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Integrating Google Earth into Scale Learning: A Learning Trajectory Through Rice Field Size Exploration

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Abstract

Students' difficulties in understanding the concept of scale, both conceptually and applicative, are caused by learning that is still abstract and has minimal connection to the real context, so it is necessary to present learning that is more meaningful and applicable. This study aimed to produce a learning trajectory for the concept of scale through rice field size exploration using Google Earth. The approach employed was design research of validation studies type, which encompassed three stages: design preparation, design experiment, and retrospective analysis. The study was conducted at State Junior High School 1 Belitang involving two classes, eight students from class VII.3 and thirty-one students from class VII.4. Data was collected through student activity sheets, observations, and interviews, then analyzed qualitatively using descriptive methods with triangulation techniques. The results showed that learning trajectory for the concept of scale starting from measuring images, comparing sizes in images and actual sizes, making model representations through double number lines, discussing the concept of scale and applying scale in real calculations. The study implied the importance of contextual digital media in fostering meaningful and concrete understanding of mathematical concepts.

Kata Kunci: basic education; google earth; learning trajectory; rice field; scale.

INTRODUCTION

Understanding the concept of scale is an important competency in mathematics that is used to compare, model real situations, and solve problems based on relative quantities in everyday life (Putri et al., 2023). Scale is a comparison between the size of the representation of an object or area in the image and the actual size in the field (Iqbal et al., 2021). The concept of scale is closely related to everyday life, especially in reading maps, making plans, and interpreting sizes in images or aerial photographs (Alfatikh et al., 2020; Chau & Dinh, 2023; Fatayan, 2024). However, the concept of scale is often learned abstractly, making it difficult for students to understand its relevance and application in real life.

Several studies show that students have difficulty solving scale-related problems and have a low understanding of the concept (Arista et al., 2022; Putri et al., 2023; Saputro, 2023; Wijayanti et al., 2022). This is due to scale learning which is still dominated by conventional approaches that are abstract and do not link concepts to real contexts (Iqbal et al., 2021; Sukmaningthias et al., 2022). In addition, students' learning habits that tend to rely on memorization methods and teacher-centered learning (Sari et al., 2022) as well as weak mastery of prerequisite material also worsen students' understanding of scale (Arista et al., 2022). As a result, students have difficulty in understanding the concept of scale both conceptually and applicative (Wijayanti et al., 2022).

Several studies in the last decade have highlighted the importance of contextual approaches in mathematics learning, including the use of digital technology. For example, Nusantara et al., (2021); Ria et al., (2024); Sari et al., (2025); and Sagita et al., (2025) emphasize the importance of real context in realistic mathematics education so that students can construct knowledge based on direct experience. In the context of digital technology, Jaeger (2024) and Wahid (2023) showed that the use of digital technology in the form of satellite images and geospatial applications such as Google Earth can improve students' spatial understanding and strengthen the connection between subject matter and the real world.

As a solution to these problems, it is necessary to improve learning by using realistic mathematics approaches such as Pendidikan Matematika Realistik Indonesia also known (PMRI) or Indonesian version of realistic mathematics education. The PMRI approach emphasizes the use of real contexts in mathematics learning to build meaningful understanding of concepts by linking students' daily experiences, thus increasing motivation and thinking skills (Mardhiyah et al., 2023; Rawani et al., 2023). The use of real contexts in mathematics makes learning more fun and meaningful (Zakaria & Dewantara, 2024). PMRI facilitates students in connecting abstract mathematical concepts with real-life situations, thereby enhancing their engagement and understanding through familiar context (Putri et al., 2025; Sari et al., 2025b). Several studies found that the use of the approach can improve students' mathematical abilities such as concept understanding (Sari et al., 2024), mathematical communication skills (Trisnawati et al., 2023), critical thinking (Herlawan et al., 2023); and problem solving skills (Widiastuti & Nindiasari, 2022). Five principles of learning activities in PMRI include the use of realistic contexts, the use of models, the existence of student activities in learning, interactivity and intertwine with other material concepts (Sari et al., 2025b; Sukasno et al., 2024).

Besides using realistic context, this research also integrates digital technology in learning. Google Earth is a globe simulation software that allows users to locate, measure distances, rotate and tilt the Earth, and visually display geographic data (Chau & Dinh, 2023). The use of Google Earth in learning can increase student motivation and engagement through visual displays and interactive quizzes, thus promoting better understanding of the material and learning achievement (Fatayan, 2024). Google Earth provides a more authentic, contextual and exploration-based learning experience, allowing students to virtually explore regions, measure distances and areas, and compare visual representations with real conditions (Ria & Handayani, 2024). Google Earth can connect students' exploration experiences with a concrete understanding of the concept of scale. The use of rice fields as an exploration object was chosen because it is contextual, easy to observe, and can be measured directly or virtually. This approach combines environment-based learning, spatial technology, and visualization strategies that aim to address the gap between symbolic representations and students' real understanding.

Previous research has utilized Google Earth for geography learning (Chau & Dinh, 2023), proven to improve geography learning outcomes (Alfatikh et al., 2020), and geospatial thinking skills (Jaeger, 2024). In mathematics learning, Google earth has only been used to improve students' critical thinking skills in plane and space geometry material (Kinanti et al., 2024) and to understand the concept of spherical geometry (Nos & Motta, 2024). There are no researchers who utilize Google Earth for scale material. In addition, research that develops learning trajectories has been done such as (Nusantara & Putri, 2018) who developed a learning trajectory for straight line gradient material using the ladder context. Risdiyanti & Prahmana research (2021) developed a learning trajectory for set material using the context of puppets. Utami et al., (2024) research developed a learning trajectory for System of Linear Equations in Two Variables using the context of Jakabaring Tourism. The study by Utari et al., (2024) developed a learning trajectory to support statistical literacy through the context of Pagaralam coffee. Then, Sari et al., (2025a) designed a learning trajectory for rate material using the context of plowing rice fields. A recent study by Sari et al., (2025b) developed a learning trajectory for ratio material using rice fertilization context. Many researchers have developed learning trajectories but not many have integrated contextual problems and digital technology to develop learning trajectories.

Mostly, previous studies still focus on the use of Google Earth in the context of learning geography and geometry materials in mathematics, not many have specifically developed a learning trajectory of scale based on the exploration of digital images of rice fields through Google Earth in the junior high school environment. This is the gap as well as the basis of the uniqueness of this research, namely the integration of Google Earth in the learning trajectory of the concept of scale through the exploration of the size of rice fields as a local context close to students' lives. This activity is relevant because agricultural land is part of the environment that is familiar to students in Belitang, and can be directly measured, observed and analysed by students. The novelty of this research lies in the integration of Google Earth with the local context of rice fields within a scale learning trajectory—an approach that has not been previously explored. This innovation is expected to bridge the gap between symbolic representations (such as maps and numerical data) and students' real understanding of size and scale, while promoting more contextual, meaningful, and relevant mathematics learning in the digital era. The use of images through digital technology such as Google Earth has the potential to create learning that is more contextual, meaningful, and interesting for students.

This research is also highly relevant to the Sustainable Development Goals (SDGs), particularly SDG 4: Quality Education, as it aims to improve students' conceptual understanding through contextual and technology-integrated mathematics learning. By leveraging local contexts and real-world exploration via digital tools like Google Earth, this study contributes to the practice of Education for Sustainable Development (ESD) and promotes meaningful, inclusive, and future-oriented learning. The integration of mathematical modelling and spatial reasoning through digital media supports interdisciplinary thinking and fosters students' readiness to solve authentic problems (Bulut & Ferri, 2025; Nurhayati et al., 2025). Thus, the mathematics education innovation offered linking practical scale concepts and digital technology supports the achievement of SDG 4 by providing meaningful, inclusive and relevant learning for students in a concrete way.

The purpose of this research is to produce a learning trajectory for the concept of scale through rice field size exploration using Google Earth. This research is expected to be a practical and theoretical contribution in the development of technology-based learning innovations and local contexts, as well as answering the need for more meaningful and applicable learning in the digital era.

METHOD

Research Type

This study uses a validation study design research approach that focuses on producing a learning trajectory of the concept of scale through rice field size exploration using Google Earth. This approach was chosen because it can accommodate iterative learning development with three stages: preparing for the experiment, design experiment, and retrospective analysis of the student learning process.

Research Procedure

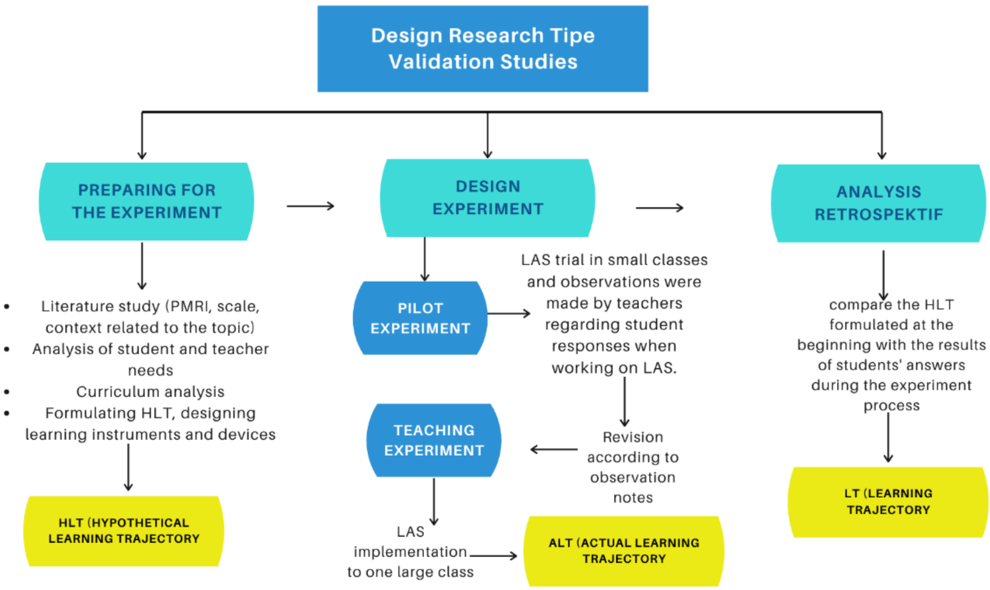


Figure 1. Validation Study Flow in the Development of a Scale Learning Trajectory

Figure 1 shows that this study used validation studies design with three main stages, namely preparing for the experiment, design experiment, and retrospective analysis. First, in preparing for the experiment stage, a literature study related to PMRI, the concept of scale, and local context, students and teachers need analysis, curriculum analysis, as well as the formulation of HLT and learning tools were conducted. Next, at the design experiment stage, the learning trajectory was tested through a pilot experiment involving a small class to observe student responses, then revised and continued with a teaching experiment implemented in one large class to produce an ALT. Finally, at the retrospective analysis stage, the HLT was compared with the ALT based on empirical data to formulate a validated learning trajectory of scale material as the result of the research.

Research Subject

This research was conducted at State Junior High School 1 Belitang in the semester involving two different classes. The subjects in the pilot experiment stage were eight students from class VII.3, purposively selected based on their level of mathematical ability. The selection process was carried out with assistance from the mathematics teacher, who provided information on each student’s prior knowledge and daily academic performance. The subject included two students with medium ability (midterm exam scores around the minimum mastery criterion or KKM, which is 70), one high-ability student (with midterm exam scores above 80), and one low-ability student (with midterm exam scores below the KKM) in each group. This selection of subjects was done to ensure the representation of diverse ability levels in the classroom, thus reflecting the varied characteristics of the students and allowing the researcher to observe the diverse responses and strategies of the students in following the designed learning trajectory. After the initial trial stage, the revised learning trajectory was then implemented in the teaching experiment stage with all 31 students of class VII.4. This stage aims to test the learning trajectory in a real classroom context.

Data Collection and Data Analysis

Data in this study were collected through several techniques, namely student activity sheets (LAS) used to record students' thinking processes and understanding during the learning activities; observations made by partner teachers to record classroom dynamics, student involvement, and the smooth implementation of the learning trajectory; and interviews with purposively selected students to dig deeper into their concept understanding, difficulties encountered, and learning experiences while using the trajectory. The data obtained was analyzed qualitatively with a descriptive approach. Analysis was conducted continuously at each stage of the experiment to revise and refine the learning design. Data validity was ensured through triangulation of techniques, namely by comparing the results of activity sheets, observation notes, and interviews to ensure consistency of findings.

RESULTS

Based on the results of the first stage of the design experiment through literature study activities, analysis of student and teacher needs, curriculum analysis, the formulation of the alleged learning trajectory of scale material is obtained as presented in Table 1.

Table 1. Design HLT on Scale Using Google Earth

Activities	Aims	Conjecture
Investigating the shape of rice fields through measurement activities and measuring the length of the rice fields in the picture.	Students knowing the shape of the rice fields and the comparison of the size in the picture with the actual size	- Students can understand that the concept of scale is an activity to compare the size in the picture with the actual size. - Some students cannot understand that the concept of scale is an activity of comparing the size on the drawing with the actual size.
Calculate and simplify the comparison between the size of the rice field in the image and the actual size.	Students can identify the relationship between the size of 1 cm in the picture and the actual size of the rice field.	- Students can understand that on a scale, one unit on a drawing represents a certain actual size. - Some students do not understand that on a scale, one unit on a drawing represents a certain actual size.
Draw a double number line that represents the ratio of the length of the rice field in the picture to the actual length of the rice field.	Students can make double number lines correctly	- Students can create model representations on a scale using a double number line. - Some students are unable to model representations on a scale and do not understand the number line, so they have difficulty

		creating a double number line.
Students discuss and write down the definition of scale and solve problems related to scale by utilizing the units on the scale.	Students understand units in solving problems related to scale.	- Students can create model representations on a scale using a double number line. - Some students are unable to model representations on a scale and do not understand the number line, so they have difficulty creating a double number line.

The second stage is experimental design which begins with the implementation of a pilot experiment. At this stage the researcher tested the scale activity sheet that had been prepared to eight students in class VII.3 who had diverse abilities. Students were formed into two groups and the teacher acted as an observer who observed and recorded student responses when working on the LAS. Table 2 is a summary of the observation results along with suggestions for improvement given by the observer.

Table 2. Observation Summary of Experimental Design

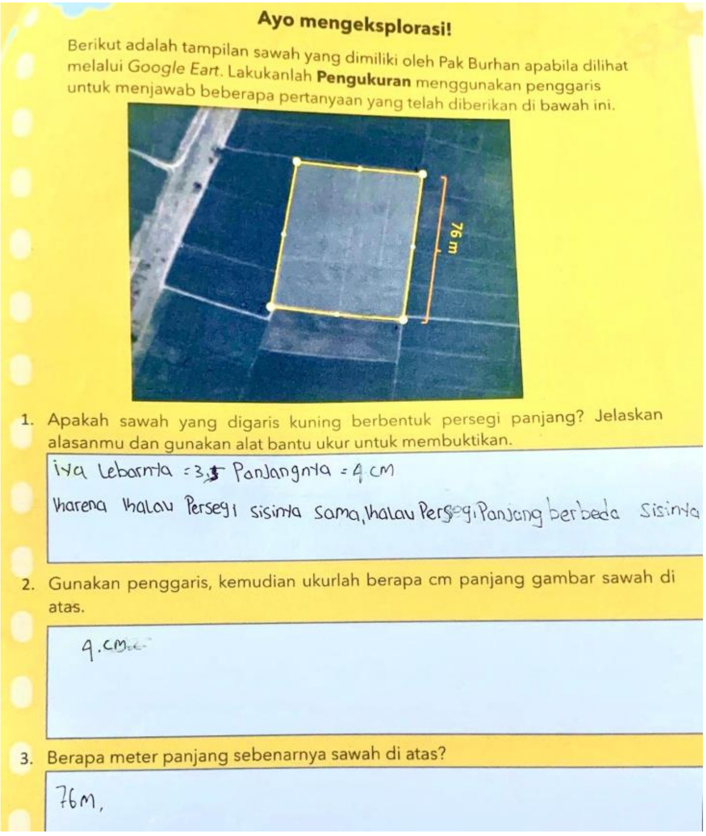
Observation Results	Advice
- Some students did not start the measurement from zero on the ruler. - Students had difficulty drawing the number line and determining the distance between points. - Some students had difficulty calculating the actual size from the data.	- Before getting into the concept of scale, students need to be given explicit understanding and practice of the use of measuring instruments (ruler) and visual representations (number line) to prevent misconceptions and ensure students have the necessary basic skills. - The questions on the LAS need to be simplified and adjusted to the students' abilities.

Based on Table 2, several obstacles were found experienced by students in understanding material related to measurement and scale. Some students did not seem to understand how to use measuring instruments correctly, indicated by not starting the measurement from zero on the ruler. In addition, students had difficulty in drawing number lines and determining the distance between points, which showed a weak understanding of visual representations. Difficulties were also seen when students tried to calculate the actual size based on the given data, indicating a lack of mastery of the concept of scale. Based on the observation notes, observer suggested that before going into scale material, teachers provide explicit understanding and practice on the use of measuring tools (rulers) and visual representations (number lines). This is important to prevent misconceptions and ensure students have adequate basic skills. In addition, the questions in LAS need to be simplified and adjusted to students' abilities so that they are easier to understand and work on.

After being corrected according to the notes from the observation results, the researcher implemented the LAS into one large class of 31 students. The following is a description of a series of activities on the scaled LAS.

Activity 1: Investigating the shape of rice fields through measurement activities and measuring the length of the rice fields in the picture.

In this activity, students are invited to investigate the shape of rice fields through direct observation and measurement activities on images of rice fields displayed, for example from Google Earth or printed images. Students are asked to identify the shape of the rice field, such as a square or rectangle, and measure the length of its sides using a ruler. The purpose of this activity is for students to understand that images are scaled representations of real objects, and to begin to recognize the relationship between size in images and actual size. This activity is the initial stage to build an understanding of the concept of scale through concrete and visual experiences. Through this activity, students know the shape of the rice fields and the comparison of the size in the picture with the actual size.



English Version:

1. Is the rice field outlined in yellow a rectangle? Explain your reasoning and use a measuring tool to prove it.
   Student's answer: Yes. The width is 3.5 cm, and the length is 4 cm. Because if it's a square, the sides are equal; if it's a rectangle, the sides are different.

2. Use a ruler and measure how many cm the field in the picture is.
   Student's answer: 4 cm

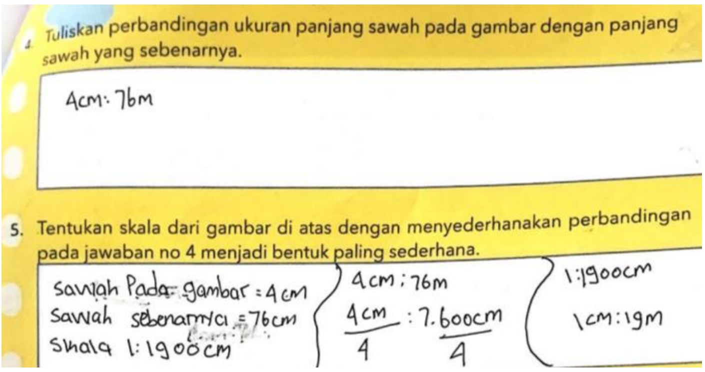
3. How many meters is the actual length of the field above?
   Student's answer: 76 m

Figure 2. Student Answers in the Investigating the Shape of Rice Fields Activity

Based on Figure 2, in question number 1, it is known that students' understanding is correct. Students compare the size of the sides of the rice field image by taking measurements using a ruler and find that one side measures 3.5 cm and the other side is 4 cm, so the shape is rectangular because the length of one side is not the same as the other side. Students can also explain the concept of the difference between a square and a rectangle quite well for the basic level. Students can answer question number 2 correctly because they already understand how to measure using a ruler correctly through teacher assistance, then students can find out the actual size of the rice field according to the information on the rice field image on Google Earth displayed. In activity 1, which consists of 3 questions, it shows that students can know the shape of rice fields and know the size in the picture with the actual size.

Activity 2: Calculate and simplify the comparison between the size of the rice field in the image and the actual size.

In this activity, students calculate and simplify the comparison between the size of the rice field in the picture and the actual size in the real world. Students use the measurement results on the picture (in centimeters) and information about the actual size to form a comparison of two quantities, then simplify it into a scale form (e.g. 1:500). The purpose of this activity is for students to identify and understand the relationship between the length of 1 cm in the picture and the actual length of the rice field, as well as develop an initial understanding of scale as a representation of the ratio between two different sizes.



English version:

4. Write the ratio of the rice field's length on the image to the actual length of the field.
   Student's answer:
   4 cm : 76 m

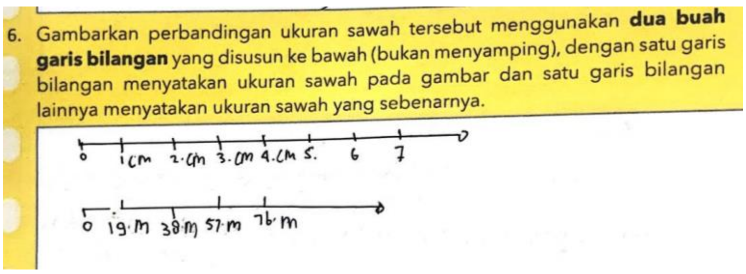
5. How many meters is the actual length of the field above?
   Student's answer:
   Field in image = 4 cm
   Actual field = 76 m = 7600 cm
   Simplified:
   4 cm : 7,600 cm → 1 : 1,900 cm atau 1:19 m

Figure 3. Student Answers in The Calculate and Simplify Comparison Activity

In Figure 3, it is known that students can write the comparison between the length of the rice field in the picture and the actual size correctly. This comparison is the basis for determining the scale. Students convert units from meters to centimeters before simplifying, then divide both sides by 4 to get the scale.

Activity 3: Draw a double number line that represents the ratio of the length of the rice field in the picture to the actual length of the rice field.

In this activity, students are asked to draw a double number line that represents the ratio between the length of the rice field in the picture and the actual length in the real world. Students set one line to show the size in the picture (e.g. in cm) and another line to show the actual size (e.g. in meters), with points that are parallel and proportional. The purpose of this activity is for students to build a visual representation model of scale and understand that scale is a comparison of two different quantities. Through the double number line, students can visualize proportional relationships more concretely and systematically.



English version:

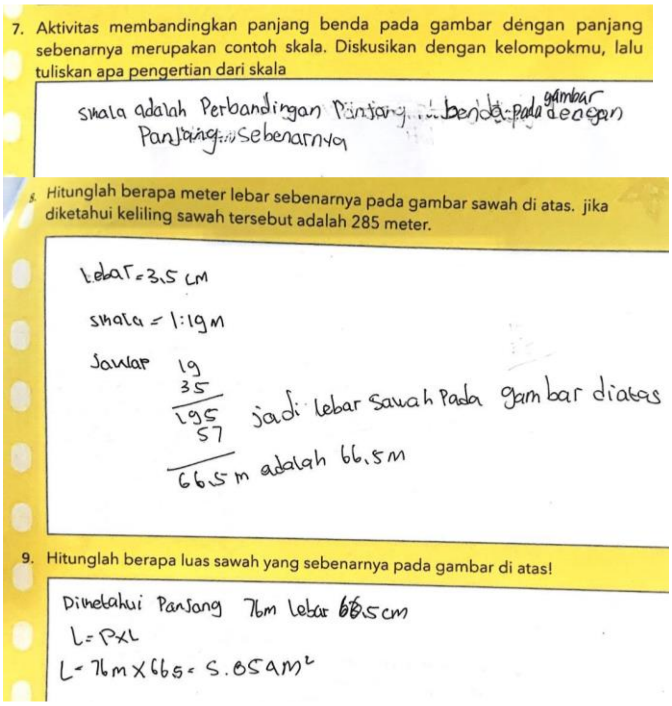
6. Draw the comparison of the rice field's size using two number lines, with one line showing the image size and the other showing the actual size.

Figure 4. Student Answers in the Drawing of a Double Number Line Activity

In Figure 4, it is known that students can make a double number line quite well. Students show an understanding that every 1 cm in the figure represents 19 m in actual size. Although the scale of the distance between numbers on the bottom number line (0, 19 m, 38 m, etc.) seems imprecise in size when compared to the top one, but the content is very good.

Activity 4: Students discuss and write down the definition of scale and solve problems related to scale by utilizing the units on the scale.

In this activity, students discuss in groups to formulate the definition of scale using the understanding gained from the previous activity. After that, students solve contextual problems involving scale calculations, such as calculating the actual length or area based on the size in the picture and vice versa, by utilizing the appropriate units. The purpose of this activity is for students to understand the meaning of units in the context of scale and be able to use them appropriately in solving problems, thus strengthening their conceptual understanding and applicative skills towards the use of scale in real life.



English version:

7. Comparing the length of an object in a drawing to its real-world length is an example of a scale. Discuss with your group, then write the definition of a scale.
   Student's answer:
   Scale is the comparison of the length of an object in a picture to its actual length.
8. Calculate the actual width of the rice field in the image above, if the perimeter of the field is known to be 285 meters.
   Student's Answer:
   Width in the image = 3.5 cm
   Scale = 1 : 19 m
   $3.5 \times 19 = 66.5$ m.
   So, the actual width of the rice field in the image above is 66.5 meters.
9. Calculate the actual area of the rice field in the image above!
   Student's Answer:
   Given: Length = 76 m, Width = 66.5 m
   Using the formula:
   $A = L \times W$
   $A = 76 \times 66.5 = 5{,}054$ m²

Figure 5. Student Answers in the Writing Definitions and Solving Problems about Scale Activity

Based on Figure 5, it is known that students' answers are correct and in accordance with the concept of scale. Students have understood that scale is the ratio between the length in the picture and the actual length. Students can apply scale in real calculations (width conversion and area calculation). Proven by students successfully solve problems about scale by multiplying the length in the picture (3.5 cm) with the scale (1 cm = 19 m), resulting in the actual width of 66.5 meters. Students can also calculate the actual rice field area by utilizing the known scale. Students use the rectangular area formula correctly. The findings on the results of student answer sheets are also corroborated by the results of interviews with one of the low ability students (SR).

T : "*After you measure the rice field in Google Earth and compare it with the actual size, what do you understand about scale?*"
SR: "*It turns out that the length of the rice field in the picture is only 10 cm, but the original can be more than 100 meters, Mom!*"
T : "*Yes, that's right. Now, why do you think that is? What explains the difference?*"

SR : "*It's because of the scale, ma'am. The image on Google Earth is scaled down from its actual size*."
T : "*Good! So, what do you think scale is*?"
SR : "*Scale is like a comparison between the size in the picture and the real size. For example, 1 cm in the picture is the same as 10 meters in the real world*."
T : "*So, did this activity help you understand scale?*"
SR : "*Yes, ma'am. Now I understand better what scale means*."

The results of the interview above show an increase in understanding of the concept of scale after participating in Google Earth-based learning activities. When asked about the difference between the size of the picture and the actual size, students can identify that the length of the rice field that appears only 10 cm in the picture, but in reality is more than 100 meters. Students state that the difference is caused using scale in the picture and define scale as the comparison between the size in the picture and the actual size. Students are also able to provide concrete examples, namely "1 cm in the picture is the same as 10 meters in the real world."

Furthermore, students recognized that the learning activities helped them to understand the meaning of scale more deeply. This finding indicates that a contextual approach involving the use of digital media such as Google Earth can support the understanding of mathematical concepts, especially for students with low initial ability.

DISCUSSION

The learning trajectory designed for the topic of scale through a design research approach demonstrates that using real-world contexts such as the shape and size of rice fields observed via Google Earth significantly supports students in building a conceptual understanding of scale. This finding align with Sari et al., (2025a); and Sagita et al., (2025) emphasize the importance of real context in realistic mathematics education so that students can construct knowledge based on direct experience. This scale learning trajectory has the distinctive characteristic of using real-world context, namely the shape and size of rice fields through Google Earth, which makes learning more meaningful and relevant to students. The process is designed in stages, starting from image observation and measurement, size comparison with real units, to scale representation using a double number line. This approach emphasizes the construction of meaning by students through group discussions and contextual problem solving and integrates digital technology to strengthen understanding. The trajectory also reflects the intertwining principle in PMRI by linking various mathematical concepts together in a progressive and contextualized learning flow. This trajectory consists of a series of progressive learning stages that facilitate students' mathematical thinking development, particularly in comprehending size comparisons.

The learning process begins with an initial understanding of images and measurements. In this stage, students are guided to observe rice field shapes and measure them using a ruler. This activity encourages students to recognize that images represent scaled-down versions of real-world objects. The results show that students can accurately measure the length of the image and distinguish between square and rectangular shapes. This supports Zakaria & Dewantara's (2024) statement that the use of real contexts in mathematics makes learning more fun and meaningful. This finding also supports the opinion of Ria et al., (2024); Sari et al., (2025a); and Sagita et al., (2025) who emphasize the importance of real context in mathematics learning so that students can construct knowledge based on direct experience.

The next phase focuses on connecting image size and actual size. Students compare the dimensions of the rice fields as shown in images with their real-world counterparts. They can express these comparisons as ratios and simplify them into scales after performing unit conversions. This indicates a growing understanding that, for instance, 1 cm in the image may represent several meters. To deepen their grasp, students engage in representing scales using double number lines. This refers to Petit et al., theory (2020) that the double number line is best used to represent the comparison of two things with different magnitudes. Through this activity, students begin to understand that scale can also be visualized. Although there were minor inaccuracies in the drawings, most students demonstrated that they understood the double number line as a tool for visually representing the ratio between two quantities.

The trajectory culminates in group discussions and the formulation of the meaning of scale. During this stage, students collaboratively construct definitions of scale using their own words. Their responses reveal an understanding of the scale as a comparison between the size in a drawing and the actual size. Furthermore, students apply this understanding to solve contextual problems, such as calculating the real-world length and area of the rice fields.

Overall, this contextually designed and structured scale learning trajectory shows that the integration of Google Earth and the use of the local environment as a learning context are effective in building students' conceptual understanding and mathematical thinking skills. The trajectory leads students from an intuitive understanding of shape and size to a formal understanding of scale as a mathematical ratio. Measurement activities, visual representations through number lines, and group discussions enable students to understand the concept of scale meaningfully. The learning outcomes show that students can calculate scale, compare drawing size with actual size, and represent it visually well. This finding align with Putri et al., (2025) and Sari et al., (2025b) statements that PMRI facilitates students in connecting abstract mathematical concepts with real-life situations, thereby enhancing their engagement and understanding through familiar context. This finding also supports Zakaria & Dewantara's (2024) statement that the use of real context in mathematics makes learning more fun and meaningful.

In addition, this trajectory also fosters students' active attitude and curiosity. Through the concrete experience of observing and measuring digital rice fields, students more easily understand scale as a comparison between image and reality. High student engagement is reflected in the many questions and active participation in activities. Not only understanding the concept of scale, but students also learn other mathematical concepts such as measurement, unit conversion, and the area of flat buildings. This is in line with the intertwining principle in PMRI, which is the connection between concepts in a whole and meaningful learning context (Sari et al., 2025b; Sukasno et al., 2024).

The findings in this study are in line with the results of Wahid (2023) research that the use of digital technology in mathematics learning can improve students' conceptual understanding. This research also strengthens Khoirunnisaa’ and Fahmi (2023) research results that Google Earth integration makes it easier for students to understand spatial concepts and apply them in a real context. This study reinforces (Sakurai & Goos, 2023) findings that the integration of digital tools can improve students' conceptual understanding by connecting math learning with real-world contexts. The findings of this study are in line with the results of a study conducted by Sari et al., (2024) which showed that through contexts close to students' daily lives such as the activity of cooking rice, students were able to move gradually from informal understanding based on real experiences to formal understanding involving mathematical notations and definitions. Recent research by (Putri et al., 2025) and (Sari et al., 2025b) strongly supports that the use of realistic contexts plays an important role in bridging abstract mathematical concepts to become more concrete and meaningful in students' learning experiences.

This study has limitations on the scope of a narrow context, namely the exploration of the size of rice fields, so the results cannot necessarily be generalized to other topics. Students' understanding still relies heavily on teacher assistance, especially in the early stages. Some students also showed inaccuracies in visual representations such as double number lines. In addition, this study has not evaluated the long-term impact and has not involved in-depth quantitative measurements. Limited access to technology is also a challenge in environments with limited facilities.

CONCLUSION

This research shows that the use of Google Earth in learning scales through a scale learning trajectory consisting of a series of structured activities starting from measuring images, comparing sizes in images and actual sizes, making model representations through double number lines, discussing the concept of scale and applying scales in real calculations, can build students' real and contextual understanding of scale. The implication is that math learning becomes more meaningful when it is associated with real context and involves digital media. This study has limitations on the scope of a narrow context, which is limited to the exploration of the size of rice fields and scale materials only. Therefore, future research is recommended to expand the context of scale learning to more diverse topics and environments so that the findings can be better generalized. In addition, future research should also explore the long-term effects of realistic context-based learning on the transfer of mathematical understanding to other topics.

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REFERENCES

Alfatikh, E. R., Winanti, E. T., Prasetya, S. P., & Budiyanto, E. (2020). Implementing google earth to enchance student’s engagement and learning outcome in geography learning. *Geosfera Indonesia*, *5*(1), 147–159. https://doi.org/10.19184/geosi.v5i1.11987

Arista, G. A., Wibawa, K. A., & Payadnya, I. P. A. A. (2022). Analysis of students' errors in solving comparison and scale problems based on Polya's four steps in Class VII SMP TP 45 Denpasar [in Bahasa]. *PRISMA (Prosiding Seminar Nasional Matematika)*, *5*, 214–221. https://journal.unnes.ac.id/sju/prisma/article/view/54274

Bulut, N., & Ferri, R. B. (2025). Bridging mathematical modelling and education for sustainable development in pre-service primary teacher education. *Education Sciences*, *15*(2), 1–25. https://doi.org/10.3390/educsci15020248

Chau, T. M., & Dinh, T. T. (2023). Application of google earth software for teaching students of geography education at an Giang University, Vietnam in the direction. *European Journal of Education Studies*, *10*(2), 193–202. https://doi.org/10.46827/ejes.v10i2.4671

Fatayan, A. (2024). Analyzing the impact of google earth on the learning motivation of elementary school. *Indonesian Journal of Research and Educational Review*, *3*(2), 103–118. https://doi.org/10.51574/ijrer.v3i2.1418

Herlawan, Armin, R., & Poa, I. R. (2023). Effectiveness of mathematics learning through pmri approach assisted by learning videos on students' critical thinking skills [in Bahasa]. *Edumatica: Jurnal Pendidikan Matematika*, *13*(3), 214–223. https://doi.org/10.22437/edumatica.v13i03.21918

Iqbal, M., Rahayu, S., & A, T. H. (2021). The effect of web-based learning media and educational games on comparison and scale material on student interest in learning at the junior high school level [in Bahasa]. *Jurnal Ilmiah Ilmu Dan Teknologi Rekayasa*, *4*(1), 1–9. https://ejournal.polsub.ac.id/index.php/jiitr/article/view/89

Jaeger, A. J. (2024). Google earth as a tool for supporting geospatial thinking. *Land*, *13*(2218), 55–60. https://www.mdpi.com/2073-445X/13/12/2218

Khoirunnisaa', K., & Fahmi, M. R. (2023). Improving problem-solving student ability: Integrating google earth with SETS model learning for effective solutions. *Abjadia : International Journal of Education*, *8*(1), 17–28. https://doi.org/10.18860/abj.v8i1.19699

Kinanti, T. R., Gunardi, D. P., & Rudhito, M. A. (2024). Development of contextual math learning activities (merapi mountain) using google earth [in Bahasa]. *Journal Numeracy*, *11*(2), 155–169. https://doi.org/10.46244/numeracy.v11i2.2802

Mardhiyah, E. I., Qohar, A., & Anwar, L. (2023). Development of smart board learning media with pmri approach on whole number material [in Bahasa]. *Edumatica : Jurnal Pendidikan Matematika*, *13*(02), 181–190. https://doi.org/10.22437/edumatica.v13i02.21617

Nos, R. L., & Motta, G. P. (2024). Using google earth to explore concepts of spherical geometry in mathematics education. *International Journal of Exact Sciences*, *1*(3). https://doi.org/10.22533/at.ed.153132423105

Nurhayati, S., Kandaga, T., Gusti, V. Y. K., & Mohamad, L. (2025). Development of the sources of mathematics online learning self-efficacy scale (SMOLSES) for SDGs quality education. *Al-Jabar: Jurnal Pendidikan Matematika*, *16*(01), 193–206. https://doi.org/10.24042/ajpm.v16i1.26653

Nusantara, D. S., & Putri, R. I. I. (2018). Slope of straight line in ladder: A learning trajectory. *Journal of Physics: Conference Series*, *1097*(1). https://doi.org/10.1088/1742-6596/1097/1/012116

Nusantara, D. S., Zulkardi, & Putri, R. I. I. (2021). Designing PISA-like mathematics task using a COVID-19 context (Pisacomat). *Journal on Mathematics Education*, *12*(2), 349–364. https://doi.org/10.22342/JME.12.2.13181.349-364

Petit, M. M., Laird, R. E., Wyneken, M. F., Huntoon, F. R., Abele-Austin, M. D., & Sequeira, J. D. (2020). *A Focus on Ratios and Proportions*. Routledge. https://doi.org/10.4324/9780429353611

Putri, N. N., Alvira, S., Nurjanah, I. J., Umairoh, U., & Rostika, D. (2023). Analysis of mathematics learning difficulties of elementary school students on comparison and scale materials [in Bahasa]. *Didaktik: Jurnal Ilmiah PGSD FKIP Universitas Mandiri*, *9*(1), 104–116. https://doi.org/10.36989/didaktik.v9i5.2459

Putri, R. I. I., Zulkardi, Sari, N., Sagita, L., Siligar, E. I. P., & Sukma, Y. (2025). Learning numeracy using new Pempek mathematics. *Journal on Mathematics Education*, *16*(1), 1–22. https://doi.org/10.22342/jme.v16i1.pp1-22

Rawani, D., Putri, R. I. I., Zulkardi, Z., & Susanti, E. (2023). The reflective teaching practices using PMRI and collaborative learning. *Jurnal Pendidikan Matematika*, *17*(1), 69–88. https://doi.org/10.22342/jpm.17.1.17208.69-88

Ria, R. R., & Handayani, G. S. (2024). Literature study : Effectiveness of using interactive media "google earth" in social studies learning for elementary school students. *International Journal* *of Education Elementaria and Psychologia*, *1*(2), 112–123. https://doi.org/10.70177/ijeep.v1i2.930

Risdiyanti, I., & Prahmana, R. C. I. (2021). Designing learning trajectory of set through the indonesian shadow puppets and mahabharata stories. *Infinity Journal*, *10*(2), 331–348. https://doi.org/10.22460/infinity.v10i2.p331-348

Sagita, L., Putri, R. I. I., Zulkardi, & Prahmana, R. C. I. (2025). Choosing the right store: How open-ended tasks help middle school students learn financial literacy. *Mathematics Education Journal*, *19*(1), 63–80. https://doi.org/10.22342/jpm.v19i1.pp63-80

Sakurai, J., & Goos, M. (2023). Revisiting tools in numeracy learning: The role of authentic digital tools. *Frontiers in Education*, *8*, 1–11. https://doi.org/10.3389/feduc.2023.1291407

Saputro, H. B. (2023). Development of math modules on comparison and scale materials for grade v elementary school students [in Bahasa]. *Jurnal Fundadikdas (Fundamental Pendidikan Dasar)*, *6*(1), 37–49. https://doi.org/10.12928/fundadikdas.v6i1.7826

Sari, F. Y., Sugiman, Asikin, M., Mulyono, & Agoestanto, A. (2022). Students' mathematical creative thinking ability in the means ends analysis model assisted by open ended questions [in Bahasa]. *Musamus Jurnal of Mathematics Education*, *5*(1), 1–10. https://doi.org/0.35724/.v5i1.4396

Sari, F. Y., Zulkardi, Putri, R. I. I., Susanti, E., & Nusantara, D. S. (2024). Ratio material learning design using the context of cooking rice to help elementary students understand concepts. *Inomatika*, *6*(1), 54–66. https://doi.org/10.35438/inomatika.v6i1.443

Sari, F. Y., Zulkardi, Z., Putri, R. I. I., & Susanti, E. (2025a). Learning trajectory of rate material using the context of plowing rice fields. *Plusminus: Jurnal Pendidikan Matematika*, *5*(1), 141–154. https://doi.org/10.31980/plusminus.v5i1.2509

Sari, F. Y., Zulkardi, Z., Putri, R. I. I., & Susanti, E. (2025b). Ratios in agriculture : A rice fertilization context for ratio learning trajectory. *Mathematics Education Journal*, *19*(3), 509–526. https://doi.org/10.22342/jpm.v19i3.pp509-526

Sari, R. M., Arifin, S., & Komarudin. (2025). Development of RME worksheets with maritime context to strengthen mathematical communication skills [in Bahasa]. *Edumatica: Jurnal Pendidikan Matematika*, *15*(01). https://doi.org/10.22437/edumatica.v15i1.41178

Sukasno, Zulkardi, Putri, R. I. I., & Somakim. (2024). Fraction learning design using the Watervang dam context [in Bahasa]. *Jurnal Pendidikan Matematika RAFA*, *10*(1), 12–22. http://jurnal.radenfatah.ac.id/index.php/jpmrafa

Sukmaningthias, N., Sari, N., Somakim, S., Susanti, E., & Safitri, D. (2022). Student worksheets based on rme with cabri 3d to students' mathematical connections on solid with non-flat surface. *Edumatica : Jurnal Pendidikan Matematika*, *12*(03), 222–237. https://doi.org/10.22437/edumatica.v12i03.21364

Trisnawati, T., Yulianto, D., & Ningsih, E. F. (2023). The influence of Indonesian realistic mathematics learning (PMRI) basedethnomathematicson the improvement of mathematical communication skills in terms of gender. *Scholar: Educational Scientific Journal Media*, *13*(3), 552–561. https://doi.org/10.35335/cendikia.v13i3.3320

Utami, M. R. P., Zulkardi, Susanti, E., & Meryansumayeka. (2024). Learning design of two-variable linear equation system material with the context of jakabaring palembang tourism [in Bahasa].

Edumatica: Jurnal Pendidikan Matematika, *14*(03), 242–258. https://doi.org/10.22437/edumatica.v14i3.38806

Utari, R. S., Ilma, R., & Putri, I. (2024). Designing learning trajectories to support prospective teachers ' statistical literacy skills. *Mosharafa : Jurnal Pendidikan Matematika*, *13*(4), 877–894. https://doi.org/10.31980/mosharafa.v13i4.2546

Wahid, A. (2023). Improving conceptual understanding of mathematics through blended learning using Google Classroom. *International Journal of Education and Teaching Zone*, *2*(1), 130–138. https://doi.org/10.57092/ijetz.v2i1.122

Widiastuti, B., & Nindiasari, H. (2022). Application of realistic mathematics learning to develop mathematical problem solving skills of elementary school students [in Bahasa]. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(3), 2526–2535. https://doi.org/10.31004/cendekia.v6i3.1190

Wijayanti, R., Kurniawan, S. B., & Budiharto, T. (2022). Analysis of mathematics learning of scale and comparison materials in grade V elementary school [in Bahasa]. *Jurnal Pendidikan Dasar*, *10*(1). https://doi.org/10.20961/jpd.v11i1.64475

Zakaria, Z., & Dewantara, A. H. (2024). Understanding multiplication concept: Exploring PMRI-enhanced thematic learning using traditional games for primary teachers. *Jurnal Elemen*, *10*(1), 55–69. https://doi.org/10.29408/jel.v10i1.19838

