Investigating The Use of Google Earth Engine on The Improvement of Students' Remote Sensing Analytical Skills

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ABSTRACT
GEE is a cloud-based software that can be accessed for free. GEE is provided by Google as a planetary scale platform for Earth science data & analysis. it really helps the learning process in remote sensing courses.This encourages lecturers to provide training on GEE to students. The training consists of (1) introduction to remote sensing, (2) Band combination (3) Visualization of Satellite Image (4) Classification of Satellite Imagery. Before and after the training, there was a pre-test and post-test to find out whether students have good remote sensing analytical skills after using GEE or not. From the results, it can be seen that the analytical skills of students have increased significantly, with pre-test score of 30 (per 100) compared to post-test score about 75 (per 100).

Keywords: *google earth engine, remote sensing skill, analytical skill, visualization, satellite imagery, training*

1. INTRODUCTION

Currently, the use of satellite sensors has increased significantly for remote sensing data. Remote sensing data is used by researchers to determine the condition of the earth without touching it. This is done using information via satellite. Remote sensing data and satellite images have a very large size, so they are not easy to process using storage on a laptop. For this reason, the analysis often involves cloud computing. An efficient way to store, access and analyze datasets on very powerful servers, which virtualize supercomputers for users through the Cloud Computing Platform (Amani et al, 2020).

The use of multiple platforms on laptop devices is greatly increasing, especially in distance learning. One of the platforms used in remote sensing courses is Google Earth Engine (GEE). The use and application of GEE is dominant in developed countries, geographical applications, and the diversity of subject matter by observing the earth and geospatial applications (Kumar & Mutanga, 2018).

This study aims to investigate the use of GEE training for students' remote sensing analytical skills in remote sensing courses, namely: (1) introduction to remote sensing, (2) band combinations (3) Visualization of Satellite Imagery (4) Classification of Satellite Imagery.

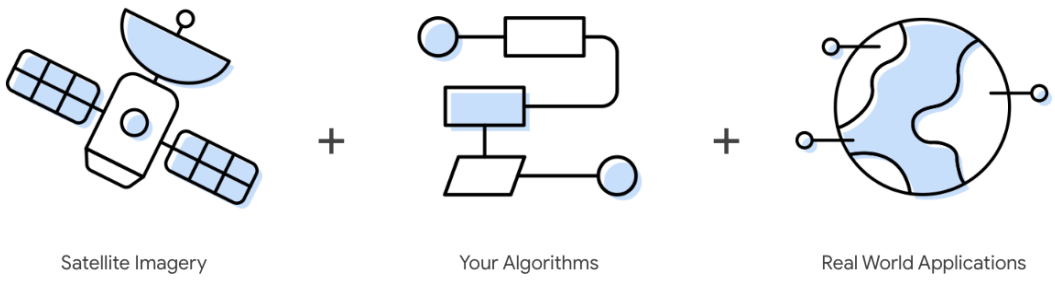

Figure 1. GEE duty cycle (data + syntax)

The objective of this research is to find out : (1) how the value of the pre test score before students are given training using GEE?, (2) how the value of the post test score after students were given training using GEE?, (3) which score is higher between pre-test and post-test?, (4) does GEE provide a significant skill increase to students?.

2. METHODS

GEE Training was attended by 40 students via zoom meeting. The study design used in research was pre-experimental design. The number of research samples involved were 40 students who took part in the training. Training is carried out using online zoom media. Data collection used google form to provide pre-test and post-test. The scores from the pre-test were then compared with the scores from the post-test.

Data analysis techniques used in this research are Descriptive Statistics and Inferential Statistics. Descriptive Statistics displays a Bar Chart, while Inferential Statistics uses a Paired t test. In the paired T test, the p-value is displayed which will then be compared with the alpha value (5%).

The composition of the training material consists of :

(1) Introduction to remote sensing,
(2) Band combination
(3) Visualization of Satellite Image
(4) Classification of Satellite Imagery.

Table 1. Geoda Research Instruments

No.	Training Material	Ordered Number	Number of Question	Score
1	Introduction to remote sensing	1	1	100
2	Band combination	2	1	100
3	Visualization of Satellite Image	3	1	100
4	Classification of Satellite Imagery	4	1	100

3. RESULTS AND DISCUSSION

After the data collection process is complete, the next step is to perform data analysis. The first stage is compiling a summary of the data in the form of the average score of students before the test and after the test using Table 1.

Table 2. Mean Score Pre & Post test

Training Material	Mean Score of Pre-Test	Mean Score of Post-Test
(1) Introduction to Remote Sensing	27	72
(2) Band Combination	30	75
(3) Visualization of Satellite Image	29	74
(4) Classification of Satellite Imagery	34	79

Source: Processed data by author

Then the graphic process is carried out using a Bar Chart to visually find out which material from the training is the easiest and which one is the most difficult according to students before the GEE training has been carried out. From the results of the pre-test, it can be seen that Classification is the easiest according to them. This is shown by the highest average score among the others in Figure 1.

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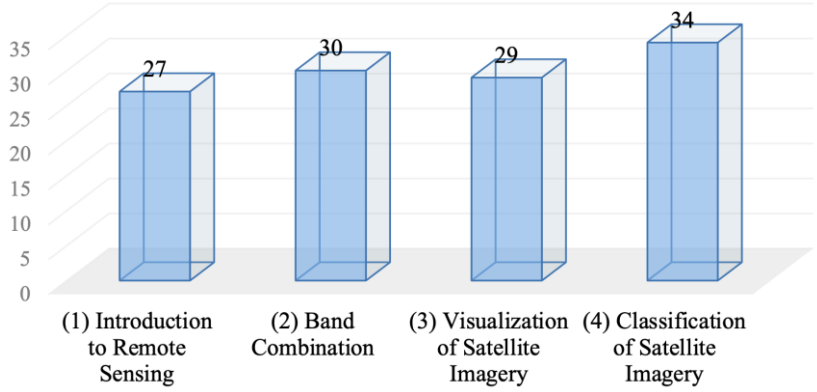

Figure 1. Mean score of pre-test

After all the training materials have been given, a post test is conducted to find out which ones are the easiest and which ones are the hardest after the training materials are taught. From the results, it can be seen in Figure 2, showing that even after training, Classification of Satellite Imagery is the easiest material to compare with other materials. Then the most difficult material is described with the lowest average score, it can be concluded that Introduction to remote sensing is a material that is more difficult than others. This requires further investigation of why students have difficulty to understand the indtroduction of remote sensing.

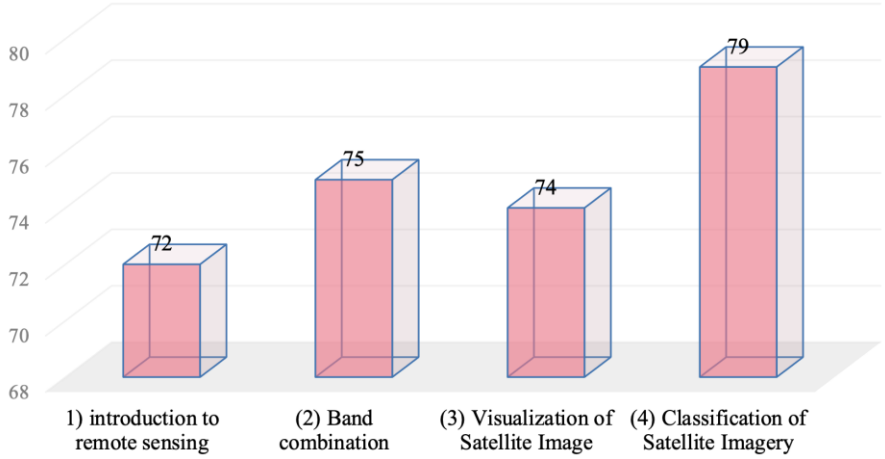

Figure 2. Mean score of post-test

After the post-test and pre-test scores were collected, a simple comparative analysis was performed using a Bar Chart. The results can be seen in Figure 3, which shows that descriptively each value of the training material experienced an increase in the average score after being given training using GEE. The fairly low gap on Bubble Chart shows that Classification of Satellite Imagery is an easy material, so the improvement experienced is not as high as other materials. This is because the Classification of Satellite Imagery pre-test score was already high at the time of the pre-test.

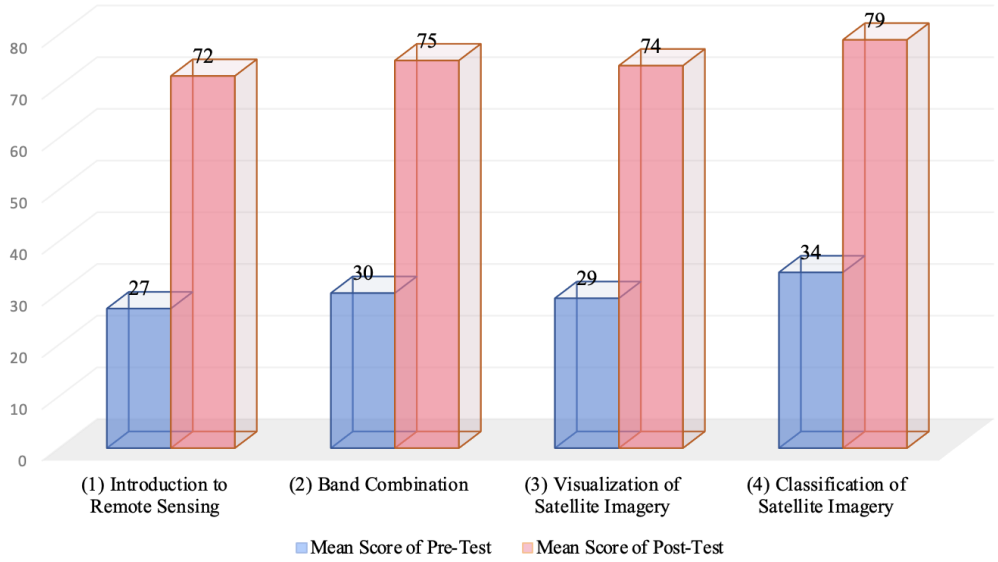

Figure 3. Mean score per indicator pre-test & post-test

From the result of Paired T-Test, it shows that the p-value statistics (3.20×10^{-55}) is less than α (0.05=5%), so it could be concluded that remote sensing analytical skills of students have increased significantly, with pre-test score of 30 (per 100) compared to post-test score about 75 (per 100) with using GEE.

Table 3. Paired t-test result

	Mean Score (Before)	*Mean Score (After)*
Mean	30	75
Variance	1.58974359	3.282051282
Observations	40	40
Pearson Correlation	0.224506628	
Hypothesized Mean Difference	0	
df	39	
t Stat	-145.1206395	
P(T<=t) one-tail	3.20354E-55	
t Critical one-tail	1.684875122	
P(T<=t) two-tail	6.40707E-55	
t Critical two-tail	2.02269092	

4. CONCLUSION

After the analysis process is carried out, it is concluded that:

(a) Pre-Test scores of students before being given GEE material, were at an average score of 30.
(b) The student's Post-Test score after being given GEE material, was at an average score of 75 So, Students have better understanding on (1) Introduction to remote sensing, (2) Band combination, (3) Visualization of Satellite Image (4) Classification of Satellite Imagery after using Geoda.
(c) Post test scores give a score of 45 higher than the pre test. The analytical skills of students in the Remote sensing training have increased significantly, with pre-test score of 30 (per 100) compared to post-test score about 75 (per 100). So, Students have good remote sensing analytical skills after using GEE

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