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Utilization of QGIS and Avenza Maps-Based Digital Maps in Geography Learning in High Schools

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Abstract

The role of learning media as a direct or indirect object for students cannot be ignored in the learning process. However, most teachers have not yet fully utilized geographic information system technology as a learning resource or representative media for learning in schools. Therefore, it is necessary to utilize GIS technology in the development of digital map media integrated with QGIS software and the Avenza Maps application in learning materials on the basics of mapping. The general objective of this study is to utilize digital map media based on QGIS and Avenza Maps to improvespatial thinkingstudents. The method used is research and development or Research and Development using the ADDIE development model. Based on a limited trial of the effectiveness of the media at SMA Negeri 2 Gorontalo, it shows that there are 34 students who were tested who achieved a mastery score of 31 students, while in a wider trial at several high schools the results showed that digital map media is very good for use in schools in the learning process. This is evidenced by student mastery data in evaluating the learning process with a presentation value between 80-100%. The presentation results are included in the category (Very Good) thus digital map media based on QGIS and Avenza maps are very good for use in the learning process.

Keyword: Digital Maps, GIS Technology, Students' Spatial Thinking.

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INTRODUCTION

Education is the learning and skills needed by the nation to continue working to create innovations to support educational progress in the country (Kusuma et al., 2019). Education is one effort to train the younger generation to enter the global era in welcoming and facing the development of the times. Therefore, it is necessary to provide education as optimally as possible to produce quality education and improve the quality of human resources in Indonesia (Kusuma et al., 2019). Education is one effort to prepare the younger generation to welcome and face the development of the times in the global era, so it must be implemented as well as possible to produce quality education and improve the quality of human resources. The learning process is highly dependent on media, methods, and learning outcomes (Nurrita T, 2018).

Learning activities are interactions between students, educators, and learning resources that occur within a learning environment. The learning process is a system consisting of interconnected and interacting components. The implementation of this process is a combination of various elements aimed at achieving optimal results, in accordance with the objectives set out in Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System. Learning styles are the basic potential or tendencies possessed by children. It is important for teachers to consider different learning styles when designing strategies, methods, media, and activities that engage students. Learning styles are usually divided into visual, auditory, and kinesthetic learning styles. These differences in learning styles can indicate the best way for students to learn more quickly (Nazmi M, 2017).

Learning media is a crucial element in the learning process. Learning media are learning resources that help teachers broaden students' horizons. Teachers can utilize various types of learning media to provide knowledge to students. The use of learning media can foster students' interest in learning new things, enabling them to understand the material presented by the teacher more easily. Learning media that appeals to students can stimulate their learning process. Managing learning aids is essential in formal educational institutions. Learning media can be used as a tool in teaching and learning activities (Nurrita, T, 2018).

Maps are a very important learning medium for students in Geography learning. Maps are a type of media that facilitates the presentation of information about the earth's surface that is very broad (such as vegetation, rivers, roads, settlements, and topography/landforms) that cannot be displayed in their original form and size on a map sheet with limited space and size. The application of GIS can be used in decision making because information based on spatial data will provide a more complete picture to select the suitability of a particular area to predetermined parameters/criteria (Rustamaji, 2013).

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QGIS is freely accessible software, making it suitable for both students and teachers in schools. To implement GIS-based learning media with the QGIS application, an educator or teacher operating it must be computer literate. In addition to the skills required to use this media, supporting facilities and infrastructure are also needed to ensure the smooth running of the GIS-based learning process. Besides QGIS, Avenza Maps is also used in geography learning. Avenza Maps - Offline Mapping, developed by Avenza System Inc., is an attractive option among the many applications offered. The features in this application are sufficient to meet the needs of GPS usage on mobile smartphones, such as reading coordinate positions, navigation features to coordinate locations, tracking features, drawing and calculating distances, calculating polygon areas, adding photo information with geotagging labels, and so on (Suprianto and Effendi, 2020). Furthermore, this application also improves students' skills in using geospatial technology and fosters a practical understanding of GIS concepts. Technical constraints such as limited GPS signals or device memory capacity can be overcome with initial training and careful data collection planning. Thus, Avenza Maps is highly recommended as a supporting media for mobile-based GIS practical learning that is adaptive to technological developments and learning needs in the digital era (Sabihi, 2025).

Geospatial technology as a learning medium is very interesting, and teachers who have TPACK skills will support it. TPACK is a 21st-century teacher knowledge framework that can combine learning materials (content), pedagogy (learning design), and technology (technological) (Wijayanto, 2017). By using geospatial technology as a learning medium that can attract students' attention in the learning process, Purnomo has the opportunity to improve spatial thinking skills and the quality of geography learning (2021). The problem-solving process involves identifying problems and developing solutions (Susetyo, 2017).

Based on the survey results, several challenges were identified in geography instruction, particularly in the fundamentals of mapping. Among the challenges encountered during direct interviews with schools were teachers' lack of optimal use of technology due to limited training, infrastructure, and appropriate teaching materials. Consequently, geography instruction has not fully captured students' interest or improved their spatial thinking skills. Furthermore, the lack of digital maps in geography instruction often leads to students' confusion when reading maps, particularly in understanding map elements.

METHOD

In general, high school education in Gorontalo City is in fairly good condition for an urban area: there are both public and private schools available, some are accredited, and the majority

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of classroom facilities are in decent condition. However, there is still room for improvement, particularly in ensuring equitable quality across schools, strengthening supporting facilities, and improving accreditation to ensure all schools are on an equal footing.Gorontalo City is a hub of educational activity, with a relatively high concentration of high schools compared to surrounding districts. Most high schools in the city have implemented the Independent Curriculum, which focuses on strengthening competencies, character, and 21st-century skills.This research was conducted at State Senior High School 2 Gorontalo. Details can be seen in Figure 1.

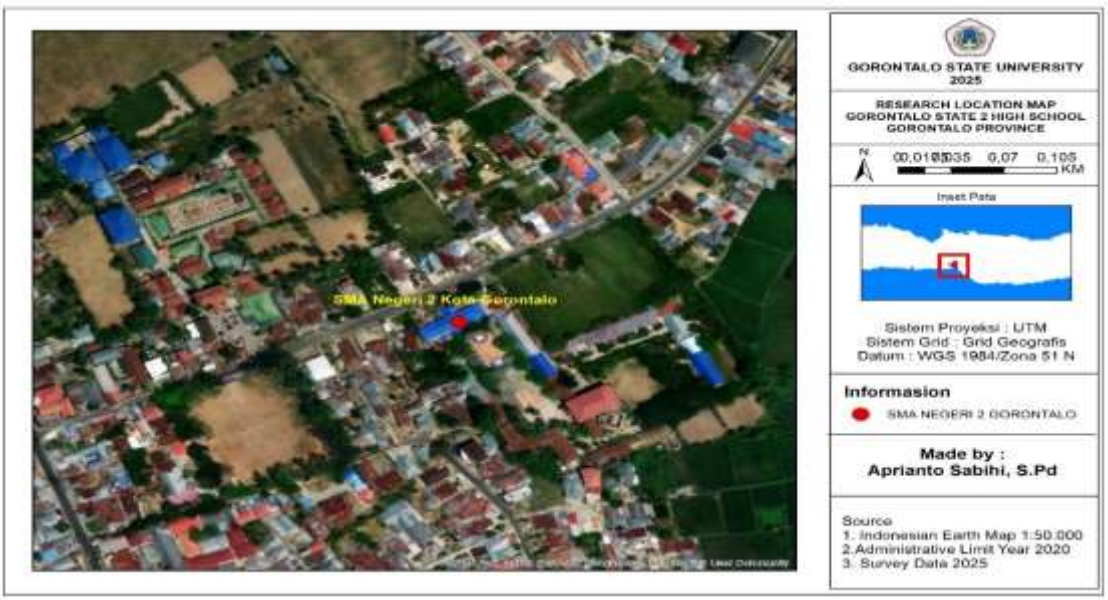


Figure 1 Research Location Map

This research uses the research and development method. According to Sugiyono (2019), research and development is a scientific way to research, design, produce, and test the validity of the resulting product. Research and development is a research method used to develop and test products, typically in the field of education (Maydiantro, A, 2021).

In conducting research, it is necessary to select research procedures to design the research process. This research uses the ADDIE development model. This development model was developed by Reiser and Mollenda in the 1990s. ADDIE stands for analysis, design, development, production, implementation, or delivery, and evaluation. The variable used in this study is digital maps, which are intended to be used as student learning media.

Analysis of student test results data to evaluate the effectiveness of the developed

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product was carried out as follows:

1) Calculate the scores obtained by each student using scoring guidelines to determine the level of student learning completion.
2) Calculate the average value of all students in the following way:

$$p = \frac{\sum x}{n} \text{ x } 100\%$$

Information:

P = percentage

$\sum x$= total score of all students

n= many students

3) Convert the average value into a qualitative value and then classify it based on the criteria referred to in the following table. The learning outcome test criteria and classical learning completion criteria can be seen in Table 1.

Table 1 Criteria for Learning Outcomes Tests and Classical Learning Completion Criteria

Student Grades	Percentage of Student Learning Outcomes	Criteria
X ≥85	P > 85	Very high
75 < X ≤ 85	75 < P ≤ 85	High
65 < X ≤ 75	65 < P ≤ 75	Enough
45 < X ≤ 65	55 < P ≤ 65	Not enough
X ≤45	P ≤ 65	Very less

Source (Zainal, 2009)

Information:

X = Student Grade

P = Percentage of Classical Learning Completion

Calculating the percentage of classical learning completion

$$p = \frac{many\ students\ graduated}{many\ students\ took\ the\ test} \text{ x } 100\%$$

RESULTS AND DISCUSSION

Effectiveness of Digital Map Media

The results of the trial learning conducted at SMA Negeri 2 Gorontalo to see the

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effectiveness of the products that have been developed in this study, namely digital map media based on QGIS and Avenza Maps, were assessed using a written test at the end of the meeting after the product trial was conducted to determine whether there was an increase in learning outcomes. Detailed written results of students can be seen in the appendix. The following are the results of the effectiveness of digital map media in graphic form, which can be seen in Figure 2.

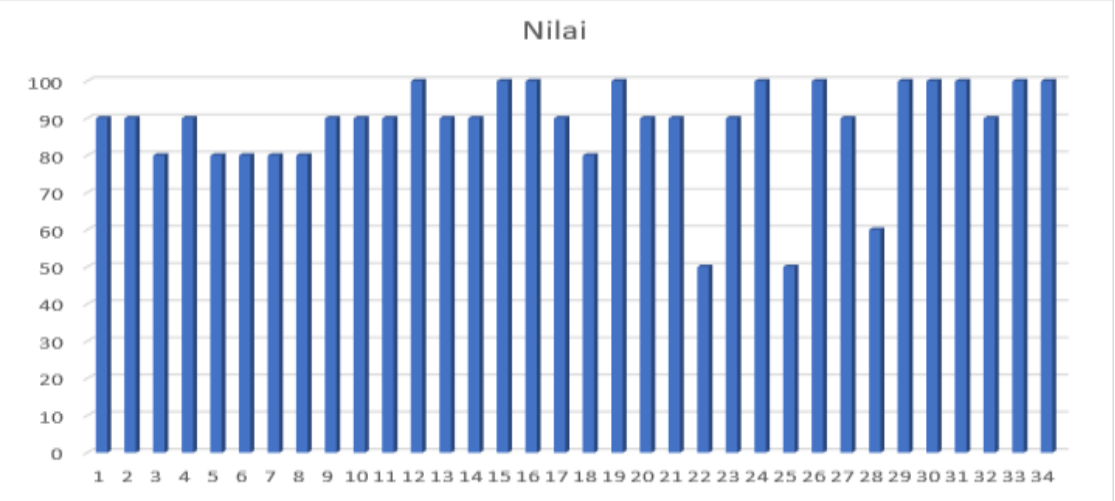


Figure 2 Results of the effectiveness of digital map media at SMA Negeri 2 Gorontalo

Based on the graphic image above, the results of the written test filled out by 34 class X students showed a significant increase with 31 students completing the test out of 34 students tested. This means that by using digital map media based on QGIS and Avenza Maps, there was an increase in student learning outcomes. This can be seen in the learning process, students seemed more focused on analyzing maps in the Avenza Maps application and can help students in spatial thinking, in addition, this digital map media is able to help students analyze the surrounding environment and also makes it easier for students to collect coordinate data in the field.

The effectiveness of the products developed in this study, namely QGIS and Avenza Maps-based digital map media, was assessed using a written test at the end of the meeting after the product trial was conducted to determine any improvements in learning outcomes. In the coordinate mapping process, students first collected field coordinate data. The following coordinate data collected by students can be seen in Table 2.

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Table 2 Field Coordinate Data

X	AND	Group	School
123,033124	0,553003	1	State Senior High School 2 Gorontalo
123,033472	0,553185	2	State Senior High School 2 Gorontalo
123,033524	0,552713	3	State Senior High School 2 Gorontalo
123,033708	0,552477	4	State Senior High School 2 Gorontalo
123,034252	0,552479	5	State Senior High School 2 Gorontalo

Source: Primary Data 2025

During the learning process, students appeared more focused on reading and analyzing digital maps on the Avenza Maps application display. In addition, in this lesson, students input data they obtained from field data collection into the QGIS application to perform mapping. Next, students conducted a simple mapping in the form of a coordinate data collection map in the school environment. Details can be seen in Figure 1.



Figure 1 Map of coordinate mapping results

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Based on the coordinate mapping results conducted by students at SMA Negeri 2 Gorontalo, it can be seen that there are 5 coordinate points for each group. As can be seen in the image above, the purple and yellow points represent groups 1 and 2, while groups 3, 4, and 5 are marked with green, blue, and red.

CONCLUSION

Based on the results of research on the Utilization of QGIS-Based Digital Maps and Avenza Maps in Geography Learning in High School, it can be concluded that the use of geospatial technology based on QGIS software and the Avenza Maps application can improve the quality of the geography learning process. The use of QGIS helps students understand the concept of mapping, spatial data processing, and the independent creation of digital maps. Meanwhile, Avenza Maps supports learning activities outside the classroom through GPS-based field mapping so that students can connect theory with real conditions in the surrounding environment.

Furthermore, the use of these two applications has been shown to improve students' spatial thinking skills, geospatial literac, and learning motivation. Learning becomes more interactive, contextual, and aligned with developments in information technology in the digital era. Therefore, the integration of QGIS and Avenza Maps in geography learning in high school is considered effective as a geospatial technology-based learning innovation and is recommended for further development in the curriculum and field practicum activities.

REFERENCE

Aliman, M., Mutia, T., Halek, D. H., Hasanah, R., & Muhammad, H. H. (2020). Development of a Spatial Thinking Ability Test Instrument for High School Students.*Journal of Geographical Science and Education Studies*, *4*, 1–10. https://doi.org/10.29408/geodika.v4i1.1823

Azhar, M., & *Surono, S. (2022). Analysis of the use of symbols and map components in high school geography learning. Journal of Geography Education, 17(2), 85–94. https://doi.org/10.24036/jpg.v17i2.4567*

Budiyanto, E. (2023). Digital Cartography and Maps for Education. Bandung: Alphabeta.

Fitrianingsih, R., & Pratama, D. (2024). Effectiveness of using QGIS in improving students' spatial literacy. Gea Geography Journal, 24(1), 33–42.

Kadir, F. (2020). Mapping and GIS Basics. Jakarta: Rajawali Press.

Kusuma, D., et al. (2019). Development of technology-based learning media for high schools. Indonesian Journal of Education Technology

Copyright to the author of some rights reserved This work is licensed under aCreative Commons Attribution-ShareAlike 4.0 International License.

Lestari, R., & Nugroho, A. (2025). Integration of GIS technology in the Discovery Learning learning model. Journal of Education and Geography, 28(1), 11–22.

Maydiantro, A. (2021). Research and development methods in educational innovation. Indonesian Educational Journal.

Nazmi, M. (2017). Application of Animation Media to Increase Student Learning Interest in Geography Subjects at Sma Pgii 2 Bandung. InJournal of Geography Education (Vol. 17, Issue 1).

Nurrita, T. (2018). Development of Learning Media to Improve Student Learning Outcomes (Vol. 03).

Rustamaji, H. (2013). Application of GIS for spatial-based decision making. Journal of Spatial Analysis.

Sabihi. A & A. Lukum. (2025). Coordinate Data Retrieval Using the Avenza Maps Application for Students in Geographic Information Systems Practicum.Journal of Research, Education and Teaching: JPPP. https://doi.org/10.30596/jppp.v6i1.24098

Suprianto, B., & Effendi, A. (2020). Utilizing Avenza Maps for geography learning. Geospatial Technology Review.

Sutanto, B., et al. (2019). Development of geographic information systems for education. Journal of Geographic Information Systems.

Wijayanto, R. (2017). The TPACK framework in 21st-century learning. Journal of Teacher Education.

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