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# The Effectiveness of Using Google Earth to Improve the Spatial Skills of Phase B Elementary School Students

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**Abstract**

This study addresses the issue of low spatial abilities among Phase B elementary school students, particularly in understanding regional location, spatial orientation, and distance. The problem is attributed to the continued use of conventional learning media that lack the capacity to visualize spatial concepts in an engaging and concrete manner. The research aims to evaluate the effectiveness of Google Earth as a digital learning medium to enhance students' spatial abilities within the IPAS subject, specifically on the topic of identifying the location of their city or regency. A quantitative research approach was employed using a pre-experimental one-group pretest-posttest design. The participants comprised 25 fourth-grade students from SDN Cisarua, West Bandung Regency. Data were collected using an essay test consisting of 10 questions. The results showed a significant increase in posttest scores compared to pretest scores, with the N-Gain categorized as high. Statistical analysis further confirmed a significant difference between pretest and posttest performance. The study concludes that the integration of Google Earth is effective in improving spatial abilities among elementary school students. These findings support the use of interactive, contextual, and technology-based learning tools as viable alternatives to traditional methods in enhancing geography-related competencies in early education.

**Keywords:** Google Earth; Spatial Ability; Learning Media; IPAS; Elementary Education

## INTRODUCTION

Basic education plays a strategic role in shaping the cognitive, affective, and psychomotor foundations of students. The Merdeka Curriculum, through the IPAS subject, promotes the integration of Natural and Social Sciences to enable students to understand their surrounding environment (Ministry of Education and Culture, 2022; Suhelayanti & Rahmawati, 2023). At the elementary level, IPS learning begins with an introduction to the immediate environment, such as the district and province, then progresses to the national level, and finally expands to the international level (Giwangsa et al., 2022). In the face of globalization and digitalization, 21st-century competencies such as critical thinking, collaboration, communication, and spatial ability are essential skills that need to be mastered from an early age (Pare & Sihotang, 2023).

Spatial ability is an important part of visual intelligence, which relates to a person's ability to understand, remember, and mentally manipulate objects and space (Ristontowi, 2018; Kusumawardani, 2018). This ability encompasses aspects of imagination and reasoning that play a role in daily life, such as remembering shapes, recognizing directions, and solving spatial problems (Azriati et al., 2020; Sudirman & Alghadari, 2020). Individuals with high spatial abilities tend to be more creative, adaptable, and have strong memories (Kusumawardani, 2018). According to Maharani & Maryani (2016), indicators of spatial ability consist of the ability to determine location, identify spatial orientation, estimate distance, and understand symbols. Conversely, low spatial ability can lead to difficulties in recognizing relationships between objects, thinking imaginatively, and understanding spatial structures (Purborini & Hastari, 2019).

In the context of education, spatial ability needs to be developed through appropriate learning, particularly in social studies subjects, where students learn about spatial concepts and the environment. Therefore, effective learning must be able to provide interactive and visual media such as maps, models, or digital simulations so that students can understand spatial relationships concretely (Faudah et al., 2023; Huda, 2020). Without appropriate learning media, the development of students' spatial abilities may be hindered (Zulfa et al., 2023).

According to Piaget's cognitive development theory, students aged 7–11 years are in the concrete operational stage, where they begin to think logically and systematically and can understand spatial concepts through direct experience (Daryanti et al., 2019). Spatial abilities

at this stage can be optimally developed through visual learning approaches and hands-on practice, such as the use of three-dimensional digital media. Thus, improving spatial abilities not only supports social studies learning but also serves as an important foundation for understanding other disciplines more deeply and practically.

However, challenges still exist in practice. Based on observations at SDN Cisarua, fourth-grade students demonstrated difficulties in identifying compass directions, determining residential locations, and drawing simple maps (Roziman et al., 2023, p. 182). This is reinforced by the PISA 2022 report, which shows that Indonesia's score in the "space and shape" content is only 367, far below the OECD average of 471 (OECD, 2023). One of the causes of students' weak spatial abilities is the use of static learning media, such as images in textbooks, which are unable to visualize spatial concepts concretely (Zulfa et al., 2023).

As a result, students face obstacles in understanding geospatial concepts that form the basis of thinking in geography and mathematics (Rahman et al., 2022; Priyono & Lestari, 2022). Limited spatial abilities not only hinder students' understanding in social studies learning but also affect their mastery of concepts in other subjects. Students with weak spatial abilities tend to have difficulty processing visual information and understanding the relationships between space and objects (Rahman et al., 2022). This also reduces their ability to think critically about location and space, thereby affecting their understanding of the environment, map navigation, and natural processes (Priyono & Lestari, 2022). If not developed, this weakness will hinder students in solving everyday problems and understanding more complex social studies material in the future (Roziman et al., 2023).

To address this challenge, digital-based learning media that can interactively visualize spatial abilities are needed. One potential medium is Google Earth, as it can display the Earth's surface realistically and dynamically, providing a more contextual spatial learning experience (Santoso, 2022; Aliman et al., 2019). Several studies indicate that the use of Google Earth is effective in improving students' spatial skills (Faudah et al., 2023; Vidiawati & Gunansyah, 2023). However, most of these studies were conducted at the junior high school and high school levels, as well as with phase C students (grades 5 and 6), so there has been little research on the effectiveness of this medium in phase B (grade 4), which has different developmental characteristics (Mutia et al., 2023; Septiana et al., 2022).

Based on this gap, this study is important to assess the extent to which Google Earth can improve the spatial abilities of elementary school students in phase B. Therefore, this

study aims to determine the effectiveness of using Google Earth in improving the spatial abilities of elementary school students in phase B. The specific objectives of this study are to analyze the spatial abilities of students before using Google Earth media, analyze their spatial abilities after using Google Earth media, and measure the effectiveness of Google Earth media based on three main indicators, namely determining location, identifying spatial orientation, and estimating distance.

## METHODS

This study used a quantitative approach with a one-group pretest-posttest design. This design was used to determine the effect of Google Earth on improving students' spatial abilities. The study was conducted at SDN Cisarua, Cisarua District, West Bandung Regency, in the even semester of the 2024/2025 academic year. The subjects of this study were 25 fourth-grade students. The research was conducted at the school over a period of two days. Data collection techniques used essay tests based on spatial ability indicators, namely determining location, identifying spatial orientation, and determining distance. The instruments were validated by two subject matter experts and pilot-tested on students before being used in the pretest and posttest. The data obtained were analyzed using descriptive and inferential statistical tests. The analysis steps were as follows: performing normality tests, homogeneity tests, and paired sample t-tests to determine the significance of the differences between the pretest and posttest, and calculating N-Gain to see the improvement in learning outcomes. The analysis was performed using SPSS version 29 software.

## RESULTS

Before learning using Google Earth, students took a pretest to measure their initial spatial abilities based on three indicators, namely determining location, spatial orientation, and distance. Table 1 below presents a summary of descriptive statistics from the pretest results.

**Table 1.** Descriptive Statistics of Pretest Results

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation | Skewness | |
|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Statistic | Statistic | Std. Error |
| Pretest | 25 | 37.50 | 55.00 | 46.5000 | 5.00000 | .027 | .464 |
| Valid N (listwise) | 25 | | | | | | |

A total of 25 students took the spatial ability pretest. The analysis results showed a minimum score of 37.50, a maximum of 55.00, with an average of 46.60 and a standard deviation of 5.00. The skewness value was 0.027. This average is still below the KKTP, indicating that, in general, the spatial ability of the students is still low. Figure 1 below presents the pre-test results of all students in the form of a bar graph.

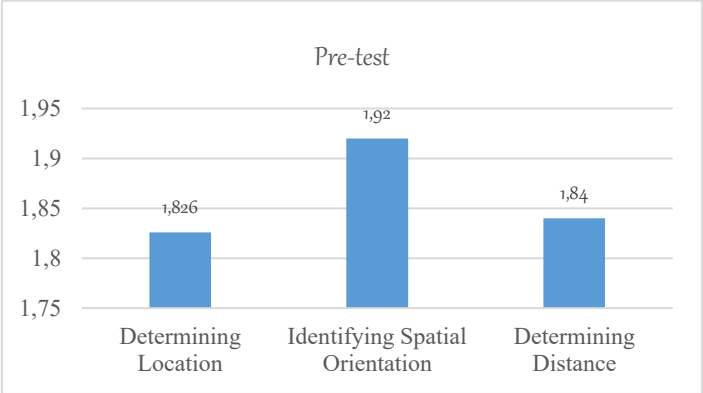


**Figure 1.** Graph of Spatial Ability Achievement Results on the Pre-Test

The pretest graph results show that the indicator for identifying spatial orientation recorded the highest average value of 1.92, followed by determining distance at 1.84, and determining location at 1.826. All of these values are still relatively low, indicating that the students do not yet have optimal spatial abilities. To measure spatial ability after learning, students were given a post-test, and the data was analyzed using IBM SPSS Statistics version 29.

**Table 2** Descriptive Statistics of Post-Test Results

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation | Skewness | |
|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Statistic | Statistic | Std. Error |
| Posttest | 25 | 72.50 | 100.00 | 85.0000 | 7.25287 | .334 | .464 |
| Valid N (listwise) | 25 | | | | | | |

Of the 25 students who took the test, the scores ranged from 72.50 to 100, with an average of 85.00 and a standard deviation of 7.25. The skewness value of 0.334 indicates that the posttest data distribution is slightly skewed to the right. This score represents a significant improvement compared to the pretest average of 46.50. These results confirm that Google Earth has a positive impact on the overall improvement of spatial abilities. To clarify the distribution of students' spatial abilities after learning, the posttest results are presented in a bar graph in Figure 2.

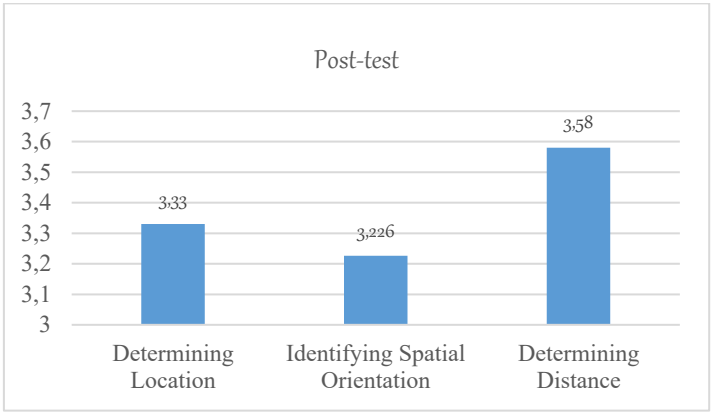


**Figure 2.** Graph of Spatial Ability Achievement Results on the Post-Test

The graph shows a significant increase in all indicators compared to the previous pretest results. The average score on the indicator determining location was 3.33, indicating an increase in students' understanding of identifying the location of a place. The spatial orientation indicator achieved an average of 3.226. Meanwhile, the distance determination indicator recorded the highest achievement with an average value of 3.58. Overall, all indicators increased from the average. Furthermore, Figure 3 presents a comparison of the pretest and posttest scores of the 25 students who were the subjects of the study.

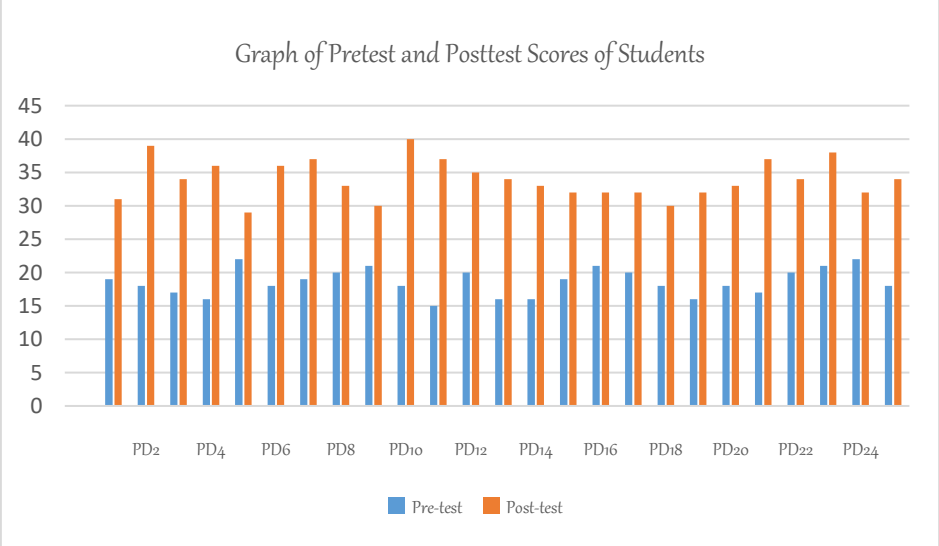


**Figure 3.** Graph of Pretest and Posttest Scores

Figure 3 shows a comparison of the pretest and posttest scores of the 25 students who were the subjects of the study. The graph shows that during the pretest, most students scored below 25 out of a maximum score of 40, with scores ranging from 15 to 22.5. Some students, such as PD4, PD10, PD13, and PD21, showed relatively low scores. After the educational intervention, posttest scores showed a significant improvement, with most students achieving scores between 30 and 40. Even students with the lowest initial scores demonstrated noticeable improvement. In general, the graph shows that all students experienced an increase without any decrease in scores, with a consistent and even trend. To obtain a more comprehensive picture of the improvement in students' spatial abilities, a comparison of the average pretest and posttest scores for each indicator was conducted. The results of this analysis are presented in the following graph 4.

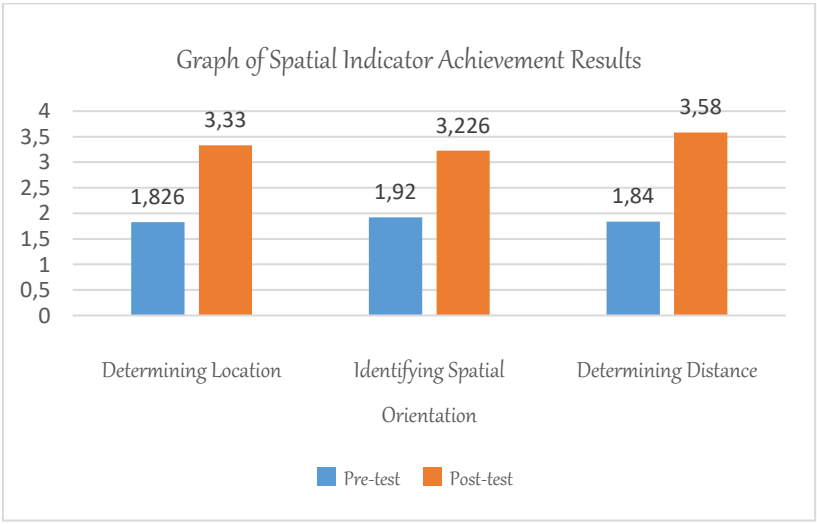


**Figure 4.** Graph of Percentage Achievement of Spatial Ability Indicators

Figure 4 presents a comparison of student achievement based on three indicators. In the location determination indicator, the average score increased from 1.826 to 3.33, or an increase of 1.504 points. For the spatial orientation indicator, the average score increased from 1.92 to 3.226, or by 1.306 points. Overall, all indicators showed a significant increase, with the highest achievement in the distance determination aspect. To ensure that the data met the requirements for parametric statistical testing, a normality test was conducted on the pretest data.

**Table 3.** Results of the Normality Test on the Pretest

**Tests of Normality**

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| Pretest | .138 | 25 | .200* | .953 | 25 | .285 |

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on the normality test output using the Shapiro-Wilk method, the significance value for the pretest data was 0.285. Since this value is greater than 0.05, $H_0$ is accepted, meaning that the pretest data is normally distributed. After determining that the pretest data is normally distributed, a normality test was also conducted on the posttest data to ensure consistency in distribution.

**Table 4.** Calculation of Normality Test Results for Post-test

**Tests of Normality**

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| Posttest | .140 | 25 | .200* | .966 | 25 | .549 |

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on the SPSS output in Table 4, the Shapiro-Wilk normality test for the posttest data showed a significance value of 0.549. Since this value is greater than 0.05, $H_0$ is accepted, which means that the data is normally distributed. Thus, both the pretest and posttest data have met the assumption of normal distribution. Next, a homogeneity of variance test was conducted using Levene's Test to test whether the pretest and posttest data had the same variance. The results are shown in Figure 4.

**Table 5.** Results of the Homogeneity of Variance Test for Pretest-Posttest Data on Students' Spatial Ability

**Tests of Homogeneity of Variances**

| | | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| Hasil | Based on Mean | 2.740 | 1 | 48 | .104 |
| | Based on Median | 2.637 | 1 | 48 | .111 |
| | Based on Median and with adjusted df | 2.637 | 1 | 44.461 | .111 |
| | Based on trimmed mean | 2.764 | 1 | 48 | .103 |

Based on the table, it shows that the significance value of the homogeneity test between the pretest and posttest values is 0.104, which is greater than 0.05. Thus, H_0 is accepted, and it can be concluded that the data has homogeneous variance. To determine the significant difference between the spatial abilities of students before and after learning, a paired t-test was used. This test was chosen because the data came from the same subjects and met the assumptions of normality and homogeneity.

**Table 6.** Paired Sample T-Test Comparison of Pretest and Posttest.

**Paired Samples Statistics**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | Pretest | 46.5000 | 25 | 5.00000 | 1.00000 |
| | Posttest | 85.0000 | 25 | 7.25287 | 1.45057 |

Based on Table 6, the average pretest score of the students was 46.50 with a standard deviation of 5.000, while the average posttest score increased to 85.00 with a standard deviation of 7.252. Since the posttest scores were significantly higher than the pretest scores, it can be descriptively concluded that there was a difference in the average spatial ability of students before and after learning using Google Earth.

**Table 7.** Interpretation of Paired Sample Test

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Significance | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval of the Difference | | | | | |
| | | Mean | Std. Deviation | Std. Error Mean | Lower | Upper | | | One-Sided p | Two-Sided p |
| Pair 1 | Pretest - Posttest | -38.50000 | 2.70031 | .54006 | -39.61463 | -37.38537 | -71.288 | 24 | <.001 | <.001 |

Based on Table 7, the average difference between the pretest and posttest scores is -38.50, with a calculated t-value of -71.288, df = 24, and a significance value of < 0.001. Since the significance value is less than 0.05, $H_0$ is rejected, which means that there is a significant difference between the pretest and posttest scores.

To strengthen the findings statistically and assess the level of treatment effectiveness, an analysis of score differences was conducted using the N-Gain test. The results of this test are shown in Table 4.9 and were calculated using SPSS Statistics version 29.

**Table 8.** Test of Differences in N-Gain Scores

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| NGain_Score | 25 | .56 | 1.00 | .7294 | .11548 |
| NGain_Persen | 25 | 56.00 | 100.00 | 72.9375 | 11.54828 |
| Valid N (listwise) | 25 | | | | |

Based on Table 8, the average N-Gain value obtained was 0.7294 or 72.93%, which falls into the high effectiveness category. These results indicate that the use of Google Earth media is effective in improving the spatial abilities of elementary school students in phase B, particularly in terms of locating their city/district of residence in grade IV.

## DISCUSSION

Before the lesson began, students took a pretest to assess their initial ability to understand the location of their city or district of residence. The pretest results showed that the average score of the students was still below the KKTP, which is in the low category. This condition is in line with the findings of Vidiawati & Gunansyah (2023) that elementary school students still have difficulty understanding geographical concepts due to the limited availability of concrete and visual learning media. Visual media such as Google Earth are believed to be able to overcome this gap (Faudah et al., 2023), as this medium allows for real and interactive exploration of spatial objects (Roziman et al., 2023).

After learning using Google Earth, students showed an increase in spatial ability on all three indicators. Digital exploration-based learning was conducted over two days using a student-centered learning approach. Posttest results showed a significant improvement compared to the pretest. The search and measurement features on Google Earth greatly aided students' spatial understanding (Maharani & Maryani, 2016). Realistic visualization also facilitates the understanding of spatial concepts (Daryanti et al., 2019; Faudah et al., 2023).

The effectiveness of Google Earth was proven through statistical testing. Normality and homogeneity tests showed that the data met the requirements for a t-test. The t-test results indicated a significant difference between the pretest and posttest scores, with an

average increase of 38.50 points. The N-Gain value of 72.94% indicates high effectiveness in improving students' spatial abilities. All indicators showed significant improvement, particularly in the distance aspect. This indicates that students experienced active, exploratory, and participatory learning (Zulfa et al., 2023). This finding is in line with Hidayah et al. (2022), who stated that Google Earth improves spatial skills through realistic geospatial visualization. Additionally, Kusumawardani (2018) states that this medium encourages students to think critically and connect geographical information with real life.

## CONCLUSION

Based on the findings and discussion in Chapter IV, it can be concluded that the initial ability of fourth-grade elementary school students to understand the location of their city/district of residence in IPAS learning is still not optimal. These findings indicate that at the initial stage, students do not yet have sufficient understanding in determining location, understanding spatial orientation, and measuring distance. After implementing learning using Google Earth, there was an overall improvement in students' spatial abilities. This improvement was reflected in the post-test results, which showed that students were able to understand the material better. This improvement was reinforced by statistical analysis, which showed a significant difference between students' initial and final achievements. The effectiveness of this medium is also supported by further analysis, which indicates that the improvement achieved falls into the high category. Therefore, it can be concluded that Google Earth is an effective learning medium for enhancing the spatial abilities of elementary school students in Phase B, particularly in IPAS class IV lessons on the location of their hometowns.

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