The Utilization of Technology-Based *Webgis* as an Effort to Establish the Spatial Thinking Ability of Geographic Students In High School

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ABSTRACT
Spatial thinking is an important competency that needs to be formed in the era of technology 4.0 so that students can master spatial concepts in Geography learning so that a cutting-edge technology-based learning media is needed. One of the potential learning media to support the formation of spatial thinking is *WebGIS*. The advantages of *WebGis* in learning are: (1) Facilitate the application of spatial concepts in Geography learning by collecting, representing, and analyzing spatial data in the form of maps so that students can understand it. (2) Using WebGIS in education can help students develop the ability to think spatially, critically, and adapt to the inquiry process, which includes exploration, data processing, and conclusion in order to produce scientific discoveries.(3) Compared to other popular geospatial technologies (*ArcGIS and Quantum GIS* mapping applications), The method used is a literature review (literature study) with data in the form of qualitative descriptions. The data collected comes from secondary data using relevant literacy sources both online and offline. Based on the analysis conducted, it can be concluded that *WebGIS* is relatively easy to use for both students and teachers because the system's base is a website so that it can be accessed by anyone, anywhere and anytime without requiring complicated installation or configuration. Utilization of *WebGIS* is easy. It supports simple and flexible tools because they can be used in all Geographical Basic Competencies in Senior High Schools. Steps to using *WebGIS* can be done by (1) Students are directed to collect and convert verbal or written information into spatial information on *WebGIS*. (2) The spatial information collected can be seen through *WebGIS* so that students can find out various kinds of spatial patterns. (3) The spatial pattern can be used by students for more in-depth geographic analysis activities

Keywords: WebGIS, Spatial Thinking, Geography.

1. INTRODUCTION

Spatial technology in the era of 4.0 has experienced very rapid development, both speed, easy access to data, information and availability of content as support, even in some versions it has arrived in real time. Advances and developments in technology, especially in terms of computerization, make it easy for humans to access spatial fields on the face of the earth that can be utilized in life. Currently there is a technology that describes space on the earth's surface known as a Geographical Information System (GIS) [5]. Geographical Information Systems (GIS) include systems that can organize computer hardware and software and data that can be stored or processed in data analysis so that information related to spatial aspects can be obtained [9]. Geographical Information System (GIS) or Geo Information System (GIS) is a computer-based system used to enter, store, manage, analyze and reactivate data that has a spatial reference for various purposes related to

mapping and planning, while other opinions say GIS is a system designed to work with spatially referenced data or geographic coordinates. From these two opinions, we can know that GIS is a system that handles spatial or spatial data. Because Geographical Information System (GIS) technology continues to evolve and be updated to cover various deficiencies in its use, any activity related to spatial or spatial, such as location, position, distance, area, and so on, can be obtained quickly and at any time according to need. Applications in everyday life can be seen in smartphone-based GPS services, for example: Google Maps, Gojek, GoFood, Grab and many platforms that use spatial technology to support human needs. The advancement and development of this technology can be used as an opportunity to be used in the field of education as an effort to form competency in students' spatial thinking, of course, by using this technology-based media.

The development and implementation of spatial-based technology in education needs to be realized because in the era of the 21st century and industry 4.0 there is an urgent need for students to master technological competencies, where the report entitled "Learning for the 21st Century" states about competencies that must be mastered by students which include "1) core subject and 21st century themes, 2) learning and innovative skills, 3) information, media and technology skills and 4) life and career skills" [6]. Based on these reports, students' mastery of technological competences, especially in Geography subjects, is very important. The field of spatial technology in Geography is relevant to a typical Geography approach, namely spatial, environmental, and regional complexity, and should be used to improve learning competence. Realizing this, there are challenges in the form of the availability of human resources for geospatial technology developers in the education sector, which is still very limited. Corroborates this statement. that government agencies whose activities are related to the mapping process of natural resource potential or land use are still limited [3]. Knowing this, it is not surprising that the role of the teacher in the process of developing students' spatial thinking skills continues to use traditional methods such as lecture, discussion, question and answer, and assignment methods because they are considered practical and do not require a long time to implement, so they are frequently used the next factor causing students' spatial thinking skills to remain low is teacher competency constraints on mastery and development of learning media based on the latest geospatial technology, because there are currently various types of platforms, software, and applications that have the potential to support the learning process, such as ARC GIS, Quantum

GIS, WebGIS, and many more. Based on this, it can be concluded that the teacher competency factor which is still minimal in spatial technology has an effect on the learning implementation process which is still ineffective, so that students' spatial thinking competencies are still not as expected.

The relevance of geography with the competence of spatial thinking is an important feature of learning activities in accordance with its approach. Geography is a discipline that studies space [10]. The study of geographical phenomena explains not only the existence of a phenomenon and the process of this phenomenon on the earth's surface, but also the shape, size, direction, pattern, and relationship of the phenomenon with other phenomena, and knowing this is important to strive for mastery of students on the potential of spatial thinking [8]. Furthermore, the ability to think spatially is essential in complex geographic analysis. For example, when looking for a good location for housing, buildings, industrial centers, and others, the ability to think spatially is required because thinking spatially will provide information about the nature and characteristics of the area that will be used as a construction location. Various data related to the development process must be combined to obtain new information, namely to become a solution for which location is right for the location of the construction. In addition, spatial thinking is very useful for helping problems that occur on the earth's surface, which can be solved by spatial thinking and, of course, with the participation of the Geographical Information System. The ability to think spatially has various benefits for students, including that students will be able to make decisions both simple and complex regarding space or location. Furthermore, the importance of mastering spatial thinking competence is consistent with the Geography competency of SMA mentioned by the Ministry of Education and Culture (No. 23/2016), namely, 1) ability to analyze spatial patterns from geosphere elements, 2) ability to analyze efforts to conserve the environment and sustainable development, 3) ability to analyze maps, remote sensing images, and 4) ability to analyze spatial patterns from geosphere elements. As a result, spatial thinking must be developed as part of the Geography learning process so that the Geography learning process does more than just explain geosphere phenomena.

Fulfilling the competency of spatial thinking in this learning can be done by technology-based media. The development of learning media that supports the formation of spatial thinking competencies has led to web-based applications, known as web-based GIS. WebGIS is thought to have the potential to aid in the development of students' spatial thinking skills [11].

WebGIS itself is a GIS application that utilizes the internet as a communication medium that functions to distribute, publish, integrate, communicate and provide information in the form of text, digital maps and perform analysis and query functions related to GIS via the internet network [7]. WebGIS can be accessed from anywhere and anytime, either using a laptop or mobile device. In addition, WebGIS also does not require installation so that the media can be used immediately. WebGIS media can be used as a tool to support students in spatial thinking, by utilizing a basemap (tile map), and various tools to create maps provided on WebGIS to support geography learning. It is hoped that as WebGIS students develop, they will become more interested in the learning process of geography, allowing students' spatial thinking skills to be easily formed and play an active role in map making. Based on the above potential, this study focuses on the benefits of using WebGIS and the implementation steps in using WebGIS in Senior High Schools.

2. METHOD

The method chosen is descriptive qualitative with literature review (literature study). The data collected comes from secondary data using existing literacy by utilizing books, scientific articles and other relevant sources. The data obtained were then analyzed and presented descriptively to strengthen the benefits of using webgis and the formation of spatial thinking skills using webgis in high school geography learning (SMA).

3.1. Benefits of Using WebGIS on Geography Learning in High School.

The use of WebGIS on Geography in High School (SMA) subjects is a potential technology to be utilized so that, in addition to making it easier for teachers to explain material concepts, students can also easily understand and learn each time independently. WebGIS is short for Website Geo Information System. The web or the world wide web (www) itself is a system that is interconnected in a hypertext format document containing a variety of information, including text, images, sound, video, and other multimedia information and can be accessed through a device called a web browser [13]. In this research, the web that is meant is a website. A website is a collection of pages that are related to other files that are related.

WebGIS is a geographic information system distributed across computer networks to visually communicate geographic information on the Web via the internet. Another opinion suggests that WebGIS is a GIS or digital mapping application that utilizes the internet network as a communication medium that functions to distribute, publish, integrate, communicate and provide information in the form of text, digital maps and perform analysis and query functions related to GIS through the network internet [7]. From these two opinions, we know that WebGIS is a web-based geographic information system (GIS/GIS) that is able to perform GIS analysis of spatial/collateral data. Web-based here means that it is not affected by the operating system of a device, either Android, Windows or Mac, because the web is accessed through a browser connected to the internet network. WebGIS in this study is a website-based geographic information system (GIS) created using programming languages such as PHP and JavaScript. The design libraries used are LeafletJS and Bootstrap. WebGIS learning activities are simple to understand and learn how to use.In addition, WebGIS has other advantages, namely:

(1) it can facilitate the application of spatial concepts in Geography learning by collecting, representing and analyzing spatial data in the form of maps so that students can understand them. In the process of collecting spatial data, students can use the internet as widely as possible to obtain reconnaissance data according to the mapping theme. In an example of real learning that has been carried out at SMA N 1 Semarang, students collect spatial data in the form of coordinate points of natural resource locations taken from the google map. Then the process of the next learning activity is to represent. At this stage, the spatial data (such as coordinate data) that has been collected by students is then inputted into WebGIS so that the data can be represented as a map of the distribution of natural resources. The next stage is analysis. In this case, students are directed to link the information they have received about the material (natural resources) and link to information on WebGIS (natural resource distribution map).

(2) The use of WebGIS in this study can help to develop the ability to think spatially, critically, and adapt to the inquiry process, which includes exploration, data processing, and drawing conclusions to produce scientific discoveries [4]. The critical thinking ability obtained from learning outcomes using WebGIS is because

students are required to seek deeper information, then connect the information they get, and analyze it spatially. In addition, the use of WebGIS itself, which is a GIS-based medium, requires students to observe representations and use spatial data repeatedly, so that this leads to the development of students' spatial thinking skills[12].

(3) Compared to other popular geospatial technologies in the form of (ARCGIS and Quantum GIS mapping applications), WebGIS is relatively easy to use for both students and teachers because the system is based on a website so that it can be accessed by anyone, anywhere and anytime without requiring complicated installation or configuration. During the online learning process, implementing WebGIS is classified as very easy because the flexible application can be opened on a laptop or smartphone. Students themselves access more WebGIS through their smartphones than on laptops. Furthermore, while online learning is not the same as face-to-face learning, WebGIS media can still function optimally due to the ease of access that can be accessed from anywhere as long as there is internet. This is clearly the difference when compared to other GIS applications such as ArcGIS or QGis which can only be accessed via a laptop, requires application installation first, and, of course, requires supporting device specifications. Therefore, considering the need for spatial data representation, where spatial data representation can be done through WebGIS, ArcGIS, and Qgis, WebGIS has a higher advantage in being used as a learning medium compared to other GIS applications.

3.2. *Formation of Spatial Thinking Skills Using WebGIS in High School Geography Learning (SMA)*

Spatial thinking is one form of thinking like the others, for example verbal, logical, statistical, hypothetical and so on. Spatial thinking is a set of cognitive abilities, which consists of three elements, namely: space, tools, and the process of resoning. Spatial thinking is not only in Geography, but also in other disciplines that make space a factor that can provide an explanation of the nature, function of objects, or symptoms such as physics, chemistry, engineering, history, art and others. Spatial thinking can be learned and can be taught at the level of education, so that students can have good spatial literacy, Spatial thinking is very important in education. This is because:

1) spatial thinking is a set of cognitive skills,

2) integrated spatial thinking in everyday life, be it people, natural objects, artificial objects, space, the interaction of people with objects must also be understood in the context of location, distance, direction, shape and pattern,

3) Spatial thinking is very powerful for solving problems by managing, transforming, and analyzing data, especially in complex and large-volume data and communicating the results of the process to itself or others.

4) Spatial thinking is a daily routine for experts and engineers, and has become a supporter of many scientific and technical breakthroughs.

5) Spatial thinking is a skill that everyone can and should learn,

6) Spatial thinking develops uniquely for each person depending on one's experiences, education and inclinations,

7) Spatial thinking is a complex, powerful, and challenging process and the support system provides an interactive environment in which spatial thinking can take place by helping students spatiate data sets, visualize work and outcomes, and perform analytical functions, (National Research Council, 2006).

Learning using WebGIS has been implemented in several high schools in the world. Like Geography learning using WebGIS media in high schools in Amsterdam, [1] observed the geography learning process in his high school, in his research entitled "The effects of geography lessons with geospatial technologies on the development of high school students" relational thinking "shows that WebGIS-based Geography learning provides results in the form of an increase in students' higher spatial thinking skills compared to conventional Geography lessons. In addition, the application of WebGIS in learning has been carried out in her research entitled "Digital storytelling in education using WebGIS" [2]. The application of WebGIS media in high school physics learning in Lesvos, Greece, was investigated in this study. In this WebGIS-based learning, students make use of ESRI's WebGIS Story Map product to create a story for a physics scientist related to the condition of the scientist's location. Students use the WebGIS Story Map to create different maps and use some of the multimedia provided by the WebGIS Story Map so that they can make the best story Map, the best layout option to make their story interesting. Students rated the WebGIS Story Map as very useful for them in terms of learning because of its contribution to a better understanding of subject concepts. Students describe it as a useful tool that helps them organize their stories, especially by inserting maps. Students actively participate and work productively with

group members. Furthermore, they are motivated to read/work using additional sources that are not included in the initial material given. Students really enjoy the learning process using the WebGIS Story Map.

The job was interesting, even though it was a little more difficult than they thought. However, the work is uncomplicated and, therefore, not stressful for students; on the contrary, it gives them a sense of satisfaction. The technical problems faced during the making of story maps did not affect students' positive attitudes towards the WebGIS Story Map they used, because it allowed them to create good stories, especially when using maps. The results of this study indicate that learning based on the WebGIS Story Map media can foster students' spatial thinking skills even though they do not study Geography in it. The WebGIS-based Geography learning developed by this researcher in its application in the classroom allows students to make a type of map because the materials in the Geography subject are closely related to spatial information, and existing media is rarely able to easily project spatial information, researchers have developed an easy-to-use web-based medium using point, line, and area-digitizing tools, students can project spatial information on these Geography materials using the WebGIS developed by this researcher. In addition, during the learning process, WebGIS is able to collect information such as student names during the digitization process so that it can make it easier for teachers to evaluate the results or effects of the application of WebGIS media on each student.

4. CONCLUSION

The application of WebGIS as a learning medium makes it very easy for teachers/instructors to teach material that previously could only be taught limited to conventional methods, using printed maps or only limited to using PowerPoint. Ease of use without requiring installation so that it can be easily used in conditions anywhere and anytime. This is a very effective support tool when doing distance learning. The benefits of WebGIS-based learning can improve critical thinking skills because students are required to seek deeper information, then connect the information they get, and analyze it spatially. In addition, the use of WebGIS itself, which is a GIS-based medium, requires students to observe representations and use spatial data repeatedly, so that this leads to the development of students' spatial thinking skills.

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