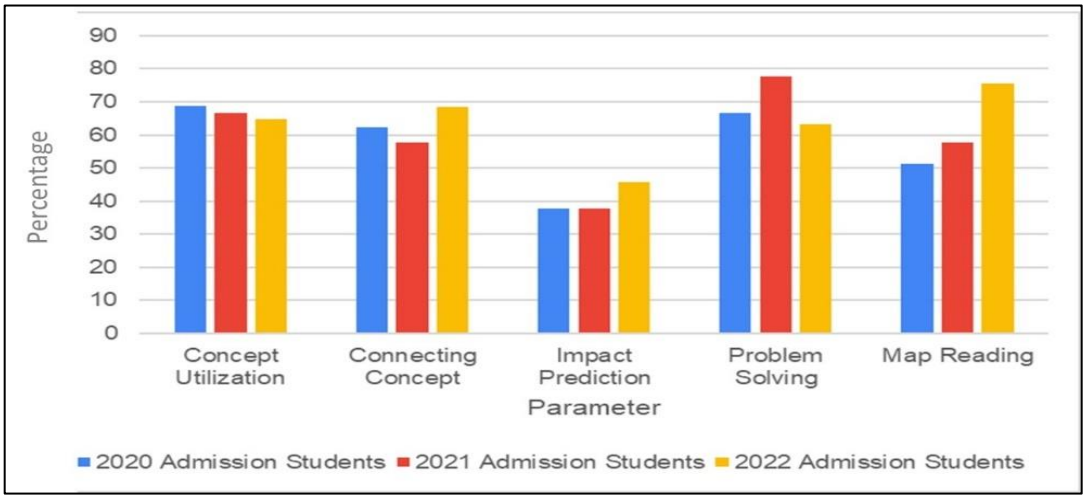

Figure 2. Spatial Citizenship Ability of Class 2020, 2021, and 2022

As shown in Figure 2, spatial citizenship skills related to map reading, asking scientific questions, producing data and ideas, and using social networking are still low. The data selection and visualization capabilities were already high. The development of the geographical inquiry model was based on the needs of the lecturers and students. Based on preliminary research on data on the needs of lecturers in Geography Education at Sebelas Maret University, innovation in new learning models to improve students' spatial citizenship skills is highly required. The learning model expert assessment results showed that the geographical inquiry model product had high validity, with a mean validity score of 0.897. The material expert's assessment results obtained an average score of 0.977, indicating high validity. Experts' assessment of the learning devices obtained an average score of 0.865, indicating that the learning devices had high validity. The expert's results for the learning assessment instrument obtained a mean score of 0.926, indicating that the learning assessment instrument had high validity. The assessment instrument was developed in the form of essay questions with indicators of spatial citizenship.

Spatial citizenship ability must be understood and practiced by geography teachers. Spatial citizenship ability can be known and measured through several strategies, such as distributing questionnaires to students with indicators of spatial citizenship characteristics and conducting direct observations of students through cases as learning themes. Learning is designed to enable students to carry out activities to formulate, negotiate, and communicate various problems in society. As a result of the questionnaire data analysis and observation, the interviews were conducted with lecturers and students who attended the class. Many European countries have developed their ability to have spatial citizenship. Indonesia is one of the 35 countries prone to devastating natural disasters worldwide and is essential for strengthening spatial citizenship skills, particularly in higher education learning. Geography Education students with spatial thinking skills have the potential to improve their spatial citizenship skills. Along with the rapid development of internet technology, students and lecturers must actively collaborate to design a comprehensive and sustainable geography-learning innovation system.

The geographical inquiry model was developed because it was inspired by geographical inquiry with essential steps to overcome problems from a geographical point of view and use geospatial data sources. Researchers have combined it with hybrid learning, which is technically highly flexible in its implementation. Through the hybrid model, the learning process can be carried out synchronously offline and online and asynchronously online, thus facilitating the learning process during a pandemic that requires distance learning and for future learning processes with virtual learning technologies. The hybrid learning model emphasizes the combination of the flexibility principle, which fosters interaction, facilitates the learning process within and outside the network, and fosters an effective learning climate (Boelens et al., 2017). A geographical inquiry model was developed while still prioritizing student-centered activities. This is in line with the results of research stating that geography learning must have several dimensions: 1) student-centered learning, 2) a positive relationship between students, 3) a positive relationship between educators and students, and 4) developing and strengthening classroom management (Mukminan, 2018). This differs from the research results, which state that learning geography will be more effective by applying learning models and considering the design of textbooks that encourage spatial thinking (Jo and Bednarz, 2009). The geographical inquiry

model is constructive, inquiry, and hybrid, and can be implemented with seven syntaxes, as presented in Figure 3.

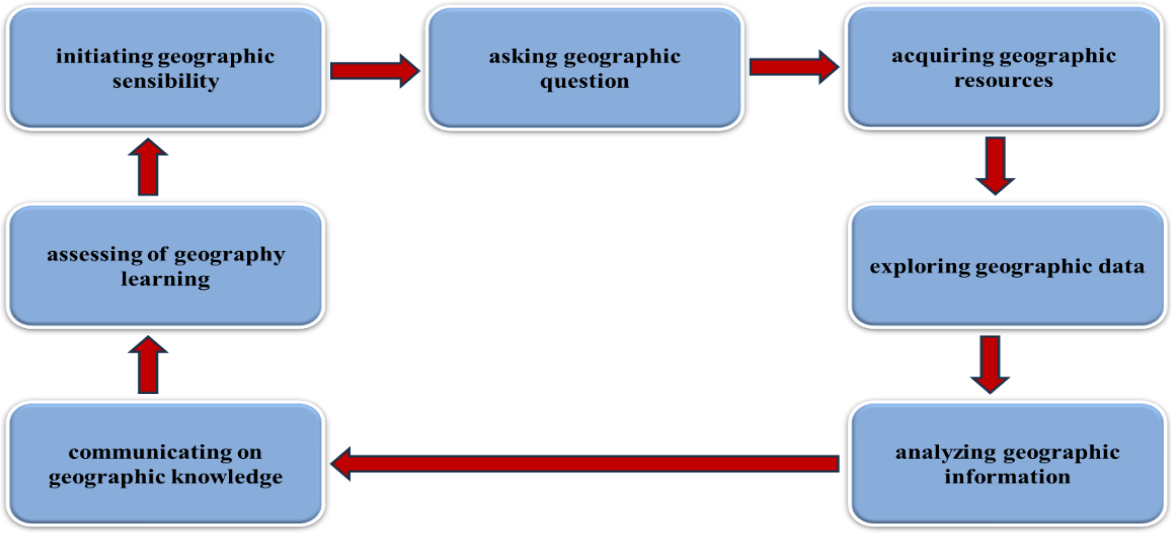

Figure 3. Geographical Inquiry Learning Model Syntax

Based on Figure 3, the seven geographical inquiry model syntaxes include 1) initiating geographic sensibility, 2) asking geographic questions, 3) acquiring geographic resources, 4) exploring geographic data with internet technology, 5) analyzing and recording geographic information, 6) acting and communicating on geographic knowledge, and 7) assessing the process and results of geography learning. This stage of initiating geographic sensibility is an activity to explain to students the learning problems that the lecturer presents. Information from lecturers was comprehensively conveyed at this stage. A stage for initiating geographic sensibility can occur both face-to-face and online (synchronously). In the stage of asking geographic questions, the lecturer presents geographic problems by involving questions from a location-based perspective. Students are encouraged to find alternative solutions to problems and where the problem occurs. Lecturers guide students to be more specific in compiling questions related to the problem topic, so that students can easily find information and answer these problems.

The stage for acquiring geographic resources is to identify data and information as the learning resources needed to answer the previous stage's geographic questions. Through identification, students clearly defined the problem and determined the data needed to carry out the analytical activities. At this stage, to acquire geographic resources, students must determine where the data can be found. The type and scope of geographic data will assist students in using the data collection and analysis processes. In exploring geographic data with internet technology, students learn to convert data into visualization presentations through maps, tables, and graphs and to determine patterns and relations. At this stage, sometimes the data obtained are not as expected, thus preventing the analysis process from being carried out. Students need to process it again into other visualizations (e.g., a map, a table, or a graph) to ease the analysis and determine the pattern of the relation. Students can use the free Google Earth application to determine the patterns and relationships of a phenomenon.

In analyzing and recording geographic information, the lecturer's activity facilitates students in determining the meaning of patterns and relationships of phenomena or events that occur based on geographic information recorded in digital data. By contrast, digital data are processed using specific online and offline software. This stage helps students to define the pattern and relation of an occurring phenomenon through the resulting tables, graphs, or maps as a form of recording geographic data. Students act and communicate based on geographic knowledge at the stage of acting and communicating with it. The communication process can be through various social media platforms to visualize the results of data analysis, so it is not limited to communication with other students. The results and presentation of the analysis are essential aspects of the geographic approach. The results of the analysis can be presented in maps, tables, graphs, and charts that can be shared in printed or digital form through the internet on a websites, e-learning portals, or social media. The stage for assessing the process and result of geography learning is an activity of the lecturer to assess geography learning that has been carried out in terms of process and results. The lecturer conducted a process assessment during the learning process in every class. Process assessment is related to student activities, collaboration, and

communication. The results were assessed by lecturers related to assignments and written exams, both individually and in groups.

In testing the effectiveness of the geographical inquiry model product, in prototype I tested, students' spatial citizenship abilities had an average score of 53.0769 in the pretest and 71.9231 in the posttest. In the second prototype test, the students' spatial citizenship skills had an average score of 53.6538 in the pretest and 74.2308 in the posttest. In the first and second prototype trials, there were differences in the average learning outcomes between the pretest and posttest. From the calculation of the paired-sample t-test in the first and second prototype trials, the value of Sig. (2-tailed) < 0.05, so there was a difference in the average pretest and posttest learning outcomes. The mean pretest and posttest scores of the test results from the geographical inquiry model's product effectiveness are shown in Table 1.

Table 1. Average Spatial Citizenship Value in Prototype I and II Tests

Evaluation	Prototype I	Prototype II
Pretest	53.0769	53.6538
Posttest	71.9231	74.2308

Based on Table 1, in the Prototype I trial, students' spatial citizenship abilities had a pretest-posttest mean score difference of 18.8642. In the Prototype II trial, students' spatial citizenship abilities differed in the average pretest-posttest score of 20.577. The first and second prototype trials showed an increase in learning outcomes. The implementation of the geographical inquiry syntax in Prototype Tests I and II is shown in Table 2.

Table 2. Implementation of the geographical inquiry model syntax in the product effectiveness test (Prototypes I and II)

No	Syntax	Prototype Test Mode I		Prototype Test Mode II	
		Lecturer Activity	Student Activity	Lecturer Activity	Student Activity
1.	Initiating geographic sensibility	3	3	4	3
2.	Asking geographic question	3	3	3	3
3.	Acquiring geographic resources	3	3	3	3
4.	Exploring geographic data with internet technology	4	3	3	3
5.	Analyzing and recording geographic information	3	3	3	3
6.	Acting and communicating on geographic knowledge	3	3	4	4
7.	Assessing the process and result of geographic learning	4	4	4	4

Based on Table 2, it can be concluded that the activities of lecturers and students in each syntax belong to the good and very good categories. Researchers continued to test Prototypes III and IV to confirm whether or the geographical inquiry model improved students' spatial citizenship. The researcher considered that previous studies have not examined the ability of spatial citizenship, but only the ability to study spatial ability, spatial thinking, and spatial literacy (Wakabayashi and Ishikawa, 2011). The researchers complemented previous research findings, stating that lecturing professionalism to equip 21st-century learning skills requires spatial literacy (Segara et al., 2018).

When testing the effectiveness of the geographical inquiry model product, students' spatial citizenship abilities in the third prototype test had an average score of 53.2692 in the pretest and 79.4231 in the posttest. In the fourth prototype test, the students' spatial citizenship abilities had an average score of 51.7308 in the pretest and 85.5769 in the posttest. Prototype III and IV trials differed in the average learning outcomes between the pretest and posttest. From the paired sample t-test calculation, the third and fourth prototype trials had Sig values. (2-tailed) < 0.05, so there was a difference in the average pretest and posttest learning outcomes. The average pretest and posttest scores of the geographical inquiry model product effectiveness test results are presented in Table 3.

Table 3. Average Spatial Citizenship Values in Prototype III and IV Tests

Evaluation	Prototype III	Prototype IV
Pretest	53.2692	51.7308
Posttest	79.4231	85.5769

Based on Table 3, in the prototype III trial, students' spatial citizenship abilities had a difference of 26.1539 in the average pretest-posttest score. In the prototype IV trial, the students' spatial citizenship abilities differed in the average pretest-posttest score of 33.8461. Prototypes III and IV trials showed an increase in learning outcomes. The implementation of the geographical inquiry model syntax for the effectiveness test is presented in Table 4.

Table 4. Geographical inquiry model syntax implementation on the product effectiveness test (Prototype III and IV)

No	Syntax	Prototype Test Mode I		Prototype Test Mode II	
		Lecturer Activity	Student Activity	Lecturer Activity	Student Activity
1.	Initiating geographic sensibility	4	3	4	3
2.	Asking geographic question	3	3	3	3
3.	Acquiring geographic resources	3	3	3	3
4.	Exploring geographic data with Internet technology	4	3	3	4
5.	Analyzing and recording geographic information	3	3	3	3
6.	Acting and communicating geographic knowledge	3	3	3	3
7.	Assessing the process and result of geographic learning	4	4	4	4

Based on Table 4, it can be concluded that the activities of lecturers and students in each syntax belong to the good and very good categories. The activities carried out by lecturers in applying the geographical inquiry model were not easy because there is an element of inquiry learning to which close attention must be paid. This is in line with the results of research stating that learning geography using the inquiry model first requires obedience and training first (Tomčíková, 2020).

Based on the results of the four trials, the spatial citizenship ability increased, while each relative indicator increased. The increases in every indicator of spatial citizenship are shown in Table 5.

Table 5. Difference in the mean pretest-posttest for each indicator of spatial citizenship

Indicator	The Difference in Mean Pretest-Posttest Prototype Test			
	I	II	III	IV
Map reading	2.88	5.96	5.96	6.73
Formulating geographic questions	4.62	4.04	5.58	6.15
Selecting and visualizing data	5.00	4.62	5.38	7.31
Producing data and ideas	4.62	3.08	3.85	6.54
Utilizing social networks	1.54	2.88	5.38	7.12

Based on Table 5, the ability to compose geography questions and produce ideas was perceived as the most difficult for students to master. The students perceived that they were the easiest to master in terms of reading maps, selecting and visualizing data, and using social networks.

In accordance with previous research, the learning needs in geography education study pograms that emphasize spatial citizenship skills require changes in methods, teaching materials, objectives, lecture activities, media, and assessment forms. Spatial citizenship is oriented to the ability to identify geospatial data, present data in a good visualization presentation, make it easier to build opinions, and increase public awareness for participating in efforts to overcome life problems (Virranmäki et al., 2021). In line with the results of this study, the researchers developed a geographical inquiry model to improve students' spatial citizenship skills in geography learning. Based on the initial research conducted, students of the Geography Education Study Program have not been optimal in mastering the ability of spatial citizenship. This is based on observations towards indicators of spatial citizenship skills, namely 1) reading maps, orientation, and navigation to describe an opinion; 2) analyzing simple questions to develop hypotheses from the representation of space; 3) selecting data and presenting it in the form of visualization; 4) producing their data and ideas from an event/phenomenon; and 5) using social networks/ the internet to access data or present data results (Solari et al., 2015). The improvement of spatial citizenship skills through the application of the geographical inquiry model was carried out through trials in conjunction with the pandemic through face-to-face and virtual learning. This is in line with the results of previous research stating that learning during a pandemic is very

effective through virtual learning (Gomez, 2022). Previous research has stated that learning with a hybrid or blended model can effectively improve higher-order thinking skills (Hariadi et al., 2022). This is different from what has been found by other researchers, namely, improving the ability of spatial citizenship. The Geographical Inquiry learning model encourages students to not only view maps as a medium of information, but also as a tool for critical thinking to analyze, evaluate, and solve spatial problems. In this context, map-thinking taxonomy refers to students' ability to use maps as a thinking tool in geography learning. With the application of the Geographical Inquiry model, students are able to achieve various levels of map thinking in a gradual and systematic manner.

Other relevant studies have shown that spatial citizenship skills must be managed and appropriately developed in Indonesia. A learning model that collaborates with technology is needed for its application to make it happen. Technology has changed learning to be oriented towards artificial intelligence applications, which support creativity and ease finding various learning resources (Wilby and Esson, 2024). Higher education must be a model for developing digital media methods to provide geographic and regional information. This is part of an effort to train students in social sensitivity, which is essential for students in the digital age. Research has shown that 21st-century learning must use digital media in classroom practice (Robillos, 2022). This statement is based on the learning model developed by the researcher, namely the geographical inquiry model, which, in its application, involves using digital map media. The geographical inquiry model was developed to be mastered by students, and is expected to help increase the basis of social participation. This aligns with research stating that spatial citizenship skills require geographic information to strengthen students competence (Gryl and Jekel, 2012).

A web-based innovation system for disaster information needs to be developed in Indonesia, which goes through several stages: identifying and selecting attributes, designing computer applications comprehensively, programming, system verification, and validation (Hadiguna et al., 2014). Many researchers have focused on comprehensive and long-term disaster management strategies, ideally involving stakeholders from higher education (Melgarejo and Lakes, 2014). In connection with this statement, higher education parties should develop the ability of spatial citizenship by determining strategies, indicators, and platforms that can be used, and technically, how to use them. Thus, spatial citizenship skills can develop well in Indonesia as part of the achievement of geography learning.

In other relevant studies, in developing the geographical inquiry model, the product forms include the geographical inquiry learning model guidebook, the learning module for teaching lecturers to apply the learning outcomes development model, learning tools, spatial citizenship ability assessment instruments, model implementation observation sheets, and product assessment sheets. Researchers have prepared guidebooks and modules to meet the demands of investigative literacy by optimizing the relationship between computational and spatial thinking abilities, including language, symbols, and skills that help students conduct scientific investigations well (Maddatuang et al., 2025). A challenge faced by the Geography Education Study Program at Sebelas Maret University in curriculum development for the Industrial Revolution 4.0 age is to produce graduates with spatial literacy skills, data literacy, technological literacy, and human literacy with noble character based on understanding religious beliefs. In this case, the Geography Education Study Program needs to reorient its curriculum development to address challenges. Geography education in higher education requires students to not only understand basic geosphere concepts, but also to integrate this knowledge into the process of solving complex and contextual spatial problems. In this context, the relationship between the Geographical Inquiry model, geographic skills, geographic inquiry process, and geographic content forms a synergistic framework that significantly contributes to the development of students' abilities to solve location-based problems (spatial problem solving).

The geographical inquiry model effectively improved students' spatial citizenship skills in geography learning, which can be detailed based on five indicators. The reading maps were the first indicator. Students were given a stimulus to use maps for learning and assigning assignments by applying the geographical inquiry model. Maps were accessed through Google Earth, Google Maps, digital atlases, or other maps. The ranking of geography questions was the second indicator. In the learning process using the geographical inquiry model, students were always allowed to ask scientific questions about the problem in its early stages. When applying the geographical inquiry model, scientific questions were submitted using the IdeaBoardz and Mentimeter platforms, considering that they minimize boredom and can be accessed online. Selecting and presenting data visualization was the third indicators. By applying the geographical inquiry model, students could analyze problems using the data collected and visualized through tables, graphs, and maps produced to record geographic data. Producing data and ideas was the fourth indicator. In this geographical inquiry model, lecturers assisted students by providing problems and simple examples of solutions, which students then explored through discussion. Lecturers gave projects, encouraging students to conduct group discussions to

arouse curiosity and spark innovative ideas about the problems studied. The use of social networks is the last indicator. Using the geographical inquiry model, student-made learning products were published on social media, namely Instagram, so that others could see and comment on them. The application of the geographical inquiry model affected the students' social participation in the community. Students must realize that they are social beings who have social sensitivity in their living spaces. This is in line with the results of previous research stating that spatial citizenship plays a role in developing spatial planning, which can help increase social participation (Horlings et al., 2021). Geographic education in the digital age requires the integration of conceptual, technical, and higher-order thinking skills. Within the Geography Inquiry model, map thinking skills, GIS thinking skills, and geography skills converge into a complex and mutually reinforcing cognitive system. The relationship between these three can be analyzed through a cognitive taxonomy approach, which reflects students' ability levels from basic understanding to complex spatial problem-solving.

4. Conclusion

The geographical inquiry model was developed because of the students' low spatial citizenship skills in geography learning. This geographical inquiry model emphasizes strengthening geographical inquiry, taking essential steps to overcome problems from a geographical point of view, and using geospatial data sources. Applying the geographical inquiry model is combined with hybrid learning, which is technically flexible in its implementation. Through the hybrid model, the learning process can be carried out face-to-face, synchronously online, and asynchronously online, thus facilitating the learning process during a pandemic that requires distance learning and, for future learning processes, which, of course, also combine with virtual learning technologies.

This geographical inquiry model can be applied based on expert agreements. The geographical inquiry model provides a new nuance for geography learning. The geographical inquiry model adds to the number of learning models that are used in education. A feasibility assessment of the geographical inquiry model was conducted and validated by seven experts from their respective fields. The conclusion shows that the geographical inquiry model and its completeness are valid and feasible for learning geography.

This geographical inquiry model can be effectively applied to geography learning to improve students' spatial citizenship. This is evidenced by the calculation of the paired sample t-test analysis on the prototype trials I, II, III, and IV, which show Sig's value (2-tailed) < 0.05, so there are differences in learning outcomes using the geographical inquiry model in improving spatial citizenship skills. The geographical inquiry model emphasizes student participation in the living space to carry out activities to formulate, negotiate, and communicate in solving daily life problems through a geographic approach. This study research implies that if geographical inquiry is applied appropriately and comprehensively in higher education geography learning, it will give students the skills to become good citizens from a spatial perspective. This geographical inquiry model is highly recommended for lecturers to apply in geography learning, because it can improve students' abilities to understand problems in society from a spatial perspective, utilizing map reading skills, and optimizing the use of social media. A limitation of this research is that, during the pilot testing of the geographical inquiry model, its application was limited to human geography materials. Future research should also aim to apply it to physical geographical materials.

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