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Reflection learning innovation in the context of the lipa sabbe bunga caramming motif

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Abstract
The low ability of students to understand and transform the concept of reflection to solve everyday problems is the main problem with learning mathematics because the implementation of learning mathematics is mechanical. Mathematics is taught by conveying formulas practically without linking them to students' daily activities. For this reason, this study aims to design a reflection learning trajectory in the context of the Lipa Sabbe Bunga Caramming motif as a starting point in learning to help students understand reflection material for solving everyday problems. The method used in this study is design research, which consists of three stages: preliminary design, design trials, and retrospective analysis. The subjects of this study were 23 students in class VIII-A of SMP Negeri 1 Tanasitolo. The instruments used in this study were student activity sheets (LAS), learning achievement tests, and interview guidelines. Student activity data during learning were analyzed retrospectively, and learning outcomes data were analyzed descriptively. The results of this study found that the learning trajectory of transformation geometry using the context of the lipa sabbe bunga caramming motif has four learning stages: (1) informal; (2) modes of; (3) modes of; and (4) formal. The learning stages can easily increase students' understanding of the concept of reflection. In the learning process, mathematical concepts are connected with daily habits, so students are enthusiastic and active in the learning process. This learning trajectory can assist teachers in optimizing learning so that students can easily understand the concept of reflection, equip them with critical thinking skills, and shape their character (cooperation, empathy, respect for others, awareness of social problems, a social spirit, and responsibility).

INTRODUCTION

Mathematics is often taught in schools as a subject free from culture and not associated with daily life activities (Rosa & Orey, 2015; Ergene et al., 2020). This indirectly forms the perception that mathematics is complex. The International Assessment of Mathematics in Indonesia program concluded that Indonesian students are still low in understanding and transforming mathematical concepts to solve everyday problems in the form of projects (Rastuti & Prahmana, 2021; Acharya et al., 2021; Pathuddin et al., 2021). The main problem is that because the implementation of learning mathematics is mechanical, mathematics is taught by presenting practical formulas without linking them to students' daily activities. (Prahmana et al., 2023; Fouze & Amit, 2018; Ergene et al., 2020).

Related to the problems of mathematics education in Indonesia, transformation efforts are needed to bring mathematics closer to the reality and culture of students. In this case,

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ethnomathematics, initiated by D'Amrosio based on his concern with the mechanistic condition of mathematics education, far from the reality and culture of students, can be a solution (D'Ambrosio, 2016). Ethnomathematics succeeded in building a relationship between mathematics and the reality of society, where initially, there were gaps due to formal education that was rigid and not contextual (Prahmana et al., 2021). Ethnomathematics combines ideas, ways, and mathematical techniques practiced and developed by socio-cultural or community cultures (D'Ambrosio, 2016; Risdiyanti & Prahmana, 2018). Ethnomathematics tries to reconstruct mathematics so that it is rooted in different cultures and accommodates other ideas so that students become able to reason critically and democratically and can be tolerant of various ideas during teaching and learning activities (D'Ambrosio, 2016; Risdiyanti & Prahmana, 2020). Therefore, ethnomathematics can be used as one of the innovations in mathematics education to bring mathematics closer to students' daily activities to foster their love for mathematics, increase their interest in learning, and increase their creativity in learning mathematics through its culture.

Indonesia, which is rich and culturally diverse, has the opportunity to improve the mathematics education system in Indonesia through transformation efforts to bring mathematics closer to the reality and culture of students (Muhtadi et al., 2017). Many cultures in Indonesia can be explored to get contexts for learning mathematics, including the culture in the Wajo Regency area, known as the City of Silk. The silk sarong motif has a distinctive style and important cultural, historical, and philosophical values to shape the character of students, for example, self-confidence, sympathy, empathy, respect for others, awareness of social problems, a social spirit, and responsibility (Srikandi et al., 2018). Silk sarongs are clothes often used by the Wajo people in traditional events, such as weddings, Wajo anniversaries, circumcision, and other official occasions. The familiarity of lipa sabbe among the community and students in Wajo allows mathematics educators to explore and use it as a context for learning mathematics. The exploration of lipa sabbe motifs in relation to mathematical concepts has been documented by several researchers (Qastarin & Siagian, 2019; Azriani et al., 2017).

Several previous studies have examined students' difficulties in understanding the concept of reflection, applying principles, transforming questions, and solving problems, including story questions related to students' daily lives (Maulani & Zanthy, 2020; Pathuddin et al., 2021). But so far, no research has examined the design of reflection learning trajectories using the context of the lipa sabbe, bunga caramming motif. Meanwhile, the concept of reflection is a basic concept that is used to understand other materials, such as the volume of rotating objects, relations, and functions (Sundawan, 2018; Prahmana & D'Ambrosio, 2020). Therefore, it is very urgent to design a reflection learning trajectory using the context of the Lipa Sabbe Bunga Caramming motif to help students understand the concept of reflection easily.

This study aims to design a reflection learning trajectory in the context of the Lipa Sabbe bunga Caramming motif as a starting point in learning to help students understand reflection material in solving everyday problems. This motif was chosen because it is often used by the community and is found in cultural activities because most of the people in Tanasitolo village work as lipa sabbe weavers.

METHODS

The method used in this research is design research, which aims to build a reflective learning trajectory to improve learning activities in the classroom (Bakker, 2018). This study has three stages, namely: the researcher conducts a preliminary design, the researcher experiments on the design that has been designed, and finally, the researcher analyzes retrospectively to obtain answers to the research questions. These three stages can be explained as follows: (1) Preliminary design is the first stage in this study. The research activities at this stage are to conduct a literature review and design a reflection learning trajectory plan using the context of the lipa sabbe caramming motif, which serves as a guide for the stages of the learning activity process for students and can be revised during the design experiment stage. (2) A design experiment (experimental design) is a stage that aims to test learning trajectories by conducting teaching experiments and pilot experiments. In the teaching experiment, the researcher, together with the teacher, seeks to obtain the students' prior knowledge and collects data for consideration in adjusting the learning trajectory plans that have been made. In the pilot experiment, the researcher adjusted the learning trajectory plan based on data obtained from previous experiments and collected data to obtain answers to research questions. (3) Retrospective analysis is a stage that aims to compare learning activities in the learning trajectory with the results at the experimental design stage to evaluate the effectiveness of learning. The results of this analysis produce a local instruction trajectory of reflection learning using the Lipa Sabbe context with caramming floral motifs.

The subjects of this research were class VIII A students of SMP Negeri 1 Tanasitolo: 23 students (8 males and 15 females). Then students were selected, each with high and low mathematical abilities, by looking at the posttest scores after the learning process to be interviewed. Each subject was asked to describe their mental activity in solving problems. This is done to explore thought processes and other existing solutions for solving problems. The instruments used in this study were (1) student activity sheets referring to the HLT of reflection learning using the context of the lipa sabbe caramming motif; (2) a problem-solving ability test; and (3) an interview guide sheet that a team of experts had validated. The data obtained were analyzed retrospectively with HLT. The data analysis carried out in this study was to compare the results of observations during the learning process with the HLT designed at the initial design stage. The stages of retrospective analysis are data analysis of problem-solving ability, reflection, interpretation of findings, and formulation of recommendations for further research.

RESULT AND DISCUSSION

Design Hypothetical Learning Trajectory (HLT)

At the Design Hypothetical Learning Trajectory stage, the researcher initially proposed using the Lipa Sabbe Caramming motif in the context of reflection transformation geometry learning. The lipa sabbe motif of the caramming flower was chosen as the context in the study because it is often used by the community and is found in cultural activities, and most of the people in Tanasitolo village work as lipa sabbe weavers. In addition, some of the findings that the use of learning media in cultural contexts can help students improve their critical thinking skills. This is in line with the research of Prahmana et al. (2021), who found that learning mathematics by utilizing local culture as a learning resource can help students understand the material easily.

The design of a hypothetical learning trajectory (HLT) is the first step in this research, which serves as a guide for activities that students must do during the learning process. In designing the HLT, a learning trajectory is needed, and a concept map containing learning materials and competencies that students must achieve, as shown in Figure 1.

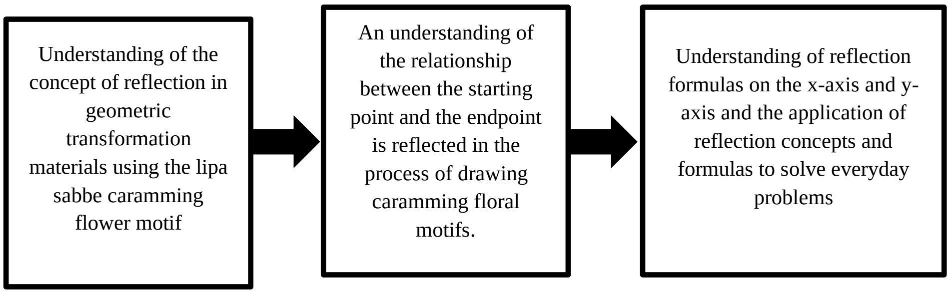


Figure 1. Learning Trajectory of Middle School Reflection Learning

Hypothetical Learning Trajectory (HLT), which contains the relationship between learning trajectories, student activities, and competencies that must be achieved by students on mirroring material, can be seen in Figure 2.

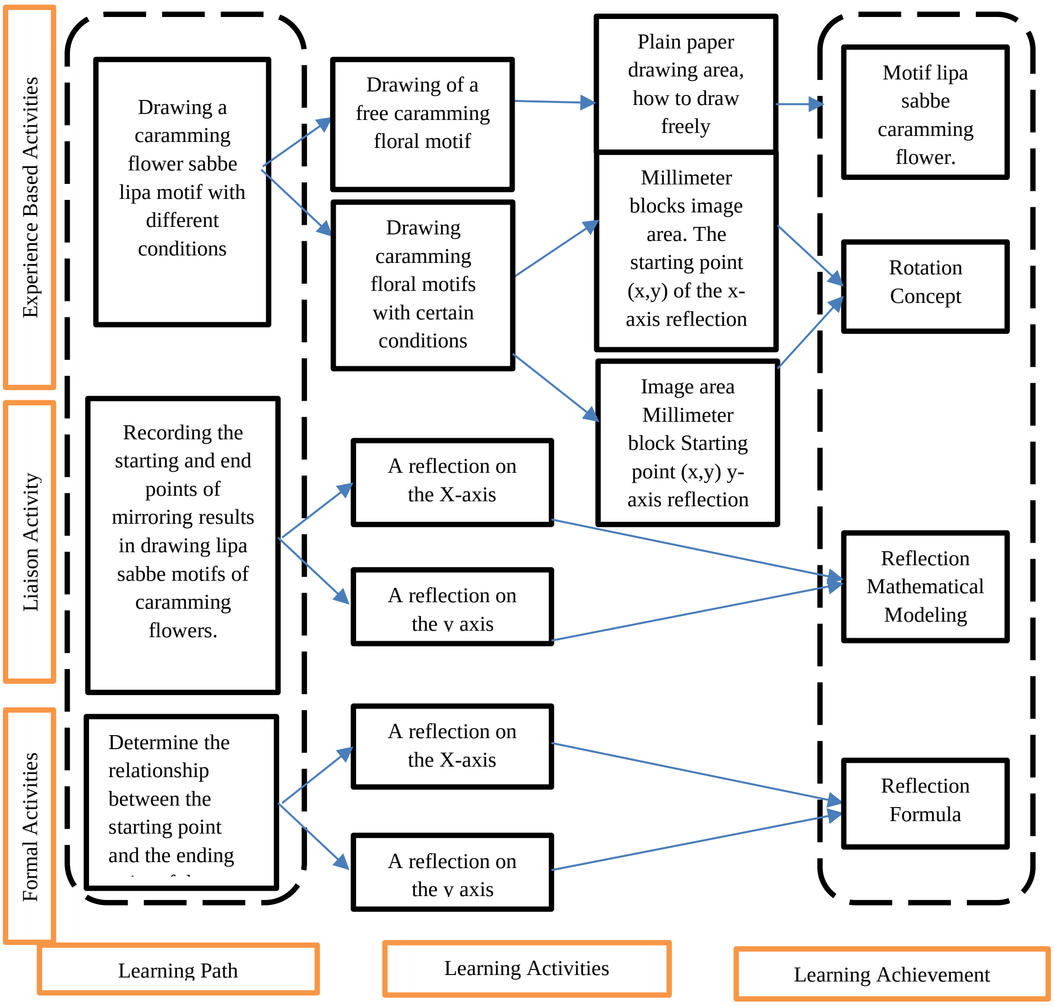


Figure 2. Desain HLT on Junior High Mirroring Material

Design Experiment

In the experiment design step, the researcher and the teacher carried out teaching practices based on the HLT that had been previously developed for class VIII students at Tanasitolo 1 Middle School.

Informal first stage. In the first step, the teacher begins learning by giving students an appreciation of the form of the caramming flower motif that is often found by students and explaining the meaning contained in the motif so that good character can be built in them. To obtain a common perception, the teacher asks students to draw caramming floral motifs freely based on their knowledge. Next, the teacher asked the students to share their learning experiences when drawing caramming floral motifs. There are different perceptions when students draw caramming floral motifs at this stage. Some students revealed that drawing caramming floral motifs started by drawing four equal-sized circles that touched each other and then making a circle in the middle to form a flower-like motif. While other students said that drawing the caramming flower motif starts with making a circle in the middle, and then it is surrounded by a semi-circle to form a caramming flower, as seen in Figure 3.

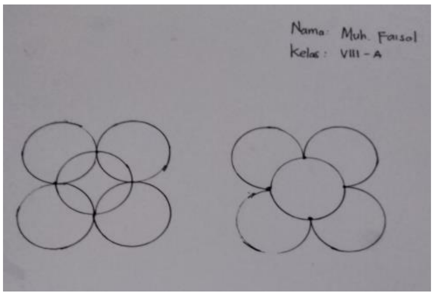


Figure 3. Students Are Drawing the Lipa Sabbe Caramming Flower Motif

After students draw caramming floral motifs freely, the teacher practices how to draw caramming floral motifs correctly to obtain a common perception. This is done to facilitate the next learning stage.

In stage 2 (modes of) of the second activity, students draw the lipa sabbe caramming floral motif on millimeter block paper based on the agreed provisions. In drawing the caramming floral motif, it is done by reflecting a shape on the y and x axes. The first step is for students to draw a circle with the center point (0,0), followed by drawing an arc (semi-circle shape) with the center point A (2,2) in quadrant I, where the end of the arc touches the circle that was made before. In this step, the initial point A (2,2) is obtained, which is positive. Point A is then reflected on the y-axis to produce a mirrored point B (-2, 2). Point B is reflected on the x-axis to get point C (-2, -2), and finally, point C is reflected on the y-axis to get the point D (2, -2). This activity is carried out to gain students' understanding of the concept of reflection in the Cartesian field. As seen in Figure 4,

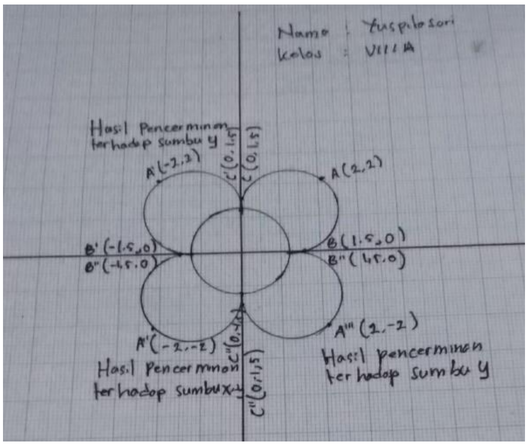
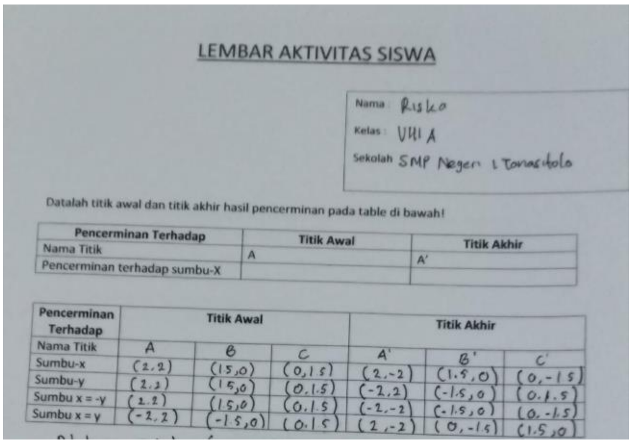


Figure 4. Results of Student Work in Drawing the Lipa Sabbe Caramming Flower Motif on the Cartesian Coordinate Plane

In stage 3 (mode for) of the third activity, students record the starting and end points of reflection results based on the Student Activity Sheet (LAS) provided to deepen students' understanding of the concept of reflection. After recording the points in the LAS, the teacher asks students to look for the relationship between the starting and endpoints after reflection by making a mathematical model by replacing the x and y values with the letters a and b. The results of student work can be seen in Figure 5.



LEMBAR AKTIVITAS SISWA

Nama : Risko
Kelas : VIII A
Sekolah : SMP Negeri 1 Tonasitolo

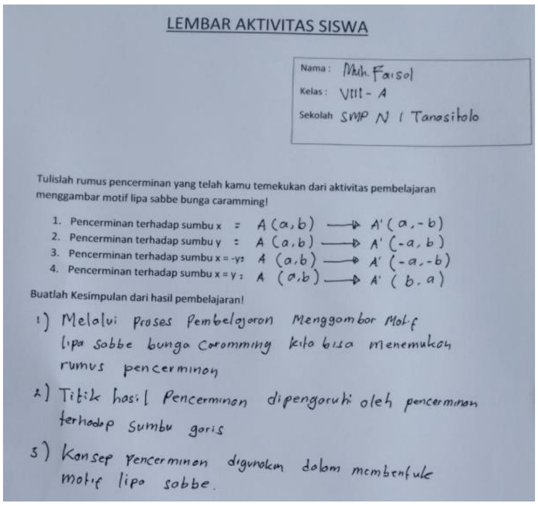
Datalah titik awal dan titik akhir hasil pencerminan pada table di bawah!

Pencerminan Terhadap	Titik Awal	Titik Akhir
Nama Titik	A	A'
Pencerminan terhadap sumbu-X		

Pencerminan Terhadap	Titik Awal			Titik Akhir		
Nama Titik	A	B	C	A'	B'	C'
Sumbu-x	(2,2)	(1.5,0)	(0,1.5)	(2,-2)	(1.5,0)	(0,-1.5)
Sumbu-y	(2,2)	(1.5,0)	(0,1.5)	(-2,2)	(-1.5,0)	(0,1.5)
Sumbu x = -y	(2,2)	(1.5,0)	(0,1.5)	(-2,-2)	(-1.5,0)	(0,-1.5)
Sumbu x = y	(-2,2)	(-1.5,0)	(0,1.5)	(2,-2)	(0,-1.5)	(1.5,0)

Figure 5. Results of Student Work in Recording the Starting Point and End Point of Reflection Results

Stage 4 formals. In the fourth step, students find the general reflection formula by connecting the starting and ending points based on the Worksheet, as shown in Figure 6. Then the teacher and the students develop a mathematical model for reflecting a point on a certain line.



LEMBAR AKTIVITAS SISWA

Nama : Muh. Faisol
Kelas : VIII - A
Sekolah SMP N 1 Tanasitolo

Tulislah rumus pencerminan yang telah kamu temekukan dari aktivitas pembelajaran menggambar motif lipa sabbe bunga caramming!

1. Pencerminan terhadap sumbu x : A (a, b) → A' (a, -b)
2. Pencerminan terhadap sumbu y : A (a, b) → A' (-a, b)
3. Pencerminan terhadap sumbu x = -y: A (a, b) → A' (-a, -b)
4. Pencerminan terhadap sumbu x = y : A (a, b) → A' (b, a)

Buatlah Kesimpulan dari hasil pembelajaran!

1) Melalui proses pembelajaran menggambar motif lipa sabbe bunga caramming kita bisa menemukan rumus pencerminan
2) Titik hasil pencerminan dipengaruhi oleh pencerminan terhadap sumbu garis
3) Konsep pencerminan digunakan dalam membentuk motif lipa sabbe.

Figure 6. Results of Student Work in Finding Reflection Formulas

At the formal stage, the students generalize the concept of reflection formulas and can solve everyday problems related to the concept of reflection.

Retrospective Analysis

Data on students' knowledge abilities were obtained using a knowledge test. This test was given before and after applying mathematics learning in the context of the Lipa Sabbe Caramming motif.

The student's knowledge abilities are described based on the pretest and posttest results. From the data processing results, a data recapitulation of students' knowledge abilities is obtained based on the absorption capacity of each indicator of knowledgeability, presented in Table 1.

Table 1. Recapitulation of Absorptive Ability of Students' Comprehension Ability from Each Indicator

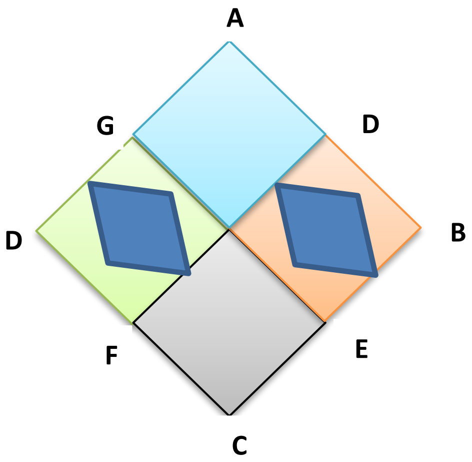
Knowledge Ability	Pretest	Posttest	Improvement
Interpretation	50,60%	100%	49,40%
Analysis	12,70%	99%	86,30%
Evaluation	2,34%	93%	90,66%
Decision	0,00%	40%	40%

Based on Table 1, it can be seen that the absorption ability of students' knowledge of each indicator experienced a significant increase before and after the teaching experiment. This shows an increase in students' understanding of the concept of reflection after the learning process uses the context of the lipa sabbe bunga caramming motif.

Interviews were conducted with students to explore and deepen students understanding abilities after the learning process.

Question:

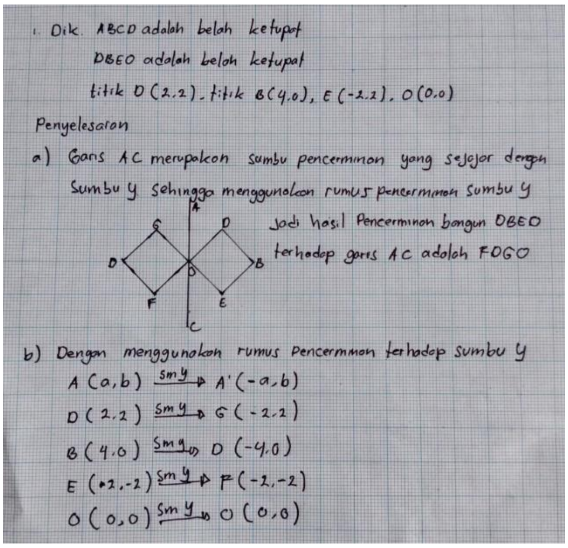
Look at the picture of the lipa sabbe motif below!



ABCD is one of the lipa sabbe motifs, namely the logo motif if a reflection line is drawn at points A and C and point O is located in the middle of the AC line.

1. Determine the reflection results of the DBEO build!
2. If point D (2,2), point B (4,0), point E (2, -2), and point O (0,0). Determine the image of the point if it is reflected on the line AC!

Subject answer:



1. Dik. ABCD adalah belah ketupat
DBEO adalah belah ketupat
titik D (2,2). titik B(4,0), E (-2,2). O(0,0)

Penyelesaian

a) Garis AC merupakan sumbu pencerminan yang sejajar dengan Sumbu y sehingga menggunakan rumus pencerminan sumbu y

Jadi hasil Pencerminan bangun DBEO terhadap garis AC adalah FOGO

b) Dengan menggunakan rumus Pencerminan terhadap sumbu y

A (a,b) $\xrightarrow{sm\ y}$ A'(-a,b)
D (2,2) $\xrightarrow{sm\ y}$ G (-2,2)
B (4,0) $\xrightarrow{sm\ y}$ D (-4,0)
E (+2,-2) $\xrightarrow{sm\ y}$ F (-2,-2)
O (0,0) $\xrightarrow{sm\ y}$ O (0,0)

From the results of the Knowledge Test (TP), the description of the ability to understand male subjects with high knowledge (LT) is stated as follows:

Interpretation. In this indicator, the LT subject already understands the problem. This can be seen from how the LT subject writes down things known in the problem. It is known that ABCD is a rhombus, and it is also known that points D (2,2), point B (4,0), point E (2, -2), and point O (0,0) are rhombuses. The LT subject can relate interrelated information to the questions from pictures or written information. The LT subject also clearly knew what was being asked from the TP, namely (a) determine the reflection result of the DBEO shape if it is reflected on the line AC, and (b) determine the image of a known point if it is reflected on the line AC.

Analysis. In this indicator, the LT subject answered part a by paying attention to the rhombus pictures in the DBEO image, while for part b, the reflection formula was used for the AC line, which he had found himself through learning activities. He used the formula for reflection about the y-axis because the line AC is parallel to the y-axis.

Evaluation. In this indicator, the LT subject solves the first problem by reflecting the DBEO shape to the AC line to obtain a mirror image of the FDGO shape. Then the LT subject reflects known points on the AC line by using the reflection formula on the y-axis to obtain a mirror image F (-2, - 2), D (-4, 0), G (-2, 2), and O (0,0).

Decision. In this indicator, the LT subject has retraced his answers by checking and rechecking every step he uses. The LT subject was sure of the answers written.

The following is a test-based interview data presentation for LT on TP. In this interview, I briefly explained the understanding of students.

Table 2. Interview Data Presentation for LT on TP

Code	***P/J***	***Interview Description***
LT1-001	***P***	*Have you ever had questions like this (question number 1) before?*
LT1-001	***J***	*I have never.*
LT1-002	***P***	*What did Faisal think after reading question number 1?*
LT1-002	***J***	*I was told to mirror the DBEO wake to the AC line.*
LT1-003	***P***	*Did Faisal have difficulty reading the questions?*
LT1-003	***J***	*I did not.*
LT1-004	***P***	*Does Faisal know the elements that are known from the problem? Try to mention it!*
LT1-004	***J***	*Yes. It is known that ABCD is a rhombus, and it is also known that DBEO is a rhombus where the points are as follows: point D (2,2), point B (4,0), point E (-2, -2) and point O (0,0).*
LT1-005	***P***	*Are the questions given enough to find out what is being asked? Try to mention it!*
LT1-005	***J***	*Yes, that's enough, the first one is asked to look for the results of the DBEO shape reflection, and the second one determines the image of the point image if it is reflected on the AC line.*
LT1-006	***P***	*Can Faisal recognize quadrilateral shapes based on the pictures/shapes he sees?*
LT1-006	***J***	*Yes.*

The LT subject can understand the problem on the interpretation indicator because it can clearly state what is known. It is known that ABCD is a rhombus, and it is also known that the DBEO shape is a rhombus, with points D (2,2), B (4,0), E (2, -2), and O (0,0). The LT subject is able to relate interrelated information to the questions, either from pictures or written information. The LT subject also clearly knew what was being asked from the TP, namely (a) determine the reflection result of the DBEO shape if it is reflected on the line AC, and (b) determine the image of a known point if it is reflected on the line AC. The LT subject also mentioned that he could recognize a quadrilateral based on the image or shape he saw.

Table 3. Interview Data Presentation for LT on TP

Code	*P/J*	*Interview Description*
LT1-008	***P***	*How did Faisal solve the problem?*
LT1-008	***J***	*For part a, I first looked at the picture provided. The DBEO rhombus is then reflected against the AC line to obtain the reflection of the FDGO rhombus, which has a similar shape. As for part b, I used the reflection formula about the y-axis because the line AC is parallel to the y-axis.*
LT1-009	***P***	*What is the formula for the area of reflection about the y-axis?*
LT1-009	***J***	*If point A (a, b) is reflected on the y-axis, then the result of the reflection is A' (-a, b)*
LT1-010	***P***	*Did Faisal experience difficulties in formulating the alleged solution to the problem? (try to say)*
LT1-010	***J***	*I had no difficulty solving part A and b questions because in the learning process that had been carried out, we were led to find the reflection formula, and the questions given, even though I had never gotten them before, were easy for me to solve.*

In the analysis indicator, the LT subject first pays attention to the pictures provided in solving part a question. I first noticed the picture provided. The DBEO rhombus is then reflected against the AC line to obtain the reflection of the FDGO rhombus, which has a similar shape. As for part b, I used the reflection formula about the y-axis because the AC line is parallel to the y-axis.

Table 4. Interview Data Presentation for LT on TP

Kode	*P/J*	*Interview Description*
LT1-011	***P***	*What are the steps to solving the problem? (try to explain)*
LT1-011	***J***	*For part a, I think looking at the picture is enough to get the answer. As for part b, that is by first recording the known points D (2, 2), point B (4, 0), point E (2, -2), and point O (0, 0), then reflecting that point to the line AC which is parallel to the y-axis, so we use the reflection formula for the y-axis so that the answers to point G (-2,2) and point D (-4, 0) are obtained. Point F (-2, -2) and point O (0, 0)*
LT1-012	***P***	*Can Faisal prove that every step used is correct?*
LT1-012	***J***	*Yes (while looking at the answer sheet.)*
LT1-013	***P***	*Does Faisal use the formula correctly?*
LT1-013	***J***	*Yes, I think that's correct.*

In the evaluation indicators according to the plan, the LT subject, in solving the problem, first records the known points D (2, 2), points B (4, 0), points E (2, -2), and points O (0, 0), then reflects that point on the AC line parallel to the y-axis, so we use the reflection formula on the y-axis so that we get the answer point G (-2, 2), point D (-4, 0). Point F (-2, -2) and O (0, 0).

Table 5. Interview Data Presentation for LT on TP

Code	*P/J*	*Interview Description*
LT1-014	***P***	*Is Faisal sure about the answers he gets? Take a look at the answer again!*
LT1-014	***J***	*I'm pretty sure (while checking the answers).*
LT1-015	***P***	*If there is a problem like this, there is no other way of solving it?*
LT1-015	***J***	*There isn't any.*

In the decision indicators, the LT subject has retraced his answers and is confident in his work; he is sure every step is correct.

Students' problem-solving abilities in solving transformation geometry problems After the learning process using the context of the Lipa Sabbe Bunga Caramming motif, there is no significant difference in the problem-solving process between students who have high and low knowledge. However, subjects with high mathematical abilities could do the problem-solving process much better than those with low mathematical abilities. This is because, in the learning process, the concept of mathematics is connected with the students' daily habits so that they are enthusiastic, active in the learning process, and critical in responding to the problems given. This finding reinforces the results of research conducted previously by Martyanti and Suhartini (2018), which concluded that ethnomathematics-based mathematics learning is relevant to indicators of problem-solving abilities, including interpretation, analysis, evaluation, and decision-making. This is in line with some of the findings of previous studies, which concluded that students' understanding of mathematical concepts and problem-solving could be improved by using ethnomathematics-based geometry material in the learning process (Sumiyati et al., 2018; Mirnawati et al., 2020; Rahmadiani et al., 2020). Thus, ethnomathematics-based mathematics learning can be used as an alternative to learning mathematics to develop students' understanding and problem-solving abilities.

Teachers in the process of learning mathematics, especially in teaching transformational geometry material, not only try to understand concepts but also need to guide students in finding formulas for developing problem-solving abilities through a learning process that has a local context by utilizing things that students often encounter as learning resources so that learning is more meaningful. The paradigm of the mathematics learning process must be changed from the formal stage, where the teacher explains definitions followed by examples, to make learning mathematics more meaningful. Teachers should start teaching mathematics at the informal stage, where students can be creative by giving concrete examples close to their reality. From these examples, students are guided to find formulas leading to the formal stage to make learning mathematics more meaningful. The learning trajectories produced in this study can be a reference for mathematics teachers and become knowledge for designing other learning trajectories using local contexts.

CONCLUSIONS

The design of transformational geometry learning trajectories using the context of the lipa sabbe caramming motif with four learning stages: (1) informal; (2) modes of; (3) modes for; and (4) formal can increase students' understanding of the concept of transformational geometry in an easy and fun way. This is because, in the learning process, the concept of mathematics is connected with the daily habits of students so that they are enthusiastic, active in the learning process, and critical in responding to the problems given. In addition, the application of the transformational geometry learning trajectory in the context of the lipa sabbe bunga caramming motif can shape student character, for example, through cooperation, empathy, respect for others, awareness of social issues, a social spirit, and responsibility.

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AUTHOR CONTRIBUTION STATEMENT

All authors listed in this research article have made substantive contributions to conducting and writing this article.

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