Aksioma: Jurnal Matematika dan Pendidikan Matematika
Volume 17, No. 1, April 2026, pp. 19-34
ISSN: 2579-7646 (e) | 2086-2725 (p)
https://doi.org/10.26877/k93t5y86

Designing hypothetical learning trajectory of geometry transformation using realistic mathematics education

Zahra Eka Fadila[1], Putri Ayunia Rahmawati[2], Saskia Eva Aprilia[3], Gladis Audia Meyfika[4], Putri Claudia Maharani Saputro[5], Farida Nursyahidah[6]

[1,2,3,4,5,6] Department of Mathematics Education, Universitas PGRI Semarang, Jawa Tengah, Semarang
[6] PUI-PT Techno-Ethno-Realistic Mathematics, Universitas PGRI Semarang
Correspondence: faridanursyahidah@upgris.ac.id

Received: March 3, 2026 | **Revised**: March 23, 2026 | **Accepted**: Apr 16, 2026 | **Published Online**: Apr 28, 2026

Abstract

Geometric transformation is an important topic in mathematics that students must master. However, many students find it difficult to understand geometric transformations abstractly. Thus, the purpose of this research is to develop a learning trajectory that facilitates students' understanding of geometric transformations by using the context of Tayub Dance and GeoGebra media for ninth-grade students at junior high schools in Semarang. The approach applied is Realistic Mathematics Education (RME). This research used a validation study design within the Design Research method, with 3 stages: preliminary design, teaching experiment, and retrospective analysis. This research resulted in a Hypothetical Learning Trajectory (HLT) design which includes 4 activities, namely: (1) observing Tayub Dance videos to identify translational and reflective movements, (2) discovering the concept of translation through the representation of *ngayang* movement assisted by GeoGebra, (3) discovering the concepts of reflection and rotation through the exploration of *ngleyang* formation using GeoGebra's trace feature, and (4) discovering the concept of dilation through the change in *gobyok* formation from a small to a large circle. Based on this series of activities, this hypothetical learning trajectory has the potential to foster students' creative thinking skills.

Keywords: Creative Thinking Skills; GeoGebra; Geometric Transformation; Realistic Mathematics Education (RME); Tayub Dance

How to Cite: Fadila, Z. E., Rahmawati, A., Aprilia, M., Meyfika, S., Saputro, B. A., & Nursyahidah, F. (2025). Designing hypothetical learning trajectory of geometry transformations using realistic mathematics education. *Aksioma: Jurnal Matematika dan Pendidikan Matematika, 17*(1), 19-34. https://doi.org/10.26877/k93t5y86

INTRODUCTION

Geometric transformations are a mathematical topic that plays a crucial role in developing students' spatial reasoning and creative thinking (NCTM, 2000). Geometric transformations are important to learn because they relate to various aspects of everyday life, such as design, art, and technology, and are connected to other mathematical topics, such as functions and algebra. Furthermore, mastering geometric transformations can foster problem-solving skills and higher-order thinking (Seah & Horne, 2020). However, many students still encounter difficulties when learning geometric transformation concepts, especially abstract ones (Naidoo, 2012).

Geometric transformations are a topic that students often find quite challenging. Difficulties encountered in geometric transformations include the inability to differentiate between translation, reflection, rotation, and dilation, recall the properties of each transformation, and apply these concepts to contextual problem-solving (Baiduri et al., 2020). Students' lack of understanding of vectors and coordinates, as well as their limited visualization skills when determining the image of a point, are also contributing factors to their difficulties (Yanik, 2014). Furthermore, students struggle to understand the concept of dynamic transformation (Güven, 2012; Jones & Tzekaki, 2016). Students struggle to visualize changes in the position and shape of abstract shapes (Hollebrands, 2003). Consequently, they struggle to solve problems related to geometric transformations (Ada & Kurtuluş, 2010).

Several factors contribute to these problems: students' lack of interest in geometry, which is perceived as distant from reality, and teachers' limited use of dynamic media (Bakar et al., 2020). Abstract concepts lead to students' poor mastery of the material (Clements & Sarama, 2011). Teachers use inappropriate teaching methods that tend to be procedural, leading to misconceptions among students (Stephan & Akyüz, 2012). Teachers' lack of creativity in delivering material is one reason students struggle to learn it (Fauzan et al., 2013). Therefore, it is crucial to design more meaningful learning experiences using appropriate approaches, models, media, and contexts to deliver geometric transformations.

Realistic Mathematics Education (RME) is an effective approach. RME is considered appropriate for mathematics learning, involving the use of contexts close to students' real world to facilitate understanding of mathematical concepts through real-world problems (Nursyahidah & Albab, 2021). The benefits of the RME approach include improving interest, attitudes, and mathematics learning outcomes (Nursyahidah et al., 2020; Laurens et al., 2018; Tanujaya et al., 2017). Furthermore, using this approach improves students' creative thinking and mathematical problem-solving skills (Yuanita et al., 2018; Putri et al., 2019). The combination of the RME approach with contextual problems can help students realize that mathematics is part of their daily activities, making the knowledge gained relevant and easier to understand.

Several local wisdom contexts have been used in previous learning of geometric transformation materials, such as Batik motifs (Risdiyanti & Prahmana, 2018), Saman Dance (Maryati & Prahmana, 2019), Joglo traditional houses (Sutarto et al., 2021), and Woven fabrics (Prahmana & D'Ambrosio, 2020). In this research, the context of the Tayub Dance of the Pantura community is used. The Tayub Dance is a traditional social dance that is still preserved and has a philosophical meaning of togetherness in the coastal communities of Central Java (Supriyanto, 2017). The use of the Tayub Dance as a learning context is beneficial because the movements and formations in the dance represent the concepts of geometric transformations of translation, reflection, rotation, and dilation, and have never been used explicitly in the mathematics learning process before. In the Tayub Dance, dancers move from one point on the stage to another; the *ngilo raga* movement involves dancers facing each other; the *puter lembayung* movement involves rotating the body around the center of the stage; and the *gobyok* formation changes from a small circle to a larger one. These movements represent translation, reflection, rotation, and dilation, not only facilitating students' understanding of the material but also introducing the values of local wisdom in Indonesia, particularly in the Pantura region. The context of the Tayub Dance used in this research is packaged in an innovative learning medium supported by GeoGebra.

The use of GeoGebra learning media has been shown to increase student active participation and enthusiasm for learning, as well as positively impact learning outcomes and the visualization of geometric concepts (Hohenwarter et al., 2008; Zengin et al., 2012). Thus, the purpose of this article is to describe the Hypothetical Learning Trajectory (HLT) at the preliminary design stage to stimulate students' conceptual understanding of geometric transformation through the context of Tayub Dance using Realistic Mathematics Education assisted by GeoGebra, while simultaneously fostering students' creative thinking skills.

METHODS

This research method uses design research, a method focused on developing Local Instruction Theory (LIT) through collaboration between researchers and teachers to improve the quality of education (Gravemeijer & Eerde, 2009). In its implementation, design research has three stages (Gravemeijer & Cobb, 2006): 1) preparing for the experiment, including designing learning activities and evaluation instruments; 2) design experiment, consisting of two activities: a) pilot experiment, which is a trial of HLT on a small group of students with varying ability levels; b) teaching experiment, which is the application of the revised design from the pilot experiment results in a real research classroom context; and 3) retrospective analysis, where the results of the teaching experiment analysis are used to develop subsequent learning.

This research is part of the preparatory phase for the experiment, conducted in July-August 2025, with the initial study subjects being ninth-grade students at a junior high school in Semarang. During the experiment preparation stage, the researcher reviewed the research topic through books, articles, and journals to inform the learning design to be implemented. The researcher also analyzed the Tayub Dance performance video from the *Sanggar Langen Budaya Pati* YouTube channel to identify the geometric transformation elements in the *ngayang, ngilo raga, puter lembayung*, and *gobyok* formation movements. Next, the researcher designed a sequence of learning activities in the form of a Hypothetical Learning Trajectory (HLT) which includes 5 activities, namely: (1) observing the Tayub Dance video to identify transformation movements, (2) finding the concept of reflection through the *ngilo raga* formation, (3) finding the concept of translation through the *ngayang* movement, (4) finding the concept of rotation through the *puter lembayung* movement, and (5) finding the concept of dilation through the *gobyok* formation.

RESULTS AND DISCUSSION

Preliminary design is the first step in design research. Experiment preparation begins with the researcher assessing students' core competencies before learning the topic of geometric transformation, as stipulated in the applicable curriculum. Then, the researcher identifies the core competencies required for learning geometric transformation based on the Independent Curriculum and designs a GeoGebra-assisted HLT for geometric transformation, grounded in the RME approach within the Tayub Dance context.

The initial stages in designing the HLT include formulating learning indicators: a) identifying elements of geometric transformation within the context of the Tayub Dance, b) identifying the concept of reflection through the *ngilo raga* movement, c) identifying the concept of translation through the *ngayang* movement, d) identifying the concept of rotation through the *puter lembayung* movement, and e) identifying the concept of dilation through the *gobyok* formation. The HLT design then took into account five characteristics of the RME approach, namely: (1) use of context, where the researcher used the context of the Tayub Dance of the Pantura community; (2) use of models, where students apply their understanding of real-life dance movements to the formal mathematical level through GeoGebra; (3) student contributions, where students are given the freedom to develop their knowledge through exploration and group discussions; (4) interactivity, where there is interaction between students and between students and the teacher during presentations and Q&A sessions; and (5) interconnectedness, where the geometric transformation material is linked to the Cartesian coordinates and vectors. The HLT for geometric transformation material based on the RME approach, using the context of the Tayub Dance and GeoGebra, is presented as follows.

1. Activity 1: Observation of the Tayub Dance Context

The description of Activity 1 in the HLT is as follows.

- Learning Objectives

  Students are expected to identify movements in the Tayub Dance that represent the concept of geometric transformation through video observation.

- Activity

  In Activity 1, students are presented with the complete context of the Tayub Dance. From this context, students are directed to observe various dancer movements, such as *ngayang*, *ngilo raga*, *puter lembayung*, and *gobyok* formations, which represent the concept of geometric transformation. Students are assisted by GeoGebra, which displays the stage and the dancers' coordinates, as shown in Figure 1.

[Source: https://youtu.be/cGoEn-IXFsU?si=jzu19eCiDeQNpLf2]

Figure 1. Context of Tayub Dance Movements

Students are asked to observe and record the types of movements they encounter in the video, then group them based on their displacement characteristics. The activities carried out to complete SAS 1 are as follows.

1. Students are given context through a video of a Tayub Dance performance. Then, students can observe the dancers' movements in each part of the dance and identify which geometric transformations they represent. After identifying the various movements, students can sketch the dancers' starting and ending positions. Students can then identify the general characteristics of displacement by completing the table provided.
2. The teacher stimulates students by reminding them of the material to be studied, then presents problems for them to solve, and provides guidance and direction for participating in the assigned activities.
3. Students are allowed to discuss with their groups to find and solve problems according to their abilities.

- Class Discussion

  After students complete SAS 1, the teacher facilitates representatives from each group in presenting their discussed answers. Students are likely able to identify movements in the Tayub Dance that indicate changes in position, shape, or size. Furthermore, students can describe the modeling of movement and identify the general characteristics of transformations. Thus, students have been able to recognize the real-world context of geometric transformations. Another possibility is that students are not yet able to differentiate between transformational movement and ordinary movement, thus incompletely identifying its characteristics. Therefore, the teacher needs to provide guidance and support, especially for students who are still having difficulty completing the provided activities. To ensure all students understand the problems in SAS 1, groups that did not present are asked to pay attention and share their findings. At the end of the session, the teacher delivered a conclusion on introducing geometric transformations as a reinforcement of the material studied.

2. Activity 2: Reflection

The description of Activity 2 in the HLT is as follows.

- Learning Objectives

  Students are expected to discover the concept of reflection through exploration of the ngilo raga formation in the Tayub Dance, using GeoGebra.

- Activity

In Activity 2, students are presented with the context of the ngilo raga formation in the Tayub Dance. From this context, students are directed to observe two dancers facing each other, representing the concept of reflection. Students are assisted by GeoGebra, which displays the dancer formation and the axis of symmetry, as shown in Figure 2.

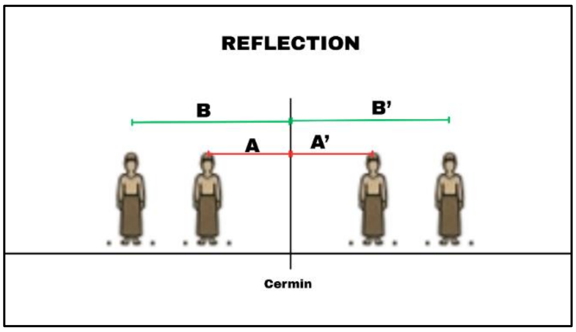

Figure 2. *Ngilo Raga* Formation in GeoGebra

Students are asked to create alternative positions for the axis of reflection that differ from the illustrated position and to determine the properties of reflection based on their exploration. The activities carried out to complete SAS 2 are as follows:

1. Students are given context through a video of the *ngilo raga* formation. Then, students can observe the dancer formation in the dance that can represent reflection. After identifying the *ngilo raga* formation as a representation of reflection, students can, with the help of GeoGebra, represent the axis of reflection and identify the image's properties. Next, students can define the concept of reflection by completing the provided table.
2. The teacher stimulates students by reminding them of the material to be studied, then presents problems for them to solve, and provides guidance and direction as they participate in the assigned activities.
3. Students are allowed to discuss problems with their groups and find and solve them according to their abilities.

- Class Discussion

After students complete SAS 2, the teacher facilitates representatives from each group in presenting their answers. Students are likely able to identify the ngilo raga formation in the Tayub Dance as one that corresponds to reflection. Furthermore, with GeoGebra, students can draw the axis of reflection and identify the properties of the resulting image. Students are then directed to define the concept of reflection by integrating the distance from a point to the mirror axis. Thus, it can be said that students have understood the properties of reflection in this context. Another possibility is that students assume reflection is the same as translation, thus incompletely understanding the concept of reflection. Therefore, teachers need to provide guidance and support, especially for students who are still having difficulty completing the provided activities. To ensure all students understand the problems presented in SAS 2, groups that are not presenting are asked to pay attention and share their findings. At the end of the session, the teacher presents a conclusion on the concept of reflection to reinforce the material learned.

3. Activity 3: Translation

The description of Activity 3 in the HLT is as follows.

- Learning Objectives

  Students are expected to discover the concept of translation through the representation of the ngayang motion in the Tayub Dance, using GeoGebra.

- Activity

  In Activity 3, students are presented with the context of the ngayang motion in the Tayub Dance. In this context, students are directed to observe the dancer's movement from one point on the stage to another, which represents the concept of translation. Students are assisted by GeoGebra, which displays the dancer's motion trajectory and displacement vector, as shown in Figure 3.

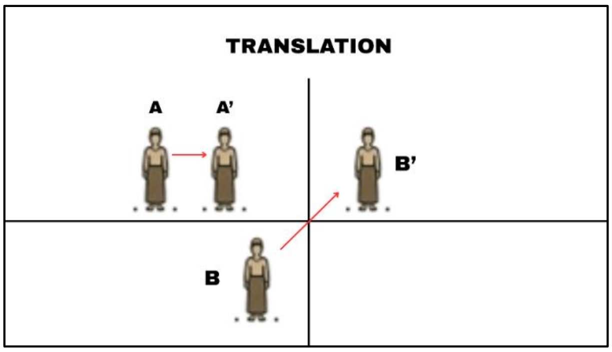

Figure 3. *Ngayang* Motion Trajectory in GeoGebra

Students are asked to create alternative *ngayang* trajectories with different directions and distances from the presented illustration and determine the concept of translation based on the displacement vector components. The activities carried out to complete SAS 3 are as follows.

1. Students are given context through a video of the ngayang motion in the Tayub Dance. They can then observe the dancer's movements in the dance, which can represent translation. After identifying the ngayang motion as a displacement, with the help of GeoGebra, students can represent the dancer's displacement trajectory in a coordinate system and identify the vector components that form it. Next, students can define the concept of translation by completing the provided table.
2. The teacher stimulates students by reminding them of the material to be studied, then presents problems for them to solve, and provides guidance and direction as they participate in the assigned activities.
3. Students are allowed to discuss problems with their groups and find and solve them according to their abilities.

- Class Discussion

After students complete SAS 3, the teacher facilitates representatives from each group in presenting their discussed answers. Students are likely able to identify the *ngayang* motion as a movement in the Tayub Dance that corresponds to translation. Furthermore, with GeoGebra, students can draw the displacement trajectory and identify the vector components that make up the translation. Students are then guided to define the concept of translation by integrating the idea of point displacement, using the vector's horizontal and vertical components. Thus, it can be said that students have mastered the concept of vectors as a building block of translation. Another possibility is that students are unable to distinguish between translation and ordinary displacement, leading to an incomplete understanding of the concept of translation. Therefore, teachers need to provide guidance and support, especially for students who are still having difficulty completing the provided activities. To ensure all students understand the problems presented in SAS 3, groups that are not presenting are asked to pay attention and share their findings. At the end of the session, the teacher provides a summary of the concept of translation to reinforce the material learned.

4. Activity 4: Rotation

The description of Activity 4 in the HLT is as follows.

- Learning Objectives

Students are expected to discover the concept of rotation through exploration of the *"puter lembayung"* motion in the Tayub Dance, using GeoGebra.

- Activity

In Activity 4, students are presented with the context of the "puter lembayung" motion in the Tayub Dance. In this context, students are directed to observe the dancer's body rotating around the center of the stage, which represents the concept of rotation. Students are assisted by GeoGebra, which displays the dancer's rotating motion, center point, and rotation angle, as shown in Figure 4.

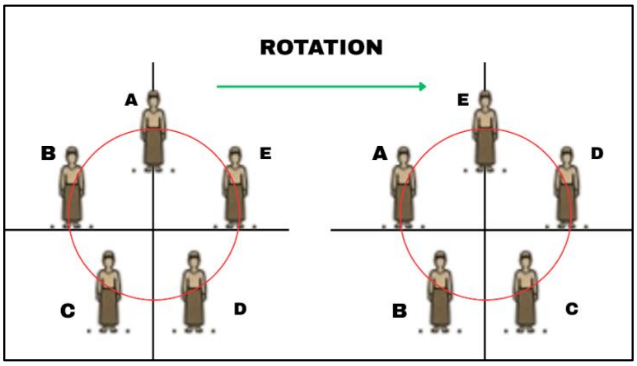

Figure 4. *Puter Lembayung* Motion in GeoGebra

Students are asked to create alternative rotation angles based on the presented illustration and to determine the properties of rotation based on their exploration. The activities carried out to complete SAS 4 are as follows.

1. Students are given context through a video of the *"puter lembayung"* motion in the Tayub Dance. They can then observe the dancer's movements in the dance, which represent rotation. After discovering the rotational motion of a circle, students can use GeoGebra to represent the center of rotation and the angle of rotation, and identify the properties of the shadow. Next, students can define the concept of rotation by completing the provided table.
2. The teacher stimulates students by reminding them of the material to be studied, then presents a problem to be solved, and provides guidance and direction for students as they participate in the assigned activities.
3. Students are allowed to discuss with their groups to find and solve problems according to their abilities.

- Class Discussion

After students complete SAS 4, the teacher facilitates a representative from each group to present their discussed answers. Students are likely able to identify the rotational motion of a circle in the Tayub Dance, which aligns with rotation. Furthermore, using GeoGebra, students can describe the center of rotation and identify the properties of the resulting shadow. Students are then guided to define the concept of rotation by integrating angle magnitude and rotation direction. Thus, it can be concluded that students have grasped the properties of rotation in this context. Another possibility is that students assume a 180° rotation is the same as a reflection, thus incompletely understanding the concept of rotation. Therefore, teachers need to provide guidance and support, especially for students who are still having difficulty completing the provided activities. To ensure all students understand the problems presented in SAS 4, groups that are not presenting are asked to pay attention and share their findings. At the end of the session, the teacher provides a summary of the rotation concept to reinforce the material learned.

5. Activity 5: Dilation

The description of Activity 5 in the HLT is as follows.

- Learning Objectives

Students are expected to discover the concept of dilation through exploration of the *gobyok* formation in the Tayub Dance, using GeoGebra.

- Activity

In Activity 5, students are presented with the context of the *gobyok* formation in the Tayub Dance. From this context, students are directed to observe the change in the dancers' formation from a small circle to a large circle, representing the concept of dilation. Students are assisted by GeoGebra, which shows the change in formation and the center point of dilation, as shown in Figure 5.

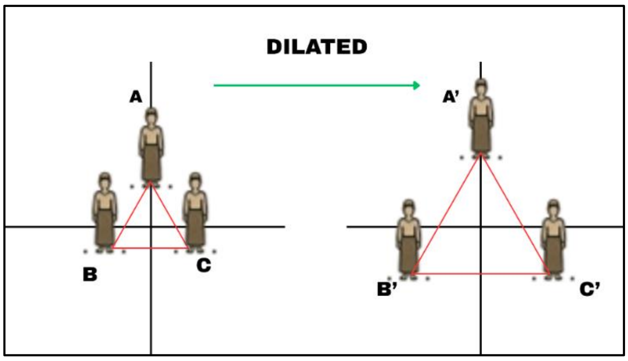

Figure 5. *Gobyok* Formation in GeoGebra

Students are asked to create alternative scale factors that differ from the illustration and to determine the properties of dilation based on their exploration. The activities carried out to complete SAS 5 are as follows.

1. Students are given context through a video of the gobyok formation in the Tayub Dance. They can then observe the dancer formation in the dance, which can represent dilation. After identifying the gobyok formation as a representation of dilation, students can use GeoGebra to represent the center of dilation and the scale factor, and identify the properties of the shadow. Next, students can define the concept of dilation by completing the provided table.
2. The teacher stimulates students by reminding them of the material to be studied, then presents problems for them to solve, and provides guidance and direction as they participate in the assigned activities.
3. Students are allowed to discuss with their groups to find and solve problems according to their abilities.

- Class Discussion

After students complete SAS 5, the teacher facilitates representatives from each group in presenting their answers. Students are likely able to identify the gobyok formation in the Tayub Dance as corresponding to dilation. Furthermore, with GeoGebra, students can describe the center of dilation and identify the properties of the resulting shadow. Then, students are guided to define the concept of dilation by integrating the concepts of scale factor and center of dilation. Thus, it can be said that students have understood the properties of dilation in this context. Another possibility is that students assume dilation is the same as translation or magnification without a center point, resulting in an incomplete understanding of the concept of dilation. Therefore, teachers need to provide guidance and support, especially for students who are still struggling to complete the provided activities. To ensure all students understand the problems presented in SAS 5, groups that are not presenting are asked to pay attention and share their findings. At the end of the session, the teacher provides a summary of the concept of dilation to reinforce the material learned. Based on the results that have been described, there are several activities designed to support the readiness of learning implementation at the experimental preparation stage, including: conducting a literature review related to the research conducted, analyzing students' initial abilities, and designing HLT which includes 5 learning activities, including: (1) observing Tayub Dance videos to identify geometric transformation movements, (2) finding the concept of reflection through the *ngilo raga* formation assisted by GeoGebra, (3) finding the concept of translation through the *ngayang* movement assisted by GeoGebra, (4) finding the concept of rotation through the *puter lembayung* movement assisted by GeoGebra, and (5) finding the concept of dilation through the *gobyok* formation assisted by GeoGebra. The series of learning activities prepared aims to facilitate students' understanding of concepts in geometric transformation material. The Realistic Mathematics Education approach, with the context of Tayub Dance, assisted by GeoGebra, is expected to help students find the basic concepts of geometric transformations while fostering creative thinking skills. This is in line with the results of previous research (Nursyahidah et al., 2025; Risdiyanti & Prahmana, 2018; Maryati & Prahmana, 2019; Yuanita et al., 2018), which found that learning grounded in a local cultural context, combined with technology, can improve students' conceptual understanding, create more meaningful learning experiences, and foster creativity.

CONCLUSION

This research has produced a Hypothetical Learning Trajectory (HLT) for ninth-grade geometric transformation material based on the Realistic Mathematics Education approach, using the Tayub Dance context and GeoGebra. The HLT consists of five learning activities: (1) observing a Tayub Dance video to identify transformation motion,

(2) discovering the concept of reflection through the *ngilo raga* formation, (3) discovering the concept of translation through the *ngayang* motion, (4) discovering the concept of rotation through the *puter lembayung* motion, and (5) discovering the concept of dilation through the *gobyok* formation. The five activities were designed sequentially, taking into account the characteristics of RME and the principles of using GeoGebra as a dynamic exploration medium.

Apart from its advantages, this research also has several limitations: it is still limited to the preliminary design stage and needs further stages, namely pilot and teaching experiments; the context used is still limited to traditional dance from Central Java, so it is limited to students in Central Java. Therefore, further research is needed to implement this HLT through pilot experiments and teaching experiments to empirically assess its effectiveness and make revisions based on students' Actual Learning Trajectories.

ACKNOWLEDGMENTS

The researchers express their gratitude to the Republic of Indonesia's Ministry of Education, Culture, Research, and Technology for awarding the 2025 Student Creativity Program Grant, number B/19802/074/VII/2025. Additionally, SMP N 38 Semarang provided the facilities for this study, for which the researcher is grateful.

DECLARATIONS

Author Contribution : The first author's contributions include conceptualization and design of the study, the second author development of the RME and GeoGebra-based learning tool, the third author development and validation of the instrument, the fourth author data collection and analysis, interpretation of the results, the fifth author writing the initial draft, literature review, supervision, and the sixth author final revision of the manuscript. All authors have read and approved the final version of the article for publication.

Funding Statement : This research was funded by the Program Kreativitas Mahasiswa – Riset Sosial Humaniora (PKM-RSH) 2025 Grant from the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia.

Conflict of Interest : The author deaclare no conflict of interest.

Additional Information : Additional information is vailable for this paper.

REFERENCES

Ada, T., & Kurtuluş, A. (2010). Students' misconceptions and obstacles regarding transformation geometry. *Procedia - Social and Behavioral Sciences*, 9, 252-256.

Afhami, A. H. (2022). Aplikasi GeoGebra Classic terhadap pemahaman konsep matematika siswa pada materi transformasi geometri. *Plusminus: Jurnal Pendidikan Matematika*, 2(3), 449–460.

Ardinata, D. (2020). Pengembangan GeoGebra untuk materi transformasi geometri berorientasi strategi IKRAR. *Wahana Matematika dan Sains*, 14(1), 87–96.

Freudenthal, H. (1991). *Revisiting mathematics education: China lectures*. Kluwer Academic Publishers.

Gravemeijer, K. (1994). Developing realistic mathematics education. CD-β Press.

Gravemeijer, K., & Cobb, P. (2006). Design research from a learning design perspective. In J. van den Akker et al. (Eds.), Educational Design Research. Routledge.

Gravemeijer, K., & Eerde, D. V. (2009). Design research as a means for building a knowledge base for teachers and teaching in mathematics education. *The Elementary School Journal*, 109(5), 510-524.

Hohenwarter, M., Hohenwarter, J., Kreis, Y., & Lavicza, Z. (2008). Teaching and learning calculus with free dynamic mathematics software GeoGebra. *11th International Congress on Mathematical Education.*

Jaenudin, A., & Kartono. (2017). The identification of students' mathematical creative thinking ability on transformation geometry. *Repository Universitas Sebelas April (UNSAP).*

Komara, K., Supratman, S., & Lestari, P. (2023). Pengembangan digibook transformasi geometri berbantuan GeoGebra. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 7(2), 1451–1468.

Nisa', M. U., Sukowati, T. A., & Adi, B. (2021). Tari Tayub sebagai kearifan lokal di Kabupaten Pati. *Jurnal Kebudayaan*, 9(1), 12–22.

Nursyahidah, F., & Albab, I. U. (2021). Learning design on surface area and volume of cylinder using Indonesian ethno-mathematics. *Mathematics Teaching-Research Journal*, 13(4), 79–98.

Nursyahidah, F., Saputro, B. A., & Albab, I. U. (2021). Desain pembelajaran kerucut berkonteks tradisi megono gunungan. *Jurnal Elemen*, 7(1), 14–27.

Nursyahidah, F., Wardono, W., Mariani, S., & Wijayanti, K. (2025). Integrating technology, ethnomathematics, and realistic mathematics education in learning statistics. *Infinity Journal*, 14(3), 633–654.

Prahmana, R. C. I., & D'Ambrosio, U. (2020). Learning geometry and values from patterns: Ethnomathematics on the batik patterns of Yogyakarta, Indonesia. *Journal on Mathematics Education,* 11(3), 439-456.

Treffers, A. (1987). *Three dimensions: A model of goal and theory description in mathematics instruction – The Wiskobas Project*. D. Reidel Publishing Company.

Ulfa, H., Roza, Y., & Maimunah, M. (2022). GeoGebra sebagai media untuk meningkatkan kemampuan berpikir kreatif matematis siswa. *Jurnal Pendidikan Matematika*, 11(1), 66–74.

Van den Heuvel-Panhuizen, M. (2003). The didactical use of models in realistic mathematics education. *Educational Studies in Mathematics,* 54(1), 9-35.

Wijaya, H., Lestari, S., & Pratama, B. (2021). Kemampuan berpikir kreatif siswa pada materi transformasi geometri. *Jurnal Matematika dan Aplikasinya*, 8(1), 21–30.

Yanik, H. B. (2014). Middle-school students' concept images of geometric translations. *The Journal of Mathematical Behavior,* 36, 33-50.

Zengin, Y., Furkan, H., & Kutluca, T. (2012). The effect of dynamic mathematics software geogebra on student achievement in teaching of transformation geometry. *Procedia - Social and Behavioral Sciences*, 31, 183-187.