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Learning design of lines and angles for 7th -grade using Joglo traditional house context

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ABSTRACT

Lines and angles are essential for students because of geometry and its many applications in daily life. However, there are still many students who have difficulty grasping the material. Therefore, it is necessary to design learning using the right approach, context, and media. This study aims to produce a learning trajectory that can assist students in understanding the concept of lines and angles, maximize the effectiveness and efficiency of learning, create meaningful learning, and motivate student learning. This study used the Joglo Traditional House context as a starting point and the design research method developed by Gravemeijer and Cobb with three main steps: preparing for the experiment, designing the experiment (pilot experiment and teaching experiment), and retrospective analysis. However, in design experiment step is limited to the pilot experiment. In this study, all activities were designed based on Indonesian Realistic Mathematics Education. It involves six 7th-grade students from one of the junior high schools at Juwana Resident with three different abilities, namely two students for each level with high, moderate, and low ability. The learning trajectory generated in this study consists of a series of learning processes in four activities that can be used to develop local instructional theories and develop designs for further activities. Those are observing Joglo traditional house video for understanding lines and angles concepts, deducing line positions, discovering the angles' properties on parallel lines intersected by other lines, and solving lines and angles problems.

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Introduction

Geometry is an essential scope of mathematics (Darwish, 2014) that studies the relationship between lines, angles, squares, triangles, cube, cuboid, prism, and their application in problem-solving (Muhassanah, 2014). Sholihah and Afriansyah (2017) revealed that geometry has a close relationship with other parts of mathematics and many applications in life. In addition, Van de Walle (1994) argued that geometry is an essential material because it can help humans appreciate the universe, develop problem-solving abilities, has a contribution outside the field of mathematics, useful in daily life, and full of puzzles and fun. One of the topics in geometry that is important to study is lines and angles. Widiawati et al. (2018) stated that lines and angles essential materials to study because lines and angles connect. The connection of one material to another mean that if one

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material concept is not well understood, it will cause difficulties and errors in the following material. However, geometry is still difficult for students (Özerem, 2012), especially understanding lines and angles (Argaswari & Usodo, 2015).

Students' difficulties in lines and angles include determining angles measure (Sari, Putri, Kesumawati, 2015), and students do not have the concept of parallel and intersecting lines (Biber et al., 2013). Perawansa and Surya (2018) stated that students have difficulty understanding the concept of two intersecting lines and mention the relationship between angles on two parallel lines. Tawil (2014) also noted that the relationship between lines and angles is complicated, especially regarding why the angles are called corresponding, alternate, and consecutive. Other difficulties are measuring certain angles such as 0^0, 180^0, 360^0 angles (Keiser, 2004) and difficulty understanding angles if angle names are changed with certain symbols. The study results by Senjaya et al. (2017) also concluded that there were some student difficulties of lines and angles such as incomprehension of the questions given, lack of lines and angles concepts understanding, inaccuracy of students in writing mathematical symbols and math calculations. From some of the students' learning difficulties in studying the lines and angles material as described above, it can be concluded that in the lines and angles material, students have a problem in determining the relationship between lines and angles. In addition, the properties of the angles on two parallel lines intersected by other lines. Students also lack the concept of lines and angles, especially the concept of parallel and intersecting lines.

Several things cause the student's difficulties in the lines and angles. Senjaya et al. (2017) explained that two factors affect student difficulties in lines and angles, namely internal factor, the lack of student interest in learning mathematics, and external factor, school and family factors. School factors identified by Senjaya et al. (2017) such as ineffective learning, monotonous media and learning methods, disharmonious relationships between teachers and students, and students who are too active in outside activities. Suryana (2016) also mentioned that students' difficulty in learning is due to the lack of student interest in the material presented by the teacher. Lack of interest in learning can be caused by teachers preferring to use the lecture and assignment method, and this causes unidirectional and boring learning. Soedjadi revealed that teachers only carry out procedural learning such as providing and explaining definitions or theorems, giving examples of questions, and giving exercises (Widyawati et al., 2016) without providing opportunities for students to discover the concept themselves.

A solution that can be applied to overcome the difficulties of learning in the lines and angles material is Student-Centered Learning (SCL). SCL is needed and allows students to construct a given concept and actively participate in learning (Kusumaningsih et al., 2020). Moreover, it is crucial for the teacher to design meaningful learning to maximize the effectiveness and efficiency of learning, improve concept understanding, create meaningful learning, and achieve optimal learning objectives (Nursyahidah et al., 2021a) by choosing appropriate approaches. One of the approaches that are suitable for constructing a given concept using a familiar context to students and allow students to be active in learning (Kusumaningsih et al., 2020) is Indonesian Realistic Mathematics Education (IRME) (Nursyahidah et al., 2013, 2018; Fahrurozi et al., 2018).

IRME is a learning approach that refers to Freundenthal's statement that mathematics is part of human activity that must have a connection in daily life (Zulkardi & Ilma, 2013). In addition, in IRME, students can discover their mathematics concepts with assistance from the teacher (Gravemeijer, 1994). IRME has been used since 2001. It can increase students' ability and motivation to solve problems (Nursyahidah et al., 2013, 2018; Fahrurozi et al., 2018) and can make students think critically and creatively so that it

is easy to understand mathematical concepts using several things that are close to students (Simanulang, 2014; Fitri & Prahmana, 2018; 2020; Kusumaningsih et al., 2019). In addition, this approach can create meaningful, effective, efficient, and fun learning objectives such as the ability to solve problems can be achieved (Nursyahidah et al., 2018).

The principle of IRME is visualizing concrete objects or using contexts that students recognize towards a more abstract level, and the context can be a starting point to learn and develop a mathematical understanding (Nursyahidah et al., 2013). The context used in IRME uses real objects and things that students can imagine (Afriansyah, 2016). It can be used as a bridge from the informal to the formal stage (Nursyahidah et al., 2021a). Several contexts have been used in mathematics, such as traditional games (Nursyahidah et al., 2013; Edo, 2016), rating games (Kusumaningsih et al., 2019), folklore, legends (Widyawati et al., 2016), traditions, and community habits (Nursyahidah et al., 2018; Aisyah et al., 2020; Nursyahidah et al., 2021b), historical buildings (Fahrurozi et al., 2018; Nursyahidah et al., 2021a), and formal mathematical form (Puspasari et al., 2015). In this study, the context used is the Joglo Traditional House context. From the researchers' observations, mathematical concepts can be explored in the Joglo Traditional House. The topic of mathematics that can be explored through the Joglo Traditional House is lines and angles. In the Joglo Traditional House, lines can be found on poles, and corners can be found on roofs, stairs, etc. The use of this context is inspired by Apriani and Agustine (2019) study which uses the context of the Museum, and Widyawati et al. (2016) study which uses the context of the *Limas* traditional house. Both studies use the context of the building, which focuses on the type of angle and the measurement of the angle. In this study, the context of the Joglo traditional house will be explored by students to understand lines and angles, especially in facilitating students to overcome learning difficulties that have been described previously. By using the Joglo Traditional House, will not only learn mathematics but can also foster a sense of pride and love for our own culture.

In lines and angles, IRME-based learning designs are needed. It can be used as a treatment to improve conceptual understanding because of the importance of lines and angles in daily life because of so many applications (Ramadhani et al., 2019). In addition, the design of lines and angles also makes it possible to create meaningful learning, helps students in learning the material (Widiawati. et al., 2018), and motivates and attracts students to stud (Apriani & Agustine, 2019). Based on the problem description above, the research paper examines learning design lines and angles for 7th grade using Joglo traditional house context to produce a learning trajectory that can provide facilities for understanding the material and also provide a good conceptual understanding to understand the lines and angles in the next grade. The learning is designed in Hypothetical Learning Trajectory (HTL).

Research Methods

This study used the design research method validation for proving the theory in cycle one learning for piloting the HLT designed for small groups of students. Furthermore, data obtained is used to revise and improve the HLT that will be used in the teaching experiment (Nieveen, McKenney & Akker, 2006). The primary purpose of design research is to develop theories and instruments used in learning (Bakker, 2014). The participants of this study were a small group of six students from 7th grade with different abilities (high, moderate, low) to find out whether the HLT design can be applied to all students' skills and used in the pilot stage. The selection of participants is six students of different abilities from the teacher's recommendation and based on student scores. This study was carried out at one of the Junior high schools at Juwana Resident because that school did not yet

have a learning design for lines and angles using IRME. Data collection was carried out from January to February 2021 through several methods: observation, video recordings, collecting student work results, giving pre-test and post-tests, and interviews. The data were collected to see the real learning process that students have passed. The data obtained from the pilot experiment were analyzed using retrospective analysis which refers to HLT. The researchers and the lecturers followed data analysis to increase validity and reliability. Validity is carried out to find out quality data or not and make conclusions and also whether the instruments used can measure what is being measured. In this study, HLT is supporting validity can connect and evaluate the conjecture with the collected facts (actual learning). In addition, track ability is also needed to describe situations and give information in detail through observing the learning process path. At the same time, reliability can be done by looking at the linkage of the data sources obtained with the learning path and also requires consideration from the lecturers regarding the data obtained to avoid subjectivity. There are three steps of implementing design research (Gravemeijer& Cobb, 2006): Preparing for the experiment, Design experiment, and Restrospective analysis. Due to several research constraints, such as pandemic conditions, the Design experiment step was limited to the pilot experiment step (HLT trial in a small group). This study will continually be developed in subsequent research. The design research steps will be explained in the following figure.

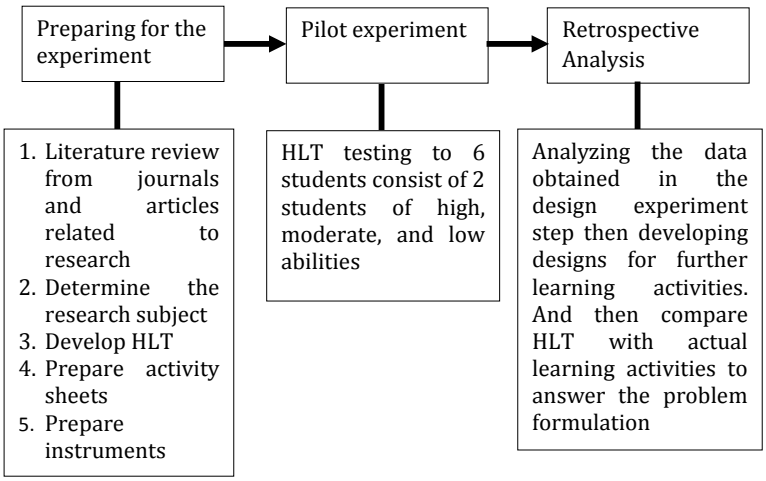


Figure 1. Design research steps

Results and Discussion

Learning trajectory that has been designed and carried out by researchers for understanding lines and angles using the context of the Joglo traditional house includes four learning activities because this process is designed according to the characteristics of IRME and handbooks used in this design. One of the characteristics of IRME is intertwining; it is expected to build more than one concept at the same time. These four activities are considered adequate to improve student's understanding. All activities (see Table 1) are designed so that students can communicate and work together in groups.

Each group consists of different ability levels, so that the six students are divided into three groups. Before and after the activity, students are given two tests, namely, pre-tests and post-tests. Those tests are for determining the ability and understanding of students before being given activities and determining the ability of students after being given activities series that has been designed. The pre-test and post-test given are in the form of

description questions consisting of formal mathematics problems containing the learning objectives to be achieved.

Table 1
Learning Process

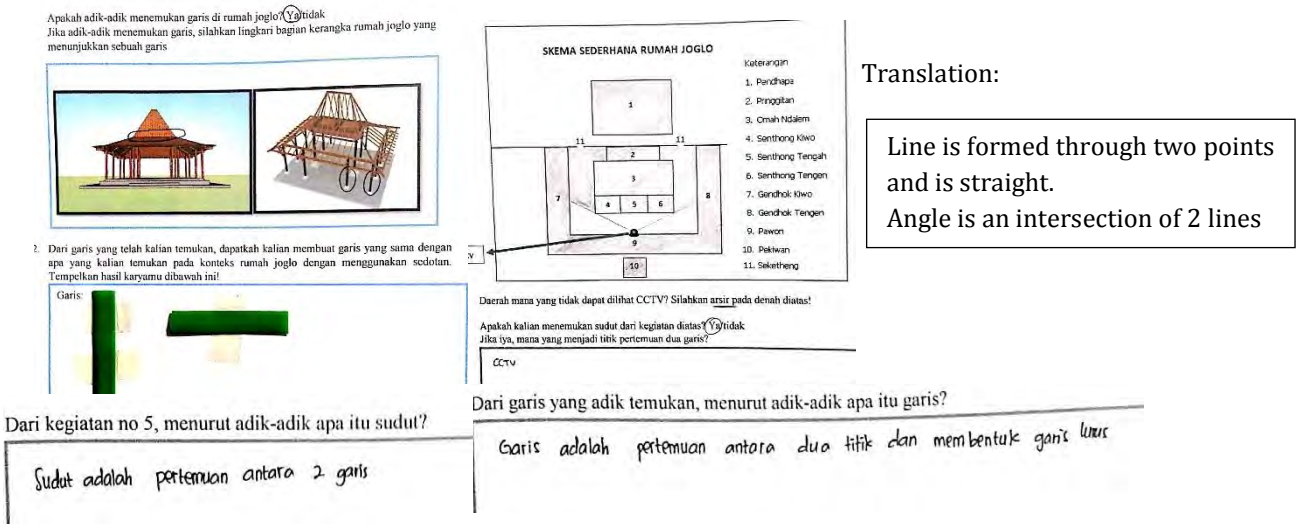
Activity	Main Goal	Conjecture
Observing the video in the context of the Joglo Traditional House	Finding the concept of Lines and Angles	• Students can find the concept of a line by observing the video/image context presented. • Students can construct an understanding of the concept of angle by observing the context and understanding how CCTV works
Deducing line positions	Understanding the concept and defining parallel lines, intersecting lines, coincided lines, and crossed lines.	• Students can identify the position of the line in the context of the Joglo traditional house • Students can model the identification results from the position of the line in the context and then paint it in a formal mathematical form • Students can represent a *ndalem* in the context given in a formal mathematical form, then determine the position of the line there and be able to define it based on the findings and observations
Finding the properties of the angles on parallel lines intersected by other lines	Understanding the concept of corresponding angles, alternate angles, consecutive angles, and their properties	• Students can find two parallel lines cut by another line then can model it using a straw and finally paint it in the formal mathematical form • Students can identify corresponding angles, alternate angles, consecutive angles according to the properties given on the activity sheet • students can use the properties of complementary angles, alternate angles, consecutive angles to work on formal math problems
Solving problems related to lines and angles	using the properties of corresponding angles, alternate angles, consecutive angles to solve the problem	Students can solve problems given based on the knowledge that has been obtained in previous activities

Activity 1: Observing the video in the context of the Joglo Traditional House to find the concept of lines and angles

In the first activity, students do the activities given in groups. Three groups of 6 students follow this activity. The first activity begins with students observing the Joglo Traditional House video to find out the concept of lines and angles. The context video is used to describe situations as real as possible to students and introduce mathematical concepts. Students observe the context to get an idea of the line. Five students get information from the context, "the line is formed through two points." In addition, the teacher provides another description of the concept of the line. Such as "what happens if any points are closing to each other and continue to extend in two directions?" The students practice the teacher's illustration, and they get a line. With guidance from the teacher, they understand better and re-explore the context to get more information about

lines. Besides that, for understanding angles, they are also asked to explore the Joglo Traditional House to define angles.

As a result of analyzing the Joglo traditional house, students can identify angles from the context and mention that "Angle is an intersection of 2 lines". On the activity sheet, students are given a CCTV working system to provide a deeper understanding of the concept of angles. CCTV is placed in the Joglo Traditional House, and then students can imagine and be able to determine the limits of the sightline and blind spots from CCTV. From the CCTV working system, students can know that CCTV and the limits of the vision can form the angle with CCTV as the vertex and the limit of the vision as the arm of the angles (line rays). In addition, students can show the area of the angle and can define angles. In the discussion session, students and teachers can mention that "an angle is an area formed from rays of lines that meet in one point, namely vertex," in the discussion session. This definition mentioned in the discussion session is better than what the students wrote on the student activity sheet because students understand it through context observation and the CCTV working system. The students' work can be seen in Figure 2.



Translation:

Line is formed through two points and is straight. Angle is an intersection of 2 lines

Figure 2. Student's answers on the first activity

Activity 2: deducing line positions

After observing the learning video of the lines and angles in Joglo Traditional House for understanding the concept of lines and angles, each group discusses and completes activity 2. Students are given a picture of the Joglo Traditional house along with the house frame. They are asked to identify the position of the line in Joglo Traditional House, such as two parallel lines, two intersecting lines, two coincided lines, and two crossed lines. The lines' position has been previously studied during elementary school. Still, in this activity, students are given experience with concrete objects to recall and identify the position of the line well. Students do not only identify the position of the line. By observing the position of the line in the context, students can paint and define the position of the line well based on previous knowledge and information on the context. After that, a part of Joglo Traditional House is given, namely *ndalem,* which will be explored again to ensure students' understanding of the position of the line. Students are asked to determine what form of space represents *ndalem* in the Joglo Traditional House then determine the position of the line in the shape of the room. At the end of the activity, students can define line positions (parallel, coincide, intersect, and cross). In learning, the teacher only facilitates students and guides them. In every activity, they are always expected to be actively

involved in constructing their knowledge. After completing an activity, the teacher gives several challenging questions to build interactivity characteristics. Students have the opportunity to express their ideas that have been poured out in the activity. The students' work can be seen in Figures 3, 4, and 5.

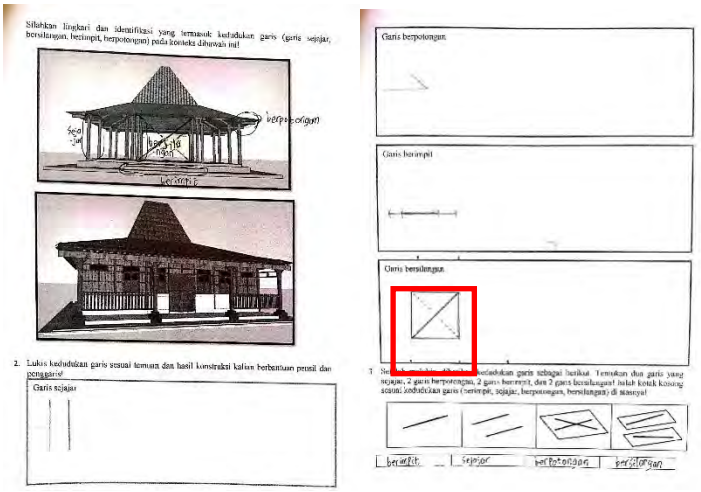
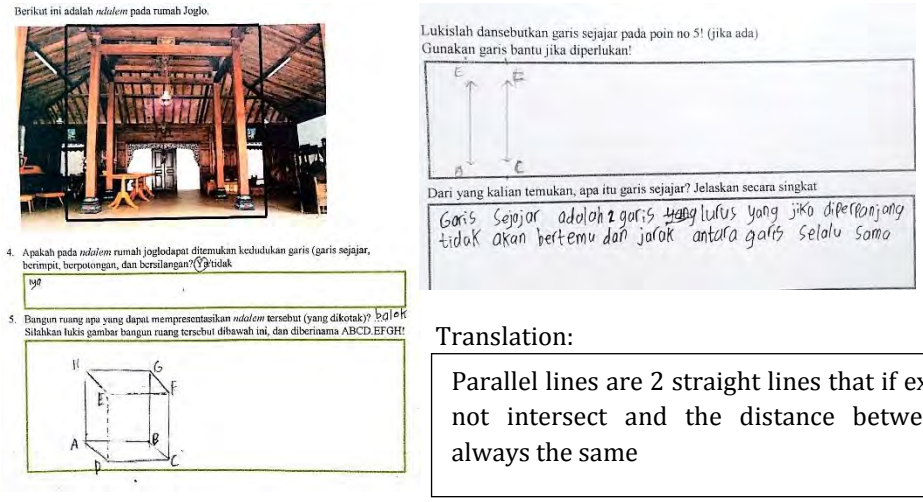


Figure 3. Student's answers on the second activity

Students' work above and the discussion between students and teacher show that students can find line positions (parallel, coincide, intersect, and cross) at Joglo Traditional House precisely and adequately. Not only is it written in the activity sheet, but students can also mention the position of another line (in a different place) and understand the position of lines located in the same field or another field. In addition, students can paint line positions that have been found in formal mathematical forms. However, it is still not suitable for the image of crossed lines because it looks to be located in the same field. After being confirmed by a discussion, they intend to paint crossed lines with different fields but still not suitable. With guidance from the teacher through observation of the Joglo traditional house again, they can understand and paint crossed lines well. Furthermore, students are given part of the Joglo traditional house *(ndalem)* and asked to represent it in a formal mathematical form, identify the position of the lines, and define them.



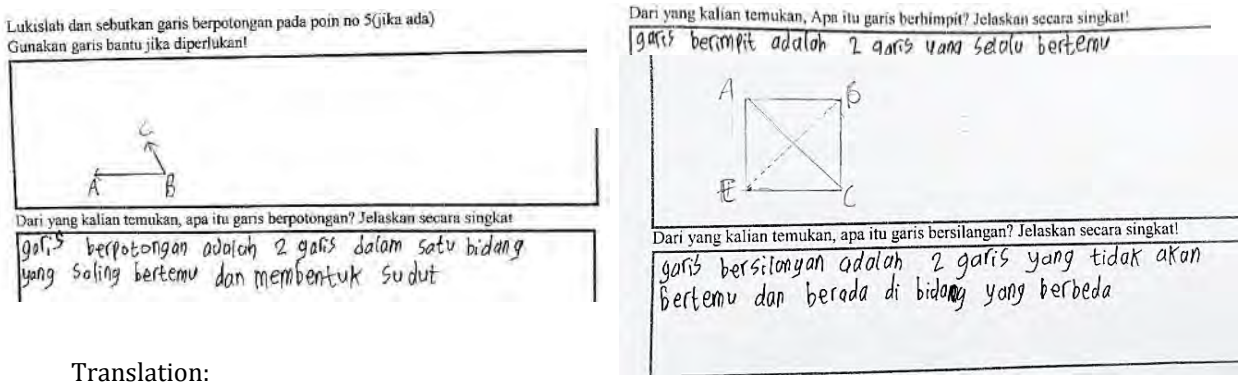
Translation:

> Parallel lines are 2 straight lines that if extended will not intersect and the distance between lines is always the same

Figure 4. Student's answers on the second activity

Figure 4 shows that students can explore and represent *ndalem* of Joglo Traditional House by painting a block with ABCD.EFGH. However, they have not been able to give the

block name correctly (inconsistent). With the guidance of the teacher, students can fix it well. Furthermore, they can find parallel lines from the blocks (representation of *ndalem*) and paint in formal mathematics well. In the end, they can define parallel lines well based on what had been observed and found in *ndalem* of The Joglo Traditional House and the block.



Translation:

Intersecting lines are 2 lines in the same field that intersect and form an angle.
Coincided lines are 2 lines that always meet.
Crossed lines are 2 lines that will not intersect and are in a different field.

Figure 5. Student's answers on the second activity

Based on Figure 5, students can identify the intersecting lines on blocks as a representation of *ndalem*. They are also able to paint intersecting lines well and show the points of intersection of intersecting lines. On the activity sheet, they can define intersecting lines, but it is still not complete. The teacher guides by asking students to observe the intersecting lines back to the context and what is obtained from observations. After observing the context back, they can mention that "intersecting lines are lines that are in the same field that intersect at a point."

Moreover, by observing the context back and the teacher's guidance, they also can define coincided lines even though the students do not find coincided lines from the block. However, the definition of coincided lines is still incomplete. With teacher guidance through discussion, students can identify coincided lines and define coincided lines precisely and adequately.

Furthermore, students can locate other line positions, namely the crossed lines in *ndalem,* and can also mention other crossed lines besides those written on the activity sheet. However, they are still not precise in painting crossed lines. Students intend to paint crossed lines on different fields on the activity sheet, but their work doesn't show it that way. This is because students don't have experience in painting crossed lines. However, students know and understand to paint crossed lines well based on teacher guidance and look back at the context. Re-observation of the context is the best step to provide a thorough understanding to students.

Activity 3: finding the properties of the angles on parallel lines intersected by other lines

After observing the learning video of the lines and angles in the context of Joglo Traditional House to understand the lines and angles concept and lines position, each group discusses and completes activity 3. This activity aims to find the properties of the angles on parallel lines intersected by other lines. The first stage is students have to identify two parallel lines intersected by straight lines at Joglo Traditional House. After students find it, they try to construct two parallel lines intersected by straight lines using a straw and give the name of the angle formed as a model to get to the formal stage. Next

stage, students paint it into formal form. The activity sheet provides stages for students to find their concepts about angles on parallel lines intersected by other lines, namely corresponding angles, alternate angles, consecutive angles, and their properties by observing contexts and following the activity sheet's steps. Therefore by knowing the concept, students do not easily forget the material that has been studied. In the learning process, teachers help and assist students in doing the activity. Then, the teacher gives challenging questions to find out student's strategies. The students' work can be seen in Figures 6-9.

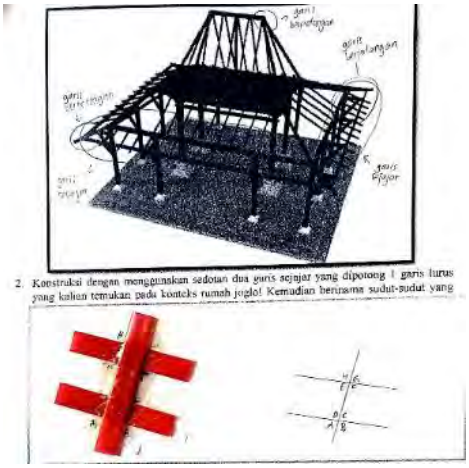
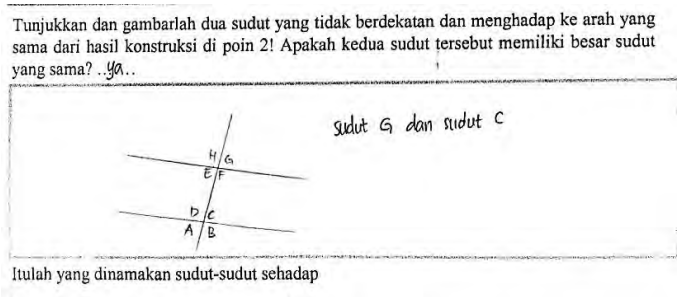


Figure 6. Student's answers on the third activity

Based on Figure 6, students can identify two parallel lines intersected by a straight context line. They find it on the roof of Joglo Traditional House. Students can construct it using a straw and give angles names according to the instructions in the activity sheet. Then the students paint two parallel lines intersected by a straight line into a formal mathematical form. After that, students are directed to understand the properties of the angles on parallel lines intersected by other lines by identifying angles according to the properties given on the activity sheet. Student's work can be seen below.

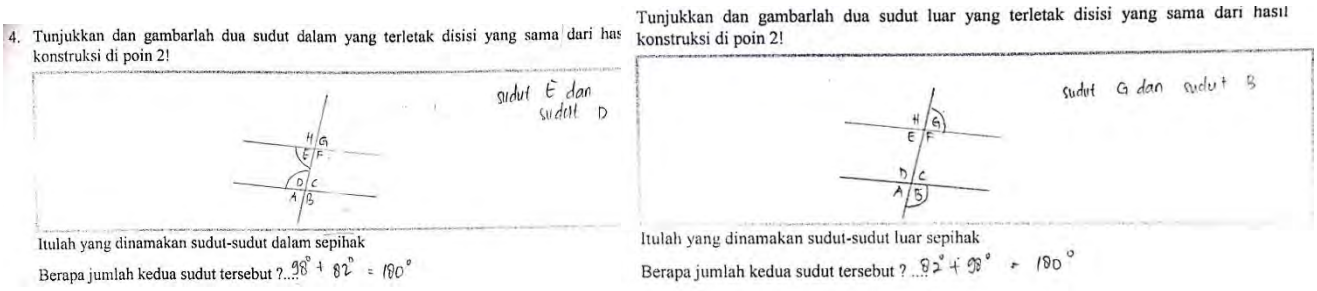


Translation :

Show two non-adjacent angles that face the same direction. Do the two angles have the same measure? *Yes* "Figure"*G and C angle* Those are corresponding angles.

Figure 7. Student's answers on the third activity

Based on Figure 7, students find angle pairs that have the properties mentioned (students find two angles that are not close and face the same direction) inactivity sheet. And conclude that the pairs of angles have the same angle measure (students measure each angle using a protractor first). Students can also answer if there is a pair of corresponding angles with one of the angles known. In addition, based on discussion between students and teacher, students can also define corresponding angles well.

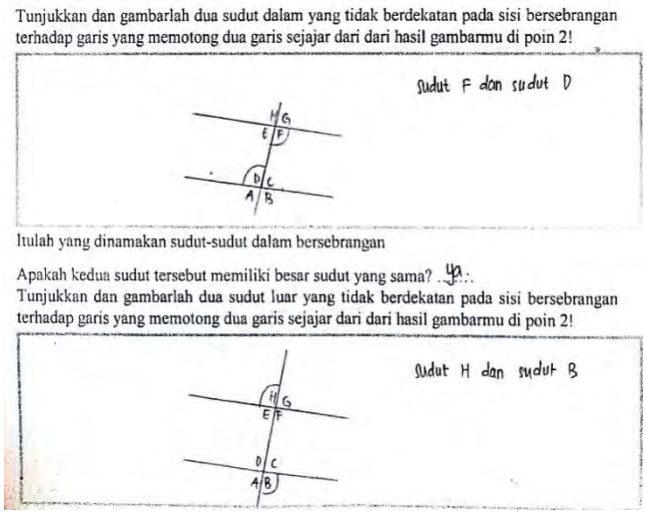


Translation:

Show two interior angles that are on the same side? "Figure" *E and D angle* Those are the consecutive interior angles What is the sum of the two angles? $98^0 + 82^0 = 180^0$	Show two exterior angles that are on the same side? "Figure" *G and B angle* Those are the consecutive exterior angles What is the sum of the two angles? $82^0 + 98^0 = 180^0$

Figure 8. Student's answers on the third activity

Based on students' work and discussion, students can find pairs of interior/ exterior angles located on the same side as properties of consecutive angles. Students can also mention that the total of the pair of these angles is 180^0 by measuring them first using a protractor. In addition, if an angle of the pair of angles is known, students can find the other angle easily without measuring it with a protractor by using the property of consecutive exterior/interior angles. And finally, students can define consecutive exterior/interior angles well.



Translation:

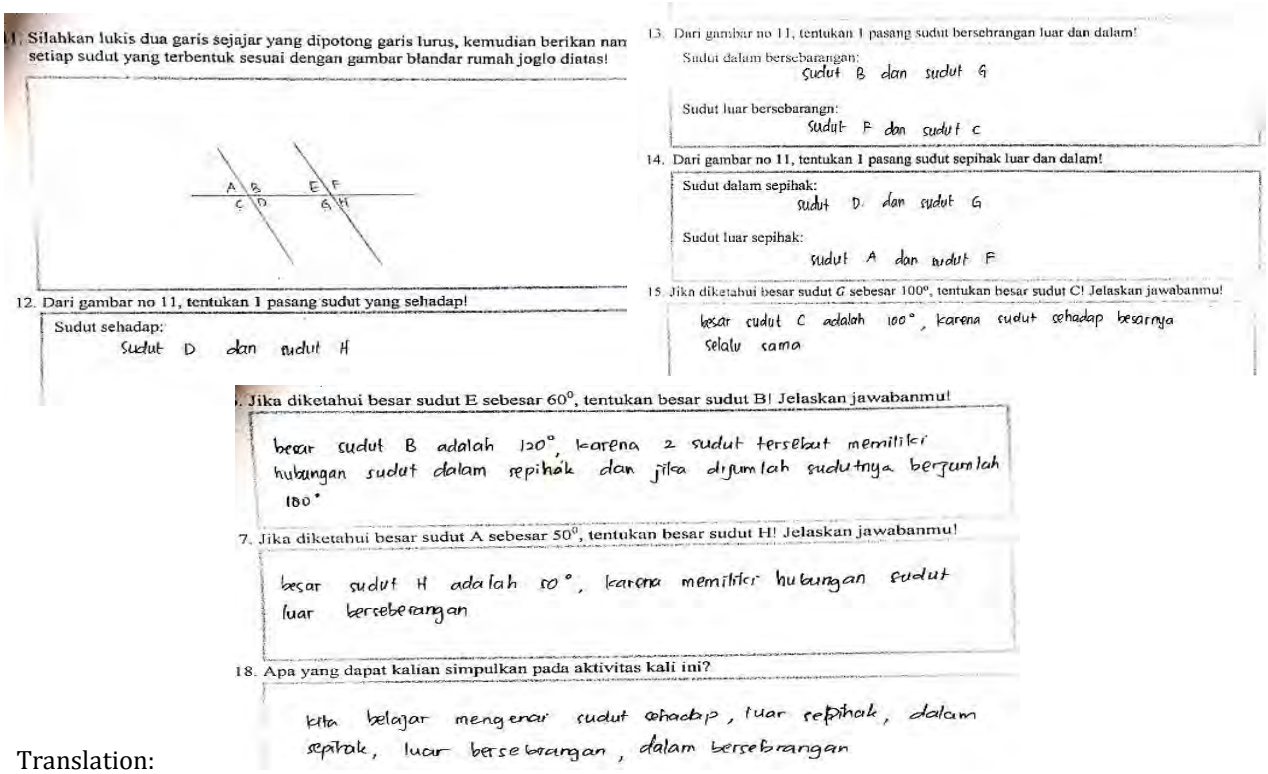
Show two non-adjacent interior angles on opposite sides of the line that intersects the two parallel lines *"Figure" F and D angle* Those are the alternate interior angles Do the two angles have the same measure? *Yes*
Show two non-adjacent exterior angles on opposite sides of the line that intersects the two parallel lines "Figure" *H and B angle* Those are the alternate exterior angles Do the two angles have the same measure? *Yes*

Figure 9. Student's answers on the third activity

From the students' answers in Figure 9 above, students can find interior and exterior angles that are not close to each other from opposite positions as properties of alternate interior/exterior angles. Students also know the angle measure in the pairs of angles found, which they have the same angle measure by measuring it using a protractor first. Based on the discussion, students can find other pairs of angles of alternate angles and can also find the measure of the angle if other angles are known. And at the end, students can define alternate interior/exterior angles. The teacher provides direction if students need more instructions to do the activity.

Activity 4: solving problems related to lines and angles

After carrying out the previous activities, each group was given activity 4, solving daily line and angles problems. Students work on these problems with concepts that have been learned in previous activities. The teacher gives guidance to students. In this activity, students are given a *"Blandar"* of Joglo Traditional House and its philosophy. Then the students identify *"Blandar"* of Joglo Traditional House and paint it into a formal mathematical form, namely two parallel lines intersected by straight lines. The figure below shows that students can determine the pair of angles from corresponding angles, alternate angles, and consecutive angles and use the properties based on the given problem. The students can solve the problem well. The students' work in a group can be seen in Figure 10.



Translation:

11. Please paint two parallel lines that are cut straight lines, then give a name for each angle formed. "Figure" 12. Find a pair of corresponding angles! *D and H angle*

13. Find a pair of alternate exterior and interior angles *Alternate interior angles: B and G* *Alternate exterior angles: F and C* 14. Find a pair of consecutive exterior and interior angles *Consecutive interior angles: D and G* *Consecutive exterior angles: A and F* 15. If it is known that angle measure G is 100^0. What is angle measure C? *The angle measure C is 100^0, because a pair of the corresponding angle has the same measure*	16. If it is known that angle measure E is 60^0. What is angle measure B? *The angle measure B is 120^0, because two angles are a pair of consecutive interior angles, and the sum of the two is 180^0* 17. If it is known that angle measure A is 50^0. What is angle measure H? *The angle measure H is 50^0, because two angles are a pair of alternate exterior angles*

Figure 10. Student's answers on the fourth activity

The learning design is adapted to the characteristics of Realistics Mathematics Education (RME). According to Widyawati et al. (2016) and Nursyahidah et al. (2021), the first characteristic of RME is the use of context. This learning is designed about lines and angles to start from something that is already recognized by students, namely the Joglo Traditional House, which is then used as a context. This context is used as a starting point and learning resource. It is explored to obtain informal information and is directed towards formal details. The second characteristic is the use of models. Models and symbols are used to connect the concrete situational stage to the formal and abstract stages. The model used in learning is constructing with a straw and painting in a formal mathematical form according to the instructions for each activity. The third characteristic is student contributions. In learning, students can solve problems and construct their understanding through activity sheets to develop various informal strategies to solve problems. All ideas, opinions, and whatever form of student's contribution are highly valued and cared for. Then, on the interactivity, the learning process must be good interaction between students and teachers, students and students, and students and learning instruments to achieve learning objectives. In this study, there are several forms of interactivity such as discussions between teachers and students, giving explanations from the teacher, group collaboration, using media and learning instruments by students, and evaluation. The fifth characteristic is intertwining; structure and mathematical concepts are interrelated. In lines and angles, they are related to one another. In this study, a series of activities that have been designed are associated with each other. Activity 1 is related to activity 2, activity three is connected to activities 1 and 2. In addition, a series of activities are designed according to students' previous knowledge. This connection makes the learning process meaningful.

A series of activities that have been designed produce a learning trajectory through four activities. Those activities are observing the video context of Joglo Traditional House to find the concept of lines and angles, deducing line positions, discovering the property of the angles on parallel lines intersected by other lines, and solving lines and angles problems. The learning design of lines and angles in Joglo Traditional House based on IRME is feasible to be applied during the teaching experiment. This design can give students the guidance to find mathematical concepts with direction from the teacher. This is in line with Simanulang (2014), which stated that the IRME approach could make students think critically and creatively so that it is easy to understand the concept using several things that are close to students. After seeing the study results, it can be concluded that the HLT that has been designed is following the actual learning process. But some activity sheets need to be improved from this study, such as some questions on the activity sheet are made more straightforward, so students will easily understand what is meant by the activity sheet.

Conclusion

Based on the results and discussion, the study result shows that a learning trajectory in the form of a series of activities that have been designed consisting of four activities. Those activities are observing the context of Joglo traditional house to find the concept of lines and angles, deducing line positions, discovering the properties of the angles on parallel lines intersected by other lines, and solving lines and angles problems. The activities adapted to the characteristics of IRME can guide students in understanding lines and angles, which start from the context as a starting point and learning resource that provides informal information to students and then leads to formal details. In every activity, students are actively involved in constructing knowledge carried out in group

work. The result of the study also reveals that the HLT designed is by actual learning. Every activity does not only rely on activity sheets, context, or media. However, teacher guidance and discussion sessions are also needed to achieve learning objectives. What needs to be improved on the learning design is that the questions given are more superficial to understand well. Also, researchers must provide a real context as possible through videos and pictures. This study is limited to a pilot experiment due to the limitations of researchers during the Covid-19 pandemic. Suggestion for the subsequent research is researchers can develop the learning trajectory that has been produced in this pilot experiment stage through learning design testing to the teaching experiment stage (testing the learning design to the research target class). That is why learning design becomes better and ready to be applied in learning and can develop designs for further learning activities.

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