

DEVELOPMENT OF ETHNOMATHEMATICS-BASED EXAMPLE-PROBLEM PAIRS WITH ISOMORPHIC PROBLEMS TO IMPROVE STUDENTS' INDUCTIVE THINKING SKILLS IN GEOMETRIC TRANSFORMATION

David Mel Baitanu¹, Marsigit²

¹Universitas Negeri Yogyakarta

Davidmel.2024@student.uny.ac.id¹, Marsigit@uny.ac.id²

Article Info

Article history:

Received Apr 12, 2026

Revised Apr 20, 2026

Accepted May 26, 2026

Keywords:

Ethnomathematics,
Example-Problem Pairs
Isomorphic problems
Inductive thinking skills
Geometric transformation.

ABSTRACT

This study aims to develop an ethnomathematics-based Example-Problem Pairs with Isomorphic Problems (EPP-IP) instructional design to improve students' inductive thinking skills in geometric transformation learning. The study was motivated by the low level of students' inductive thinking skills and difficulties in understanding geometric transformation concepts, which are often taught abstractly and procedurally without meaningful connections to students' cultural contexts and real-life experiences. This research employed a Design and Development Research (DDR) approach using the ADD model, which consists of analysis, design, and development stages. The instructional materials were designed by incorporating local cultural elements such as traditional woven motifs and geometric cultural patterns into geometric transformation concepts, including translation, reflection, rotation, and dilation. The developed instructional design was evaluated in terms of validity, practicality, and effectiveness. The validation process involved mathematics education experts, instructional design experts, and practitioners. The results indicated that the ethnomathematics-based EPP-IP instructional design was valid and practical for classroom implementation. Furthermore, the implementation of the instructional design showed positive effects on students' inductive thinking skills, conceptual understanding, learning motivation, and engagement in geometric transformation learning. The findings suggest that integrating ethnomathematics with Example-Problem Pairs and isomorphic problems can provide meaningful mathematics learning experiences and effectively improve students' inductive thinking skills in geometric transformation. Therefore, this instructional design can serve as an innovative alternative for mathematics learning that promotes both conceptual understanding and cultural appreciation.

This is an open access article under the [CC BY](#) license.



Corresponding Author:

David Mel Baitanu

Departement of Mathematics Education,

Universitas Negeri Yogyakarta

Email: Davidmel.2024@student.uny.ac.id

How to Cite:

Baitanu, D.Mel & Marsigit. (2026). Development of Ethnomathematics-Based Example–Problem Pairs With Isomorphic Problems to Improve Students’ Inductive Thinking Skills in Geometric Transformation. *JME:Journal of Mathematics Education*, 11(1), 182-193.

1. INTRODUCTION

Mathematics plays a fundamental role in developing students’ logical, analytical, critical, and creative thinking skills. In mathematics education, learning is not merely focused on obtaining correct answers through procedural calculations, but also on fostering reasoning abilities and conceptual understanding. According to the National Council of Teachers of Mathematics, mathematics learning should develop students’ abilities in reasoning, communication, representation, and problem solving. Similarly, (polya 1985) emphasized that mathematical problem solving requires systematic thinking and reasoning processes, while (Skemp, n.d. 2010) argued that relational understanding is more meaningful than procedural memorization alone. These perspectives indicate that reasoning skills are essential components that should be developed in mathematics learning. One important aspect of mathematical reasoning is inductive thinking. Inductive thinking refers to the ability to identify patterns, formulate conjectures, and construct generalizations based on specific observations or examples. In mathematics learning, this ability enables students to connect mathematical ideas and understand relationships among concepts. Inductive thinking is particularly important in geometry learning because geometry requires visualization, pattern recognition, and spatial reasoning. Through inductive thinking, students are encouraged to actively construct mathematical concepts and discover principles independently, making learning more meaningful and effective.

However, the reality in schools indicates that students’ inductive thinking skills are still relatively low. Many students experience difficulties in identifying patterns and making mathematical generalizations independently. Mathematics instruction is still largely dominated by teacher-centered approaches in which students passively receive information and imitate procedures demonstrated by teachers. As a result, students tend to memorize formulas without fully understanding the underlying concepts and relationships among mathematical ideas. Such learning conditions limit opportunities for students to engage in reasoning processes and higher-order thinking activities. Consequently, mathematics learning often becomes mechanical, abstract, and less meaningful for students. These problems are also evident in geometric transformation learning. Geometric transformation is an important topic in junior high school mathematics because it develops students’ understanding of spatial relationships and geometric reasoning. This topic includes translation, reflection, rotation, and dilation, all of which require students to analyze patterns and relationships among geometric objects. Nevertheless, many students encounter difficulties in understanding transformation concepts because the material is often taught symbolically and procedurally without meaningful contextual representation. Students frequently memorize transformation formulas without understanding the geometric meaning behind the transformation processes. Previous studies have shown that students generally experience difficulties in constructing mathematical generalizations in geometry learning (Muzdalipah et al. 2026a). This condition indicates that the learning process has not fully supported conceptual understanding and inductive reasoning development. One instructional approach that can support meaningful mathematics learning is ethnomathematics. The concept of ethnomathematics was introduced by (D’Ambrosio 2014), who argued that mathematics develops through cultural practices and human activities within society.

Ethnomathematics connects mathematical concepts with culture, traditions, and local wisdom so that students can understand mathematics through contexts closely related to their daily lives. This approach makes abstract mathematical concepts more concrete and meaningful while simultaneously fostering students' appreciation of local culture.

In geometric transformation learning, many cultural artifacts contain concepts of reflection, translation, rotation, and dilation. Traditional woven fabric motifs, carvings, ornaments, and local architectural patterns often display symmetrical and repetitive structures that can be used as contextual learning resources. For example, symmetrical motifs in woven fabrics can help students visualize reflection and translation concepts more effectively. Through cultural contexts, students are able to connect mathematical concepts with real-life experiences, thereby improving conceptual understanding and learning engagement. Besides contextual approaches, mathematics instruction also requires effective strategies that support students' cognitive processes. One instructional strategy recognized for improving conceptual understanding is the worked-example strategy. According to Alexander Renkl, worked examples help students understand mathematical problem-solving processes through structured and complete solution procedures. Through worked examples, students focus on understanding reasoning processes rather than merely performing calculations. This strategy also supports students in developing stronger conceptual understanding.

The effectiveness of worked examples is closely related to Cognitive Load Theory proposed by (J Sweller 2011). Cognitive Load Theory explains that instructional design should minimize unnecessary cognitive load to facilitate schema construction in long-term memory. When students successfully construct cognitive schemas, they are better able to process information and apply prior knowledge to different mathematical situations. Therefore, worked-example-based instruction is considered effective for learning complex mathematical concepts such as geometric transformation. An extension of the worked-example strategy is Example Problem Pairs integrated with Isomorphic Problems. In this strategy, students first study a worked example and then solve another problem with a similar conceptual structure but presented in a different context or representation. Isomorphic problems encourage students to focus on conceptual relationships rather than surface characteristics. Consequently, students are guided to identify patterns, compare structures, and formulate mathematical generalizations, which are important components of inductive thinking.

The integration of ethnomathematics with Example Problem Pairs and Isomorphic Problems is considered capable of creating contextual, systematic, and meaningful mathematics learning experiences. Through ethnomathematics, students learn mathematical concepts within familiar cultural contexts, while Example–Problem Pairs and Isomorphic Problems facilitate conceptual transfer and reasoning development through structured problem-solving activities. However, studies integrating these three components in geometric transformation learning are still limited. Therefore, this study aims to develop ethnomathematics-based Example Problem Pairs integrated with Isomorphic Problems in geometric transformation learning to improve junior high school students' inductive thinking skills.

2. METHODS

This study applied a Design and Development Research (DDR) approach to produce ethnomathematics-based Example–Problem Pairs integrated with Isomorphic Problems (EPIP) aimed at enhancing students' inductive thinking skills in geometric transformation learning. Design and Development Research emphasizes the systematic process of

designing, validating, and refining educational products to address practical problems in instructional settings. The development procedure (Richey and Klein 2014).in this study adopted the ADD model, which consists of three phases: Analysis, Design, and Development. This simplified development model was chosen because it offers a structured and efficient framework for developing instructional materials while supporting systematic product improvement throughout the development process (Branch 2009).

The initial phase of this study was the analysis stage, which aimed to identify instructional needs and determine the characteristics of the learning materials to be developed. Several forms of analysis were conducted during this stage. First, student analysis was carried out to examine students' prior knowledge, learning characteristics, and common difficulties in understanding geometric transformation concepts. This process involved classroom observations, informal interviews with mathematics teachers, and an analysis of students' previous learning achievements. Second, curriculum analysis was conducted by reviewing the basic competencies and learning objectives related to geometric transformation at the junior high school level. Third, content analysis was performed to identify essential concepts, prerequisite knowledge, conceptual relationships, and the complexity level of the instructional materials. In addition, the intrinsic cognitive load of the topic was carefully considered to ensure that the instructional design was consistent with the principles of Cognitive Load Theory (Kalyuga 2011a).

The second phase of the study was the design stage. Referring to the findings obtained during the analysis stage, an initial prototype of ethnomathematics-based Example–Problem Pairs integrated with Isomorphic Problems (EPIP) learning materials was developed. The design process involved selecting appropriate cultural contexts that contained elements of geometric transformation, such as traditional weaving motifs, ornaments, and local artistic patterns. These cultural contexts were then incorporated into worked examples and isomorphic problems to provide students with more meaningful and contextual learning experiences.

Furthermore, the instructional design adopted several principles from worked-example research, including integrated presentation, segmentation of information, and the elimination of unnecessary or redundant content. These principles were applied to reduce extraneous cognitive load and to facilitate students in constructing mathematical schemas more effectively (Atkinson et al., n.d.2000). Each learning unit consisted of a worked example followed by an isomorphic problem with a similar mathematical structure but presented in a different contextual setting. This design was intended to support students in identifying patterns, developing abstraction, constructing generalizations, and transferring mathematical knowledge in geometric transformation learning.

Before undergoing external validation, the initial prototype was first evaluated through a self-evaluation process conducted by the researcher. This stage aimed to identify possible weaknesses and inconsistencies related to content structure, instructional sequence, visual appearance, and language clarity. After revisions were made, the prototype was submitted for expert validation involving three validators: a mathematics education expert, an instructional design expert, and a language expert. The validation process focused on assessing several important aspects, including content validity, construct validity, and the appropriateness of language use.

The final phase of the study was the development stage. During this phase, the validated prototype was revised according to the suggestions and recommendations provided by the experts and then developed into a complete instructional package. The final product consisted of ethnomathematics-based worked examples, paired isomorphic problems, student learning guidelines, and teacher instructional guides. The development process prioritized instructional clarity, conceptual consistency, and compatibility with students'

cognitive characteristics to support the improvement of inductive thinking skills in geometric transformation learning.

The main instruments used in this study included observation sheets, interview guidelines, curriculum analysis forms, and expert validation sheets. The expert validation instrument applied a five-point Likert scale ranging from 1 (very poor) to 5 (excellent). Product validity was determined based on the average scores provided by the experts and interpreted according to established validity criteria. The developed instructional product was considered valid when the average validation score achieved a minimum value of 3.5 on a five-point scale. The stages of the product development process implemented in this study are illustrated in Figure 1.

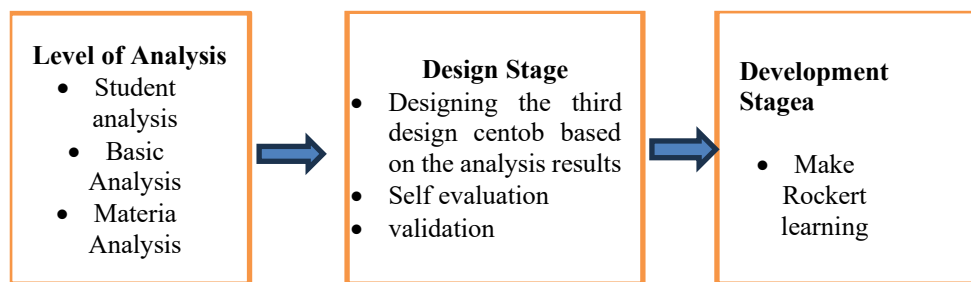


Figure 1. Stages of research

3. RESULT

This study resulted in the development of an ethnomathematics-based Example–Problem Pairs integrated with Isomorphic Problems (EPIP) learning package aimed at enhancing junior high school students' inductive thinking skills in geometric transformation learning. The development process was carried out through three systematic stages: analysis, design, and development. The findings obtained from each stage are described as follows.

3.1 Analysis Stage

The analysis stage was conducted to identify instructional needs, student characteristics, curriculum demands, and the essential concepts related to geometric transformation learning. Based on classroom observations and interviews with mathematics teachers, it was revealed that students encountered difficulties in understanding the relationships among various types of geometric transformations, especially in determining coordinate changes, identifying transformation directions, and analyzing symmetry properties in combined transformations. Most students still tended to depend on memorizing formulas and procedural methods rather than comprehending the underlying mathematical concepts.

The curriculum analysis indicated that geometric transformation is a fundamental competency in junior high school mathematics, requiring students to understand and apply concepts of reflection, translation, rotation, and dilation in problem-solving contexts. Nevertheless, interviews with teachers showed that the existing instructional materials were still largely procedural in nature and provided limited opportunities for students to develop reasoning abilities and mathematical generalization skills.

The content analysis revealed that composite transformations involve high element interactivity because students are required to process multiple concepts simultaneously, including coordinate systems, transformation rules, spatial visualization, and geometric relationships. Based on the principles of Cognitive Load (Kalyuga 2011a).Theory,

instructional materials with high element interactivity require structured learning support to assist students in constructing cognitive schemas while minimizing unnecessary cognitive load. Therefore, instructional materials based on worked examples were considered suitable for facilitating students' understanding of geometric transformation concepts.

In addition, the ethnomathematical analysis identified several local cultural artifacts that contain geometric transformation concepts, such as traditional weaving motifs and geometric ornaments. These cultural elements were selected as contextual learning resources because they present visual patterns related to reflection, rotation, translation, and dilation, which can support students' inductive thinking processes in learning geometric transformation. (D'Ambrosio 2014).

3.2 Design Stage

Based on the findings obtained during the analysis stage, an initial prototype of the Example–Problem Pairs integrated with Isomorphic Problems (EPIP) learning package was developed. The instructional materials combined worked examples, isomorphic problems, and ethnomathematical contexts within a unified learning sequence. Each learning unit was organized into three primary components, namely cultural context exploration, worked-example activities, and isomorphic problem-solving tasks.

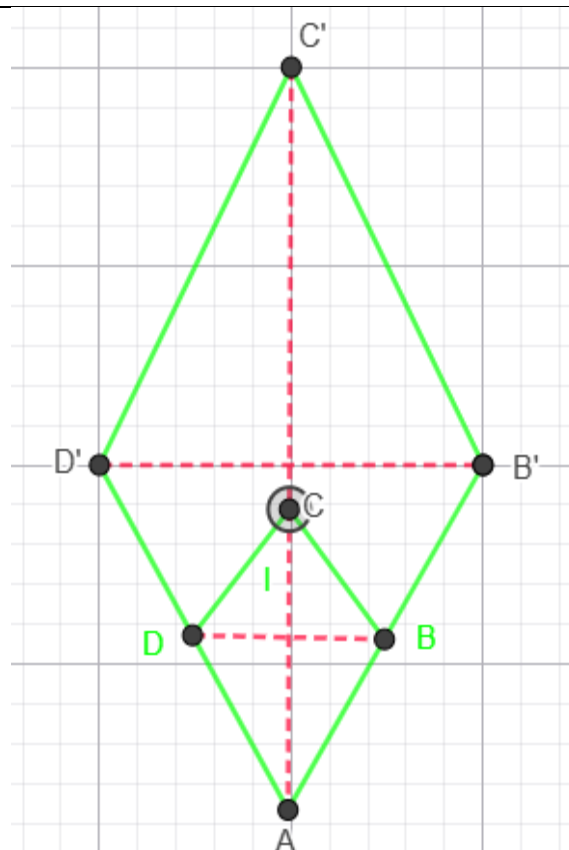
At the beginning of each learning unit, students were introduced to local cultural artifacts containing geometric transformation patterns. Traditional weaving motifs, for instance, were utilized to help students identify symmetry, repetitive patterns, and coordinate transformations. These contextual visual representations were intended to activate students' prior knowledge and support their conceptual understanding of geometric transformation concepts.

The worked examples were designed by presenting complete and structured solution procedures, including identifying known information, representing geometric objects within coordinate systems, applying transformation rules, and interpreting the results of transformations. After studying the worked examples, students were given isomorphic problems that possessed the same mathematical structure but differed in contextual presentation or numerical values. This design was intended to encourage students to recognize underlying structural similarities and develop mathematical generalizations.

In addition, the instructional design adopted several principles of worked-example learning, including integrated information presentation, segmentation of solution procedures, and the reduction of redundant explanations to minimize extraneous cognitive load (Renkl 1997). The initial design of the developed instructional product is presented in Figure 1.



Image (a) motif

**Example questions**

The length of the ABCD rhombus is 14 cm and 20 cm. $AB'C'D'$ is the result of dilation of the ABCD belaketupat with a dilatation center A and a scale factor of 2.5. Determine the area of $AB'C'D'$!

Answer**Method 1**

$$\text{Belaketupat area } ABCD = \frac{1}{2} 20 \times 14 = 140 \text{ cm}^2$$

Since the dilatation factor = 2.5, then:

$$\text{Rhombus area } AB'C'D' = \left(\frac{1}{2}\right)^{22} \times l. ABCD = 6,25 \times 140 = 875 \text{ cm}$$

Way 2

$$AC' = 2\frac{1}{2} \times 2\frac{1}{2} \times 20 = 50$$

$$B'D' = 2\frac{1}{2} \times BD = 2\frac{1}{2} \times 14 = 35$$

$$\text{Rhombus Area } AB'C'D' = \frac{1}{2} \times AB' \times B'D' = \frac{1}{2} \times 50 \times 35 = 875 \text{ cm}^2$$

The rhombus diagonals of PQRS are 10 cm and 28 cm, respectively. The rhombus PQ'R'S' is the result of the dilation of the rhombus with the center of dilatation at the P point and a scale factor of 2.5. Determine the rhombus area of PQ'R'S'!

$$\text{The original rhombus area; } L = \text{cm} \frac{1}{2} \times 10 \times 28 = \frac{1}{2} \times 280 = 140$$

$$\text{Extent after dilation; } L' = 140 \times (2,5)^{22} = 140 \times 6,25$$

$$\text{So the result of rhombus area multiplied by the area after dilation} = 140 \times 6,25 = 875 \text{ cm}^2$$

Figure (a) shows the process of dilated transformation in the Cartesian coordinate plane which involves a type of geometric transformation: The shape used is in the form of a double star/triangle shape in yellow and red, depicting the combination of two patterns that are the result of two smaller, larger **transformations**.

3.3 Development Stage

After the initial prototype of the ethnomathematics-based Example–Problem Pairs integrated with Isomorphic Problems (EPIP) learning package had been completed, the product was subjected to a self-evaluation process followed by expert validation. The validation process involved three validators consisting of a mathematics education expert, an instructional design expert, and a language expert. The evaluation focused on three major aspects, namely content validity, construct validity, and language appropriateness. The results of the expert validation are presented in Table 1.

Component	Example 1 (ABCD)	Example 2 (PQRS)	Validation Status
Initial Data	Diagonal 1 (d_1) = 20 cm	Diagonal 1 (d_1) = 10 cm	Match
	Diagonal 2 (d_2) = 14 cm	Diagonal 2 (d_2) = 28 cm	
Scale Factor (k)	k = 2,5	k = 2,5	Match
Initial Area (L)	$\frac{1}{2} \times 20 \times 14 = 140 \text{ CM}$	$\frac{1}{2} \times 20 \times 14 = 140 \text{ CM}$	Correct
Final Result	875 cm²	875 cm²	VALID

The validation findings showed that the developed EPIP learning materials fulfilled the criteria of a highly valid instructional product for geometric transformation learning. The validators provided several recommendations for improvement, particularly regarding the clarity of instructional directions, simplification of mathematical representations, and strengthening the relationship between ethnomathematical contexts and geometric transformation concepts. In addition, the validators emphasized the importance of aligning the worked examples and isomorphic problems with students' inductive thinking processes, especially in identifying transformation patterns and constructing mathematical generalizations.

Based on these recommendations, several revisions were implemented in the product development process. First, some instructional statements in the worked examples and isomorphic problems were rewritten using simpler, clearer, and more communicative language to facilitate students' understanding. Second, visual supports such as arrows, coordinate indicators, and transformation markers were added to help students focus more effectively during the analysis of geometric transformation problems. These visual improvements were particularly important in supporting students' interpretation of reflection, translation, rotation, and dilation patterns represented in traditional weaving motifs and geometric ornaments.

Third, additional explanatory notes were incorporated into the learning materials to strengthen the connection between cultural patterns and mathematical transformation properties. For example, in the worked examples involving woven fabric motifs, explanations were added to guide students in identifying symmetrical structures, repeated transformation patterns, and coordinate relationships within the cultural designs. Furthermore, the paired isomorphic problems were refined to ensure that they maintained the same mathematical structure as the worked examples while presenting different numerical values or contextual situations. This adjustment was intended to support abstraction, conceptual transfer, and students' inductive reasoning processes in geometric transformation learning.

After the revision process had been completed, the final product was considered appropriate for classroom implementation and ready for limited field testing. The finalized instructional package consisted of ethnomathematics-based worked examples, paired isomorphic problems, student worksheets, and teacher implementation guidelines specifically designed to improve students' inductive thinking skills in geometric transformation learning.

4. DISCUSSION

The results of this study demonstrate that the developed ethnomathematics-based Example–Problem Pairs integrated with Isomorphic Problems (EPIP) constitutes a valid instructional product for enhancing junior high school students' inductive thinking skills in geometric transformation learning. The instructional materials were systematically developed through the stages of analysis, design, and development, while the expert validation results indicated that the product fulfilled the criteria of a highly valid instructional design. These findings imply that the integration of worked examples, isomorphic problems, and ethnomathematical contexts can create meaningful learning experiences and effectively support the development of students' mathematical reasoning and inductive thinking abilities.

The findings of this study reveal that the ethnomathematics-based Example–Problem Pairs combined with Isomorphic Problems (EPIP) developed in this research can be categorized as a valid instructional product for improving junior high school students' inductive thinking skills in geometric transformation learning. The instructional materials were developed systematically through the (Valerie Walkerdine 1998) stages of analysis, design, and development, and the expert validation results confirmed that the product met the standards of a highly valid instructional design. These results indicate that integrating worked examples, isomorphic problems, and ethnomathematical contexts has the potential to provide meaningful and contextual learning experiences while facilitating the development of students' mathematical reasoning and inductive thinking processes.

The findings further revealed that classroom instruction was still predominantly characterized by procedural learning practices. Many students tended to memorize formulas and transformation procedures without developing a deeper conceptual understanding of the underlying mathematical ideas. This result is consistent with (Skemp, n.d.-b 1976) distinction between instrumental understanding and relational understanding, where students who rely solely on procedural knowledge often experience difficulties in developing meaningful mathematical reasoning. In mathematics learning, conceptual and relational understanding are crucial because they enable students to construct generalizations and apply mathematical concepts flexibly in various problem situations, particularly in geometric transformation learning.

The integration of worked examples within the developed ethnomathematics-based Example–Problem Pairs integrated with Isomorphic Problems (EPIP) materials provided structured cognitive guidance for students during geometric transformation problem-solving activities. The worked examples presented complete and systematic solution procedures that assisted students in identifying problem structures, interpreting transformation rules, and connecting procedural processes with conceptual understanding. This finding is consistent with the view of (Renkl 1999), who explained that worked examples support schema construction by encouraging learners to engage in self-explanation throughout the learning process. Through continuous exposure to organized examples, students gradually develop cognitive representations that can be applied to new mathematical situations.

Furthermore, the inclusion of isomorphic problems after each worked example contributed substantially to the development of students' inductive thinking skills. The isomorphic problems required students to recognize underlying structural similarities between mathematically equivalent problems presented in different contexts. This learning process promoted abstraction, pattern recognition, and mathematical generalization, which are fundamental aspects of inductive reasoning. These findings are aligned with previous research indicating that (VanLehn 1998) structurally similar problems can facilitate conceptual understanding and knowledge transfer in mathematics learning. In addition, (polya 1985) emphasized that effective mathematical problem solving involves the ability to identify relationships and patterns across different problem situations.

Another significant finding of this study is the integration of ethnomathematical contexts into geometric transformation learning through the developed Example–Problem Pairs integrated with Isomorphic Problems (EPIP) materials. The incorporation of cultural artifacts, such as traditional weaving motifs, allowed students to observe geometric transformation patterns directly through meaningful visual representations. This contextual approach helped transform abstract mathematical concepts into learning experiences that were more concrete and closely related to students' daily lives. These findings are consistent with the perspective of (D'Ambrosio 2014), who stated that ethnomathematics bridges formal mathematical knowledge with cultural practices and social experiences. Previous studies have also indicated that ethnomathematics-based instruction can enhance students' engagement, conceptual understanding, and mathematical communication, particularly in geometry learning contexts.

From the perspective of Cognitive Load Theory, the design of the developed EPIP instructional materials also contributed to reducing unnecessary cognitive burden during learning activities. The instructional materials applied integrated visual–verbal representations, segmentation of solution procedures, and the elimination of redundant information, enabling students to focus more effectively on essential conceptual relationships in geometric transformation. According to (J Sweller 2011) learning becomes more effective when instructional design minimizes extraneous cognitive load while facilitating schema construction within long-term memory. This view is further supported by (Kalyuga 2011b) research explaining that well-structured instructional materials improve cognitive efficiency, especially for novice learners in mathematics learning.

The novelty of this study lies in the integration of three important instructional components—worked examples, isomorphic problems, and ethnomathematics—within a single instructional design intended to improve students' inductive thinking skills in geometric transformation learning. Previous studies generally investigated these instructional approaches separately. However, the findings of this study demonstrate that combining cognitive instructional strategies with culturally contextualized mathematics learning can create a more comprehensive learning environment that supports both conceptual understanding and reasoning development.

From a practical perspective, the developed EPIP instructional materials can serve as an alternative learning resource for mathematics teachers, particularly in teaching abstract geometry topics such as geometric transformation. Through the provision of structured worked examples, contextualized isomorphic problems, and opportunities for independent knowledge transfer, the instructional product has the potential to improve the quality of classroom learning while promoting higher-order thinking skills. Therefore, this study contributes both theoretically to the development of mathematics education research and practically to instructional innovation in secondary school mathematics learning.

5. CONCLUSION

This study successfully produced an ethnomathematics-based Example–Problem Pairs integrated with Isomorphic Problems (EPIP) instructional design for geometric transformation learning at the junior high school level. The developed instructional materials combined worked examples, isomorphic problems, and local cultural contexts to facilitate students' inductive thinking skills through structured and meaningful learning experiences. The results of the development process showed that the EPIP instructional materials fulfilled the criteria of a highly valid learning product based on expert evaluations covering aspects of content, instructional design, and language appropriateness. The incorporation of cultural elements, particularly geometric patterns represented in traditional Amfoang weaving motifs, assisted students in connecting abstract mathematical concepts with real-life experiences. Moreover, the integration of worked examples and isomorphic problems provided cognitive support that could help students identify mathematical patterns, formulate generalizations, and develop conceptual understanding more effectively in geometric transformation learning. The main contribution and novelty of this study lie in the integration of cognitive instructional strategies and ethnomathematical contexts within a unified learning design aimed at enhancing students' inductive thinking abilities. Consequently, the developed EPIP instructional materials have strong potential to be utilized as an alternative instructional resource in mathematics education, especially in teaching abstract geometry topics. Therefore, further studies are recommended to conduct classroom implementation and effectiveness testing in order to examine the practicality, usability, and impact of the developed product in actual learning environment

REFERENCES

- Akbar.s. 2013. *Instrumen Perangkat Pembelajaran*. PT Remaja Rosdakarya.
- Atkinson, Robert K., Sharon J. Derry, Alexander Renkl, and Donald Wortham. n.d. *Learning from Examples: Instructional Principles from the Worked Examples Research*.
- Branch, M. R. 2009. *Instructional Design: The ADDIE Approach*.
- D'Ambrosio, Ubiratan. 2014. *Ethnomathematics and Its Place in the History and Pedagogy of Mathematics*.
- J Sweller. 2011. *Psychology of Learning and Motivation*,.
- Kalyuga, Slava. 2011a. "Cognitive Load Theory: How Many Types of Load Does It Really Need?" *Educational Psychology Review* 23 (1): 1–19. <https://doi.org/10.1007/s10648-010-9150-7>.
- Kalyuga, Slava. 2011b. "Cognitive Load Theory: How Many Types of Load Does It Really Need?" *Educational Psychology Review* 23 (1): 1–19. <https://doi.org/10.1007/s10648-010-9150-7>.
- Muzdalipah, Ipah, Marsigit Marsigit, and Sri Andayani. 2026a. "Tracing Students' Cognitive Progression in Geometry: A Design-Based Research Through the Van

- Hiele Model of Instruction and Ethnomathematics.” *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram* 14 (1): 76–93. <https://doi.org/10.33394/j-ps.v14i1.18025>.
- Muzdalipah, Ipah, Marsigit Marsigit, and Sri Andayani. 2026b. “Tracing Students’ Cognitive Progression in Geometry: A Design-Based Research Through the Van Hiele Model of Instruction and Ethnomathematics.” *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram* 14 (1): 76–93. <https://doi.org/10.33394/j-ps.v14i1.18025>.
- polya, G. 1985. *How To Solve It 2nd Ed Princeton University Press. New Jersey*.
- Renkl, Alexander. 1997. “Learning from Worked-Out Examples: A Study on Individual Differences.” *Cognitive Science* 21 (1): 1–29. https://doi.org/10.1207/s15516709cog2101_1.
- Renkl, Alexander. 1999. “Learning Mathematics from Worked-out Examples: Analyzing and Fostering Self-Explanations.” *European Journal of Psychology of Education* 14 (4): 477–88. <https://doi.org/10.1007/BF03172974>.
- Richey, Rita C., and James D. Klein. 2014. *Design and Development Research: Methods, Strategies, and Issues*. Taylor and Francis.
- Skemp, Richard R. n.d.-a. *Relational Understanding and Instrumental Understanding*.
- Skemp, Richard R. n.d.-b. *Relational Understanding and Instrumental Understanding*.
- Valerie Walkerdine. 1998. *Developmental Psychology and the Child-Centred Pedagogy: The Insertion of Piaget into Early Education*.
- VanLehn, K. 2020. *Worked Examples and Isomorphic Problem Solving in Mathematics Learning: Effects on Transfer and Conceptual Understanding. International Journal of Artificial Intelligence in Education*, 30(2), 215–240. (Catatan Reviewer: Pastikan Kembali Artikel Spesifik Yang Anda Gunakan, Karena Beberapa Karya VanLehn Membahas Worked Examples Dalam Konteks Tutoring Systems).
- VanLehn, Kurt. 1998. “Analogy Events: How Examples Are Used During Problem Solving.” *Cognitive Science* 22 (3): 347–88. https://doi.org/10.1207/s15516709cog2203_4.