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Geography teacher profile towards geospatial technology usage for geography learning in senior high school

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Abstract

In the current era, the utilization of WebGIS technology in geographical learning is not yet optimized by educators. This is due to the fact that their knowledge and abilities in this field are still limited. Consequently, it is crucial to identify the variables that impact the integration of WebGIS in educational settings. This research endeavors to ascertain the influence of age, teaching tenure, and teacher gender on the utilization of WebGIS. This research employed a quantitative approach with multiple linear regression analysis techniques. The sampling method involved distributing a Google form to member teachers who had attended a webinar on the use of geospatial technology for learning, which was conducted by the Geography Subject Teachers Association. The research results indicate that age, gender, and teaching period influence the use of WebGIS, with variations in the type of WebGIS used being minimal. The results also show a significant influence of the third variable on the use of WebGIS in geography learning (p less than 0.00036). However, the influence of the third variable on WebGIS use is only 17.5 percent, with the remaining variance explained by other variables. The length of teaching experience exhibits a positive estimated value, indicating that longer teaching experience is associated with greater WebGIS use. In contrast, age and gender have negative estimated values, indicating that younger people and male teachers use WebGIS more frequently. This data also indicates that the use of WebGIS in learning activities is still limited among teachers. Geography teachers continue to use GIS technology on a limited scale and in a limited number of materials. Besides, they have not yet been able to integrate it into various relevant materials. The aforementioned data leads to the conclusion that it is necessary to reinforce the use of spatial technology in the education of prospective geography teachers and to provide training and assistance in the use of spatial technology for teachers who have previously taught while continuing to investigate other variables that may influence the use of WebGIS in learning.

Keywords: WebGIS; multiple linear regression model; geography teacher

1. Introduction

In the recent contemporary era, the use of digital maps in learning, procured from a multitude of sources, both local and global, is a prevalent phenomenon. These maps are accessible for free. In Indonesia, the Geospatial Information Agency (BIG) has developed a multitude of GIS web portals. Various types of maps are available on this portal prepared by the Indonesian government. Further, interactive maps offer general and specific information. Apart from the Geospatial Information Agency, several Ministries or Agencies have also provided Geographic Information System web portals (WebGIS), such as the Ministry of Energy and Mineral Resources (ESDM) (Ministry of Natural Resources and Minerals, 2023), Ministry of Forestry and Environment (Ministry of Environment and Forestry, 2023), Ministry of Agrarian Affairs and Spatial Planning (Ministry of Agrarian Affairs and Spatial Planning, 2023), Ministry of Marine and Fisheries (Ministry of Marine and Fisheries, 2023), Council of Meteorology Climatology and Geophysics (Council of Meteorology Climatology and Geophysics, 2023), National Board for Disaster Management (National Board for Disaster Management, 2023) and so forth. However, this variety of geospatial information has yet to be utilized optimally by geography teachers in schools as a learning medium.

In addition, the transformation from the Industrial Era 4.0 to the Society Era 5.0 has had a profound impact (Fukuda, 2020) in the field of education, especially in the area of maps and mapping. There has been a notable increase in knowledge about maps and mapping in recent years. This condition is characterized by the use of digital mapping platforms in the form of WebGIS (Kuria et al., 2019) and Unmanned Aerial Vehicles (UAV) in various fields (Mohsan et al., 2022). WebGIS enables easy access to various information, such as learning material and analysis, for teachers.

Teacher's ability to deliver geography learning material makes a significant contribution to school achievement (Alufohai & Ibhafidon, 2015; Ismail & Abas, 2018). Therefore, geography learning activities must adapt to developments over time in order to ensure that modern geography is aligned with the latest technological developments. One form of this change is the use of Big Data, especially in the field of geospatial or mapping as well as spatial-based learning. The foundation of geography subjects that cultivate these concepts necessitates the utilization of representative tools to facilitate the comprehension of the material presented by students.

Geography subject teachers generally assume that the existing maps only encompass conventional, printed, or analog maps. These maps often illustrate the Indonesian Earth Map and the Indonesian Geological Map. Accordingly, most geography teachers require training on how to use portals of geospatial information. As demonstrated by the results of a survey conducted on 104 teachers in a webinar with the theme "Application of Geospatial Technology for Geography Learning," only 71.1% of teachers had used GIS technology in the learning. Nevertheless, a significant proportion of educators, approximately 77%, do not employ GIS at any level of instruction for the purpose of processing and integrating educational content (Šiljeg et al., 2022). To date, no studies have been conducted that specifically examine the influence of age, gender, and teaching experience on the utilization of WebGIS in learning. Meanwhile, a study Wang et al. (2009) indicates a correlation between age and gender in the acceptance of modern technology in learning.

A number of studies have demonstrated the efficacy of WebGIS in enhancing student learning outcomes and improving teacher competence (Fadlan, 2023; Febrianto et al., 2021; Fortuna & Saputra, 2024; Putri & Sriyanto, 2022; Santoso et al., 2022; Somantri & Hamidah, 2024). This suggests that WebGIS is a modern technology in geography that should be more widely utilized by geography teachers. Meanwhile, the GIS technology utilized is limited to InaRisk and Google Earth among the other available WebGIS, such as WebGIS esdm, WebGIS KLHK, Ipasoet, Magma. go.id, DIBI, ArcGIS Living Atlas, WebGIS KKP, Wofi BMKG, and so forth. These imply that the proficiency of teachers in utilizing WebGIS in instructional contexts remains relatively limited.

In addition, studies have demonstrated that the integration of GIS in educational settings can enhance intrinsic motivation and facilitate higher-order thinking (Aladağ, 2010; West, 2003). WebGIS has also been widely recognized as a useful educational tool for creating inquiry-based learning environments (Demirci, 2011). Further, teacher ignorance is frequently identified as a critical factor contributing to students' limited understanding and analysis of geospatial information (Šiljeg et al., 2022). A study shows that most teachers in Germany do not have sufficient computer skills to apply GIS in practice (Siegmund et al., 2007). His issue of having the necessary equipment (hardware and software) but lacking the requisite knowledge to implement GIS is prevalent in both developed and developing countries (Mzuza & Van Der Westhuizen, 2019). Consequently, teachers who lack an understanding of GIS will also fail to comprehend and utilize GIS in a variety of contexts. In light of this, a review of teacher profiles in relation to WebGIS is required in order to examine the influencing factors of teachers' abilities to utilise WebGIS.

Following the aforementioned discussion, this study explores the possible influencing factors on teachers' ability to use WebGIS, focusing on age, gender, and years of teaching. These three factors are demographic factors that influence the application of the TPACK (Technological Pedagogical and Content Knowledge) concept to teachers (Nindya, 2022). Previous research has investigated the influence of age, gender, and years of teaching on teachers' decisions and actions in the classroom (Aloka & Bojuwoye, 2013; Alufohai & Ibhafidon, 2015; Goebel & Cashen, 1979; Ismail & Abas, 2018). The study concludes that the majority of participants believe that most of these three profiles influence teachers' actions and decision-making. However, previous research does not elucidate the extent to which the three variables affect teachers' capacity to utilize technology and learning. Consequently, this research employs a multiple linear regression methodology to ascertain the influence and magnitude of the three variables on teacher actions utilizing WebGIS in geography learning. Through this method, the extent and magnitude of influence can be determined, thereby enabling other variables to be projected in subsequent research.

2. Method

This research adopted a quantitative methodology for data collection and analysis. The data were gathered through a survey using Google Forms distributed to 104 respondents from 45 cities across Java, Sumatra, and Kalimantan, Indonesia. The sample was selected using voluntary sampling techniques, involving all geography teachers in the 45 cities who were willing to complete the forms included. However, through sorting and filtering the data, only 99 respondents could participate because some of the responses were incomplete. The data collection was conducted in conjunction with a webinar on the use of geospatial technology in spatial-based learning, which was held in collaboration with the Universitas Negeri Malang and the Association of Geography Subject Teachers of Kediri Regency, Indonesia. The gender distribution of respondents was 65.4% female and 34.6% male teachers participating in the Geography subject teacher association in several Indonesian cities. The research instrument used open-ended questions. The questions of the instrument are presented in Table 1.

Table 1. Question Indicators in the Survey

Num.	Question	Indicators
1.	Do you use WebGIS in Geography Learning?	Score 1 = no Score 2 = yes
2.	How often do you use WebGIS in teaching?	Score 1 = never Score 2 = Sometimes Score 3 = Often Score 4 = Always
3.	Do you have difficulty using WebGIS?	Score 1 = never Score 2 = Sometimes Score 3 = Often Score 4 = Always
4.	What WebGIS have you ever used in learning?	Essay questions
5.	What sub-material do you convey using WebGIS?	Essay questions
6.	What difficulties do you experience when using WebGIS?	Essay questions

To ascertain whether the predictor variable exerted an influence on the response variable, multiple linear regression analysis was carried out. The variables that were found to influence the use of WebGIS included gender, age, and years of teaching experience. These findings are presented in Table 2.

Table 2. List of Response and Predictor Variables

Variable	Variable Type
Use of WebGIS	Variable Response
Long time teaching	Variable Predictor 1
Age	Variable Predictor 2
Gender	Variable Predictor 3

Table 2 indicates that this study focused primarily on three predictor variables and one response variable. The response variable is a variable influenced by the predictor variable, while the predictor variable is the variable that influences the response variable. Based on Table 2, this research used the following hypothesis.

H0 = Length of teaching, age, and gender do not influence teachers' ability to use WebGIS

Ha = Length of teaching, age, and gender influence teachers' ability to use WebGIS.

The research procedures comprised of data collection, data filtering, prerequisite tests, multiple linear tests, visualization, and conclusions, as illustrated in Figure 1.

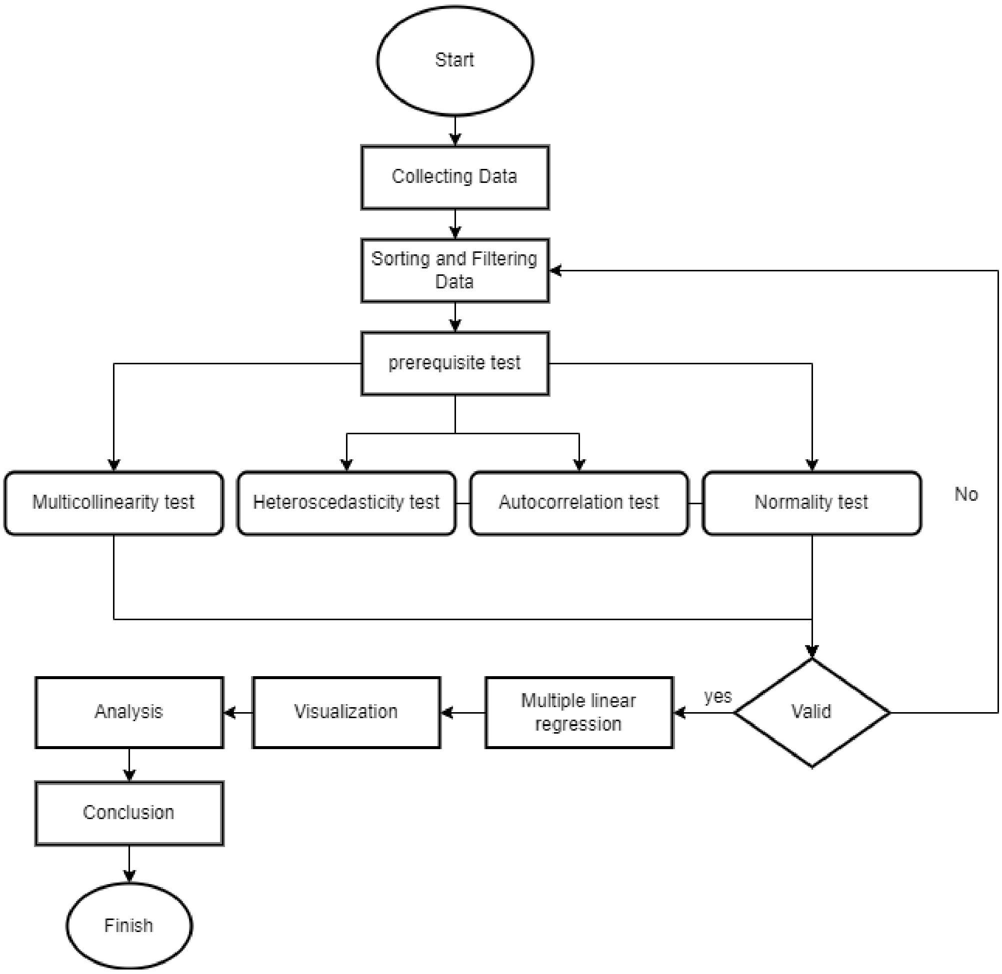

Figure 1. Research Flow Diagram

The prerequisite tests for data analysis include several key assessments. The Multicollinearity Test, as described by Haitovsky (1969), considers the data quality satisfactory if there is no evidence of multicollinearity, which is indicated by a Variance Inflation Factor (VIF) of less than 10 or a tolerance value greater than 0.1. If the data is deemed invalid, predictors with high correlation can be eliminated or adjusted by modifying the variables.

The Heteroscedasticity Test ensures that the data is satisfactory if heteroscedasticity is not present, which can be identified by examining the variance inequality between the residuals of observations (Koenker, 1981). A regular pattern of dots, such as wavy widening and narrowing, indicates heteroscedasticity, whereas scattered points without a clear pattern suggest the absence of heteroscedasticity. Erroneous data can be corrected by transforming the regression model or applying logarithmic transformation, according to the logarithmic transformation according to Harrell Jr et al. (1996).

$$\text{Log } Y = bo + b1 \log X1 + b2 \log X2 \quad (1)$$

The Normality Test, using the Kolmogorov-Smirnov test, is employed to determine if the data is normally distributed, which is suitable for data quantities between 50 and 100 (Berger & Zhou, 2014). Data is considered normally distributed if the significance value (sig) is greater than 0.05, and not normally distributed if sig is less than 0.05. The Autocorrelation Test checks for correlations between variables, but in this research, since the data is not time series, the absence of autocorrelation is assumed, rendering the test invalid. Lastly, the Multiple Linear Regression Test is utilized to ascertain the influence and magnitude of the influence between predictor variables and the response variable (Ryan, 2008). The linear regression formula follows Aiken et al. (1991).

$$Y = b_1X + b_2Z + b_0 \quad (2)$$

Data analysis was carried out using the R studio application. The packages employed included nortest for normality tests, car, and carData for multicollinearity and multiple linear regression and lmtest for heteroscedasticity tests. The normality test was performed using the Kolmogorov Smirnov. Table 3 provides an overview of the packages and functions utilized in this analysis.

Table 3. Prerequisite Test Method and Multiple Linear Regression

Prerequisite Test	Libraries (packages)	Functions in R
Multicollinearity Test	car and carData	Vif(Modelreg)
Heteroscedasticity Test	Lmtest	Bptest(Modelreg)
Normality test	Nortest	lillie.test(per variable)
Multiple Linear Regression Test	car	Summary(Modelreg)

3. Results and Discussion

The geography learning paradigm in Indonesia has evolved over time. In general, teachers describe geography as closely related to maps (Bednarz et al., 2006; Wiegand, 2006). Geography concerns memorizing the position and location of one place relative to another, as well as the toponymy of a natural landscape and culture. This learning is characterized by the use of printed textbooks, maps, and atlases.

In the following period, the Google Earth platform started to be adopted in geography learning as geography teachers have been gradually using it as a learning media (McDaniel, 2022; Patterson, 2007). The use of Google Earth has the potential to enhance the appeal and variety of geography learning. Teachers and students can look for the geographic features of any location being studied. Irawan et al. (2014) explains that the use of Google Earth in geographical learning encompasses elements of remote sensing interpretation. Moreover, his research revealed that students who employed Google Earth in their learning found it more straightforward to comprehend remote sensing material than their counterparts who studied using analogue maps.

The media used by teachers in geography learning activities are PowerPoint, school plans, Google Earth, mitigation reps, maps, YouTube, Inarisk, posters, Google My APs, and textbooks. In general, those who have utilized Inarisk WebGIS are relatively young educators who have been teaching for less than five years. In contrast, Google Earth has been employed by educators who have been teaching for approximately ten years.

3.1. Prerequisite Test Results

3.1.1. Multicollinearity Test

The multicollinearity test is carried out to determine the linear relationship between predictor variables. Data is categorized as valid if VIF < 10. The results of the multicollinearity test are shown in Table 4.

Table 4. Multicollinearity Test Results

-	t value	Sig	Vif	Results	
Years of Teach	3,273	0.001483	5.81957	sig < 0.05 and vif < 10	Valid
Gender	-2,102	0.038158	1.00179	sig < 0.05 and vif < 10	Valid
Age	-3,977	0.000136	5.82277	sig < 0.05 and vif < 10	Valid

Table 4 indicates the absence of multicollinearity in each variable, which indicates that there is no relationship between the predictor variables. The value of years of teaching has a significance level of 0.0014, which is greater than 0.05, and a variance inflation factor (VIF) of 5.819, which is less than 10. These values indicate that multicollinearity does not occur. The significance value of 0.000 > 0.05 and the variance inflation factor (VIF) of 5.822 < 10 for age also indicates that there is no relationship between variables. The same is true for gender, with a significance value of 0.03 > 0.05 and a VIF of 1.001 < 10. Therefore, it can be concluded that the data is valid and can be used in the subsequent stage of analysis.

3.1.2. Heteroscedasticity Test

The Heteroscedasticity Test was carried out to assess the inequality of variance from the residuals of one observation to another. A sig value > 0.05, tolerance > 0, and VIF less than 10 indicate that the data is valid and can be subjected to subsequent prerequisite tests. The results of the heteroscedasticity test are presented in Table 5.

Table 5. Heteroscedasticity Tests Results

Heteroscedasticity Tests Breusch-Pagan test					
BP	Df	p-value	Alpha	Results	Conc.
4.3309	3	0.2279	0.05	p-value > 0.05	Valid

The heteroscedasticity test was carried out using the bptest function with the Breusch-Pagan test algorithm. The result of this test suggests sig 0.227 > 0.05, which implies that the data is valid and the subsequent normality test can be performed.

3.1.3. Normality Test

The last prerequisite test is the normality test. The normality test was carried out to ascertain whether the data distribution could be considered normal. Data is considered normal if sig > 0.05. The results of the normality test calculations are presented in Table 6.

Table 6. Normality Test Results

Data	Sig	Results	conclusion
Years of Teach	0.12397	> 0.05	valid
Gender	0.41037	> 0.05	valid
Age	0.13958	> 0.05	valid
Using Status	0.4561	> 0.05	valid

Table 6 indicates that the significance value for each variable is less than 0.05, thereby confirming that the data is within the normal range and can be subjected to further analysis through the multiple regression test.

3.2. Multiple Linear Regression Test

The multiple linear regression test demonstrates the influence of the predictors' variables on one another. Additionally, it assesses the magnitude of the influence of the predictor variables included in the statistical calculation process. Table 7 shows the results of multiple linear regression tests.

Table 7. Multiple Linear Regression Test Result

Variables	Residual standard error	Multiple R-squared	Adjusted R-squared	F-statistic	sig
Modelreg	0.4128	0.1757	0.1497	6,749	0.00036

The results of the multiple linear regression test of the model are presented in Table 7. This model is utilized to predict the response variable, "Use of WebGIS," based on the predictor variables, years of teaching, age, and gender. Table 7 indicates that all variables exert an influence on the predictor variable. However, only 17.5% of the variance in the predictor variable can be attributed to these variables. Meanwhile, the remaining 82.5% of the variance in the predictor variable is explained by other variables. This figure can be seen from the Multiple R-squared column.

These results are derived from the p-value and F-table. In this research, we only interpret the sig 0.00036 < 0.05, which indicates that the predictor variables influence the predictor variable by 17.5%. The detailed results for each variable are shown in Table 8.

Table 8. Variable Test Results

Variables	Estimate	t value	sig	Information
Constant	5.18427	15,881		
long time teaching	0.04146	3,273	0.001483	positive influence
Gender	-0.18148	-2,102	0.038158	negative influence
Age	-0.04448	-3,977	0.000136	negative influence

The constant value shows a positive t-value of 15.881. This implies that the predictor variable is associated with the response variable in a similar direction. An increase in the predictor's variable signifies an enhanced response variable. In the absence of a change in the predictors variable, the influence value is 15.881 (17.5% of all predictors variables that influence the predictors variable). The t-value for years of teaching is positive at 3,273, indicating that an increase of 1% in the number of years spent teaching will result in an increase in the use of WebGIS. This implies that the longer the time spent teaching, the greater the value of using WebGIS in learning. In contrast, the age variable shows a negative value of -3,977, indicating a negative direction. Consequently, if the variable increases by 1% (age increases), the value of using WebGIS will decrease.

As for gender, it has a Beta value of -2.102, indicating a negative direction. This implies that when there is an increase, the use value will decrease. The conversion of nominal data to ordinal in this instance is that men use the number 1 and women use the number 2. Given that it has a negative direction, the influence is greater on the smaller number, namely number 1, which represents men. Consequently, this data demonstrates that men use WebGIS more than women.

These results indicate that the three predictor variables (teaching years, age, and gender) collectively contribute significantly to the response variable "WebGIS use in geography learning". Positive or negative t values indicate the direction of the relationship between each predictor variable and the response variable, while the significance value measures the statistical significance of the relationship (Guetterman, 2019; Nathans et al., 2012; Rubinfeld, 2000; Zou et al., 2003). These guidelines are used to determine the direction of influence of the predictors variable on the predictors variable.

3.3. Data Interpretation

The regression results presented in Table 8 suggest that the use of webGIS is negatively proportional to teacher age. This is reinforced by the results of the multiple linear regression test that the t-value of age has a negative value on the use of WebGIS in geography learning. This implies that the lower the age, the more intense the use of WebGIS in learning. This is corroborated by the results of survey data processing, which are presented in Table 9.

Table 9. WebGIS User Data by Age

Age	Once	No	Amount	Percentage of Users
20 to 30	25	7	32	78%
30 to 40	30	9	39	77%
40 to 50	14	9	23	61%
> 50	5	5	10	50%

Table 9 indicates that teachers in the 20-30 age range utilize WebGIS more frequently than their older counterparts. This phenomenon may be attributed to the transition of prospective teachers' learning from conventional learning methodologies to contemporary approaches that leverage cutting-edge technologies. Consequently, supplementary courses in the form of technology-based media development stimulate prospective teachers to explore modern spatial technologies. Table 10 shows the use of WebGIS based on years of teaching.

Table 10. WebGIS User Data According to Years of Teaching

Long time teaching	Once	No	percentage
< 5 years	18	5	78%
5 to 10 years	22	13	63%
10 to 15 years	20	3	87%
15 to 20 years	6	5	55%
> 20 years	8	4	67%

Table 10 indicates that teachers with 10-15 years of teaching experience use WebGIS more frequently than teachers with other years of teaching experience. This variation may be influenced by other factors, such as the location of the teaching institution and the courses and training programs attended. However, this research has not identified these other factors as potential contributors to the observed results. Nevertheless, the regression results indicate that teachers with more experience tend to utilize WebGIS more frequently.

The results of our research diverge from research conducted by Ismail and Abas (2018) which revealed that older teachers presented higher effectiveness than younger teachers. This discrepancy can be attributed to the fact that older teachers tend to exercise greater caution and deliberation in their decision-making processes than their younger counterparts. In contrast, Alufohai and Ibhafidon (2015) research indicates that students taught by teachers aged 36-48 years perform better than students taught by teachers aged 21-34 and over 49 years. This research suggests that age affects teachers' experience in teaching. The highest effectiveness value is observed in middle-aged teachers, as demonstrated by Goebel and Cashen (1979). Young teachers are still developing the capacity to make mature decisions. In contrast, teachers in old age have already begun to exhibit a decline in performance due to age-related factors.

Aloka and Bojuwoye (2013) found that younger teachers tend to make more frequent riskier decisions and do not analyze the context when dealing with problems. This is caused by immaturity and lack of experience. Besides, these three studies are not in alignment with the findings of Rajammal and Muthumanickam (2012) which revealed the absence of significant differences between old and young teachers. The authors posited that differences in teachers' ability to teach were more pronounced due to gender and the location of teaching. Conversely, age and the duration of teaching were found to have no impact on teacher effectiveness in the classroom.

Previous research indicates that teacher age is not the sole factor influencing teachers' capacity to utilize WebGIS. Access to personal development and teaching resources also plays a role in teachers' ability to integrate media into their pedagogical practices. WebGIS emerged in 1993 and, at that time, was a prevalent technology in the western world (Li et al., 2022). Consequently, older teachers may lack familiarity and expertise in utilizing WebGIS. They continue to rely on analog maps, which are straightforward to use and reliable in displaying the shape and location of an object on the Earth's surface. Their inclination towards caution often results in a tendency to be reluctant to embrace new concepts and technologies.

This differs from the approach of younger teachers, who tend to be more open but less likely to filter the incoming information. Consequently, they can readily utilize WebGIS without much consideration. However, it is important to note that further investigation is required to ascertain whether the management of younger teachers using WebGIS in the classroom is more effective than the management of older teachers who only use analog maps. The incomplete nature of the information available in WebGIS raises concerns that teachers may only convey it without ensuring that students are able to interpret and analyze the data available in WebGIS. Table 11 provides an overview of the percentage of male and female teachers who use WebGIS.

Table 11. WebGIS User Data According to Gender

Gender	User	Not User	Percentage
Man	30	6	83%
Woman	44	24	65%

Table 11 indicates that the percentage of WebGIS use by male teachers is higher than that of female teachers, as consistent with the results of calculations using multiple linear regression. However, a closer examination of the data reveals that more female teachers use webGIS in learning activities. Female teachers are also more active in participating in self-development activities organized by the institution. A number of studies have indicated that these differences may be attributed to the differing ways in which the male and female brains process information (Darwanto & Putri, 2021). Men are better at using logic and tend to be stiff in demeanor (Bernstein, 1961). Conversely, women are better at managing emotions, feelings, language, melody, and tone. Consequently, in practice, due to the fact that WebGIS places greater emphasis on logical thinking, men are more likely to utilize Google Earth.

Mwamwenda and Mwamwenda (1989) and Zuzovsky (2009) revealed that women's performance is better than men's performance. This study utilized student performance data to investigate the correlation between teacher gender and academic achievement. The findings revealed that students taught by female teachers exhibited higher levels of academic success than those taught by male teachers. Meanwhile, Alufohai and Ibhafidon (2015) asserts that there is no significant difference between gender differences and teaching ability. Research that corroborates the findings of our study includes research by Arbuckle and Williams (2003) and Martin and Smith (1990), which states that men's performance is better than women's performance. According to surveys distributed to students, male lecturers tend to be more logical and organized in presenting material than women. The results of our analysis indicate that male teachers are more likely to use WebGIS because this technology supports logical thinking.

Google Earth is a software that visualizes data according to real locations on the Earth's surface. Male teachers who rely on logical rationale choose to use WebGIS rather than other media. In contrast, female teachers are more inclined to embrace media that attract attention, such as videos. The video shows animation and sound, which makes learning more enjoyable and facilitates the discovery of concepts. It differs from traditional forms of analysis and interpretation of existing data.

In addition, the survey results indicate that the variety of WebGIS utilized is still limited. The majority of teachers have not employed other WebGIS, such as WebGIS KLHK, Magma.go.id, DIBI, WebGIS esdm, and Living Atlas from ESRI. Therefore, it can be concluded that teachers have only utilized 28% of the GIS technology presented in the survey. Consequently, the materials that employ GIS technology are confined to those pertaining to remote sensing and geographic information systems. The following graph illustrates the utilization of WebGIS in geographic materials, which can be observed in Figure 2.

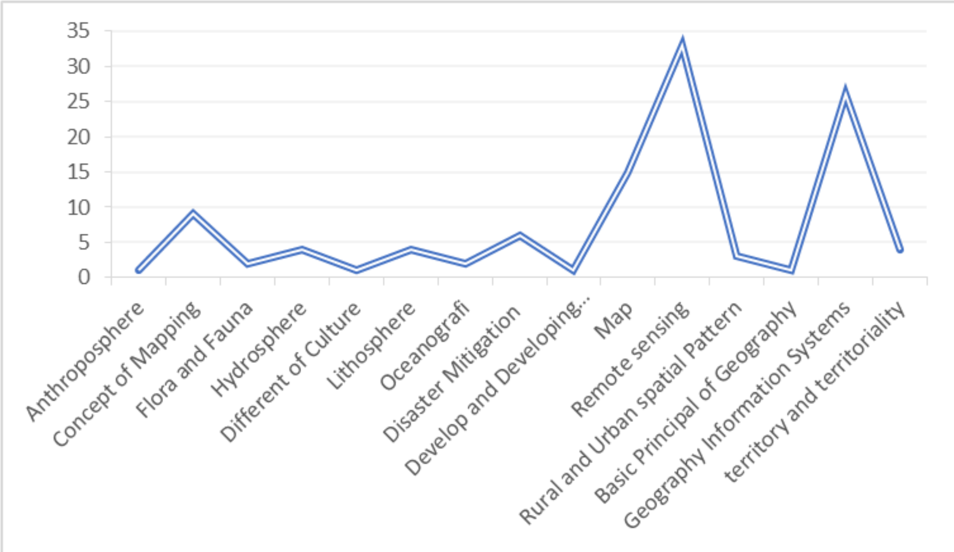

Figure 2. Graph of WebGIS Use in High School Geography Material

Figure 2 illustrates a notable disparity between the utilization of WebGIS in Remote Sensing and Geography Information System material compared to other subjects. Despite the availability of open-source WebGIS from numerous government institutions in domains such as disaster management, natural resources, forestry resources, and land use, the survey findings indicate several challenges persist in WebGIS learning activities. Students are not yet proficient at reading maps, and internet connections are often unstable. Additionally, facilities and infrastructure are inadequate, and there has been no implementation of mitigation measures. Students also lack the requisite speed to comprehend the learning material, and there are limited resources and teaching materials. The maps used are not up to date, disaster evacuation maps are incomplete throughout Indonesia, and there are difficulties related to information technology. Furthermore, student cell phones often lack the necessary support, teacher data sources are incomplete, the media is limited and less interactive, and not all students are active in learning activities.

These issues are pervasive and have been identified through surveys conducted at various educational institutions. The majority of these concerns relate to the condition of school facilities and infrastructure. Therefore, it is imperative that the government allocates sufficient resources to ensure that schools have adequate infrastructure to facilitate optimal learning. As for problems relating to student understanding, it is necessary to review student backgrounds, student learning motivation, and teacher methods and management in teaching.

4. Conclusion

The analysis results indicate that age, gender, and years of teaching influence the use of WebGIS in geography learning. These three variables collectively account for 17.5% of the variance in the predictor variable, while the remaining variance is explained by other variables. The results of sig 0.00036 < 0.05 show that age, gender, and teaching experience affect the ability of geography teachers to use WebGIS. The length of teaching experience is directly proportional to the use of WebGIS. Teachers who have been teaching for a longer period of time tend to use WebGIS more frequently. Gender has a negative direct effect, with a conversion result of 1 indicating that male teachers use WebGIS more frequently. Age also has a negative influence, suggesting that younger teachers tend to use WebGIS more than their older counterparts.

The challenges faced by educators include limited infrastructure and the limited number of WebGIS variants in use. Remote sensing material is the material most often delivered using GIS technology. Meanwhile, the other sub-themes are still in their infancy. The use of WebGIS in learning activities is not yet very familiar to teachers. Geography teachers still use GIS technology on a limited scale and have not yet been able to integrate it into various relevant materials.

Author Contributions

All authors have accepted responsibility for the entire content of this manuscript and approved its submission.

Conflict of Interest

Authors state no conflict of interest.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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