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#7725 Summary

SUMMARY REVIEW EDITING

Submission

Authors	Maryati Maryati, Rully Charitas Indra Prahmana
Title	Designing Learning Translation Using the Motifs of Anyaman Bambu
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Date submitted	April 29, 2020 - 07:58 AM
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Editor	Muhammad Irfan
Author comments	

Dear Dr. Sri Adi Widodo,
Editor in Chief of IndoMath: Indonesia Mathematics Education

We hope this submission finds you well.

We as the research collaboration team are writing the manuscript entitled "Designing Learning Translation Using the Motifs of *Anyaman Bambu*" for consideration for publication in the IndoMath: Indonesia Mathematics Education. This manuscript was written using the IndoMath: Indonesia Mathematics Education Manuscript Template mentioned on the website with the blind-reviewed format.

This paper provides to produce the learning trajectory of students in learning one subject in geometry transformations namely translation, which develops from informal to formal level through the Indonesian Realistic Mathematics Education (IRME) approach. The research method used is design research starting from preliminary design, design experiments, and retrospective analysis. This study explores how the motifs of *Anyaman Bambu* make a real contribution for ninth-grade students to understand the concept of translation. The results of design experiments show that the context of the motifs of *Anyaman Bambu* can stimulate students to understand their knowledge of the concept of translation. All the strategies and models that students find, describe, and discuss that show how students' constructions or contributions can be used to help their initial understanding of the translation concepts.

This paper also describes our original work and is not under consideration by any other journal. All authors approved the manuscript and this submission. The two co-authors do not have any conflict of interest regarding this manuscript. This document was reported as the result of the research we conducted as one of the requirements of our responsibility as a researcher in our university. Furthermore, This year, we didn't get funding for our research publication so that I would like to waive all article processing charges, if our paper is accepted. Lastly, we do hope that this article can be published in this journal so that we can contribute our research results to your journal.

Thank you for receiving our manuscript and considering it for review. We do really appreciate your time and look forward to seeing your response.

Best Wishes,
Rully Charitas Indra Prahmana

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Title and Abstract

Title	Designing Learning Translation Using the Motifs of Anyaman Bambu
Abstract	Indonesia has many cultures, one of which is in the form of traditional crafts namely Anyaman Bambu. It's a form of traditional craft in the community that uses bamboo as its basic material. However, people only see these crafts as only a form of traditional craft, even though there are many motifs in these crafts that can be used as a starting point in learning mathematics, namely geometry transformations. Therefore, this research aims also to produce the learning trajectory of students in learning one subject in geometry transformations namely translation, which develops from informal to formal level through the Indonesian Realistic Mathematics Education (IRME) approach. The research method used is design research starting from preliminary design, design experiments, and retrospective analysis. This study explores how the motifs of Anyaman Bambu make a real contribution for ninth-grade students to understand the concept of translation. The results of design experiments show that the context of the motifs of Anyaman Bambu can stimulate students to understand their knowledge of the concept of translation. All the strategies and models that students find, describe, and discuss that show how students' constructions or contributions can be used to help their initial understanding of the translation.

Indexing

Keywords	Translation; Indonesian Realistic Mathematics Education; The motifs of Anyaman Bambu; Design Research
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Supporting Agencies

Agencies	—

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Designing Learning Translation Using the Motifs of *Anyaman Bambu*

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ABSTRACT

Indonesia has many cultures, one of which is in the form of traditional crafts namely Anyaman Bambu. It's a form of traditional craft in the community that uses bamboo as its basic material. However, people only see these crafts as only a form of traditional craft, even though there are many motifs in these crafts that can be used as a starting point in learning mathematics, namely geometry transformations. Therefore, this research aims also to produce the learning trajectory of students in learning one subject in geometry transformations namely translation, which develops from informal to formal level through the Indonesian Realistic Mathematics Education (IRME) approach. The research method used is design research starting from preliminary design, design experiments, and retrospective analysis. This study explores how the motifs of Anyaman Bambu make a real contribution for ninth-grade students to understand the concept of translation. The results of design experiments show that the context of the motifs of Anyaman Bambu can stimulate students to understand their knowledge of the concept of translation. All the strategies and models that students find, describe, and discuss that show how students' constructions or contributions can be used to help their initial understanding of the translation.

Keywords: Translation, Indonesian Realistic Mathematics Education, The motifs of *Anyaman Bambu*, Design Research

ABSTRAK

Indonesia memiliki banyak kebudayaan, salah satunya dalam bentuk anyaman tradisional yang diberi nama Anyaman Bambu. Ini merupakan salah satu kerajinan tradisional masyarakat yang mana menggunakan bambu sebagai bahan dasarnya. Namun, masyarakat hanya melihat kerajinan ini sebagai kerajinan tradisional semata, padahal pada kerajinan tersebut terdapat banyak motif yang dapat dilihat sebagai titik awal dalam pembelajaran matematika, yaitu transformasi geometri. Oleh karena itu, penelitian ini bertujuan untuk menghasilkan lintasan belajar siswa dalam pembelajaran salah satu bagian materi transformasi geometri, yaitu translasi, yang dikembangkan dari level informal ke level formal melalui pendekatan Pendidikan Matematika Realistik (PMR). Metode penelitian yang digunakan adalah design research yang dimulai dari *preliminary design, design experiments,* sampai *retrospective analysis*. Penelitian ini mengeksplorasi tentang bagaimana motif pada anyaman bambu memberikan kontribusi nyata bagi siswa kelas IX untuk memahami konsep translasi. Hasil penelitian menunjukkan bahwa konteks motif pada anyaman bambu dapat menstimulasi siswa untuk memahami pengetahuan mereka akan konsep translasi. Seluruh strategi dan model yang siswa temukan, deskripsikan, dan diskusikan yang menunjukkan bagaimana konstruksi atau kontribusi siswa dapat digunakan untuk membantu pemahaman awal mereka tentang topik translasi.

Kata Kunci: Translasi, Pendidikan Matematika Realistik Indonesia, Motif Anyaman Bambu, *Design Research*

INTRODUCTION

The translation is a transformation that moves each point on a plane according to a certain distance and direction (Ditasona, 2018; Maryati & Prahmana, 2019). Furthermore, the concept of

translation is widely applied in daily life (Kriegeskorte & Kievit, 2013; Francken & Slors, 2018). In Indonesia, translation subject begins to be taught at the junior high school level. On the other hands, this concept underlies other concepts such as function, symmetry, and other aspects of higher mathematics (Hollebrands, 2003). Therefore, understanding the concept of translation is very crucial in learning geometry transformations.

The results of the PISA study (Program for International Student Assessment) analyzed by Stacey (2011) shows that Indonesian students still have difficulty in solving problems related to daily life. One contributing factor is the process of learning mathematics, which tends to use practical formulas and has not linked mathematical concepts with students' daily activities (Naidoo, 2012; Arisetyawan, Suryadi, Herman, & Rahmat, 2014). Therefore, meaningful learning activities are needed, so that students can understanding the concepts of translation quickly, fun, and meaningful.

In Indonesia, mathematics educators are motivated to find learning methods that connect learning material with everyday life (Sembiring, Hadi, & Dolk, 2008). One of them is Indonesian Realistic Mathematics Education (IRME), which is an adaptation of Realistic Mathematics Education (RME) and has been developed by the contexts, cultural values, or local wisdom in Indonesia (Prahmana, Zulkardi, & Hartono, 2012; Lestariningsih, Putri, & Darmawijoyo, 2015). IRME is not only concerned with the final results, but emphasizes the process that occurs during the learning process (Sembiring et al., 2008). Thus, IRME would be able to use in learning mathematics that connect in daily activities of students.

Realistic mathematics education reforms are carried out based on two pillars, firstly, the ability of teachers to create a problem-oriented classroom culture and inviting students in interactive learning and secondly, designing learning activities that can encourage the rediscovery of mathematics (Heuvel-panhuizen & Drijvers, 2014). In addition, one of the developments in IRME was carried out with research aimed at improving classroom learning practices through an interactive analysis of the allegations of what would happen in the classroom and its implementation, and the research was design research (Cobb & Gravemeijer, 2006).

Therefore, as an innovation in learning mathematics which is oriented to the relationship of mathematics to the conditions of reality and culture of students, researchers design a translation learning trajectory using the context of the motifs of Anyaman Bambu through the PMRI approach. This context was chosen because it is close to students and easily found in students' daily activities. Through this design, it is expected to be an innovation in learning mathematics that can facilitate students in understanding the concept of translation and be able to solve everyday problems related to the concept and have a cultured character.

RESEARCH METHOD

The research method used in this research is design research, which is an appropriate way to answer research questions and achieve research objectives starting with the preliminary design, experimental design, and retrospective analysis (Prahmana, 2017). The subjects in this study were ninth-grade students of SMP Negeri 1 Tepus consisting of 31 students. Data collection techniques used in this study include video recording, documentation, written data, and observation. Data

analysis conducted in this study was to compare the observations during the learning process with the Hypothetical Learning Trajectory (HLT) that had been designed at the preliminary design stage.

RESULTS AND DISCUSSION

The results obtained in this study in the form of learning trajectories in learning translation using the context of the motifs of *Anyaman Bambu* through the IRME approach. The following is an explanation of the learning process of translational material in ninth-grade.

The Beginning of Learning Stages

Learning begins with assigning tasks in groups (4 - 5 people every group), namely working on the student worksheets "Activity 1". Before working on a worksheet, the teacher first remembers the prerequisite material by asking questions related to coordinate points. All students look active in this question and answer activity, such as the dialogue excerpt at the beginning of the lesson below.

Teacher : For example, there is a coordinate point A (0,1), if my point A moves upwards as far as two units, then point A located in the coordinates? (Teacher while drawing the coordinate axis on the blackboard like Figure 1)

Student: (0,3)" (Some students answer in unison)

Teacher : For example, point A moved to the right as far as six units, then point A located in the coordinates

Student: (6,1)" (Some students answer in unison)

Figure 1. The teacher explains the coordinate points

The conversation in the dialog above shows that most students still remember how to read coordinates. It will make it easier for students to record the starting point and endpoint after they are translated.

After students recall the prerequisite material, the teacher divides students into seven discussion groups. The teacher instructs all students to count from 1 to 7, starting with the student

sitting front. Next, students gather with their respective groups, and the teacher gives assignments to each group to work on the student worksheets "Activity 1" about the concept of translation.

Informal Stages

At this stage, students do activities based on the steps or instructions in student worksheets "Activity 1," which starts from making of *Anyaman Bambu* the motifs of two axes single from manila paper. Before students make *Anyaman Bambu*, the teacher facilitates the process of class discussion by asking questions related to the motifs of *Anyaman Bambu*. All students look active in this discussion activity, such as the dialogue quotation at the beginning of the lesson below.

Teacher : Does anyone know and have ever made of Anyaman Bambu the motifs of two axes single? (Teacher while showing pictures of the motifs of Anyaman Bambu on student worksheets)

Student : Never, Miss ... (All students answer in unison)

Students' answers in the dialog above show that students are the familiar making of Anyaman Bambu the motifs of two axes single, making it easier and faster to make, as shown in Figure 2.

Figure 2. Students making *Anyaman* paper from Manila

Next, students make the coordinate axis on *Anyaman* that has been made with markers, as shown in Figure 3. Then students prepare a square-shaped ornament that is used as a tool to record the starting point and endpoint after translating.

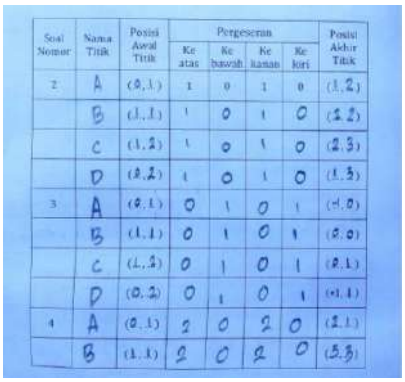
Figure 3. Students making coordinate axis in the *Anyaman* field

After all, students are ready with their *Anyaman* and ornaments, and the teacher instructs each group to record the starting point and endpoint after they are translated according to the instructions on the worksheet. In Figure 4, students are seen shifting ornaments according to the instructions in student worksheets "Activity 1" and list the coordinates.

Figure 4. Students shifting the ornaments and listing the coordinates (Informal)

The stage of "Model Of"

At this stage, students write the coordinates that have been obtained at an informal stage in a table, as shown in Figure 5.

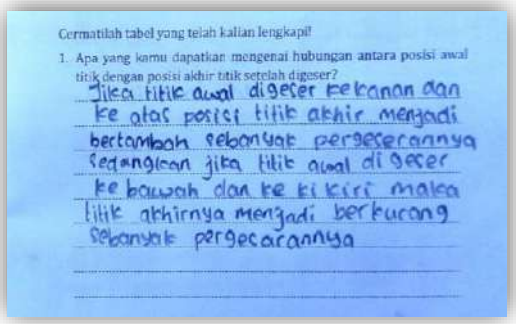


Soal Nomor	Nama Titik	Posisi Awal Titik	Pergeseran				Posisi Akhir Titik
			Ke atas	Ke bawah	Ke kanan	Ke kiri	
	C	(1,2)	2	0	2	0	(3,4)
	D	(2,2)	2	0	2	0	(2,4)
5	A	(2,1)	0	2	0	2	(=2,=1)
	B	(1,1)	0	2	0	2	(=1,=1)
	C	(1,2)	0	2	0	2	(=1,0)
	D	(2,2)	0	2	0	2	(=2,0)

Figure 5. Student work results list the starting and ending points translation results in a table (Model of)

The stage of "Model For"

At this stage, students analyze the change from the starting point to the endpoint and make interpretations related to the concept of translation with their language, as shown in Figure 6.



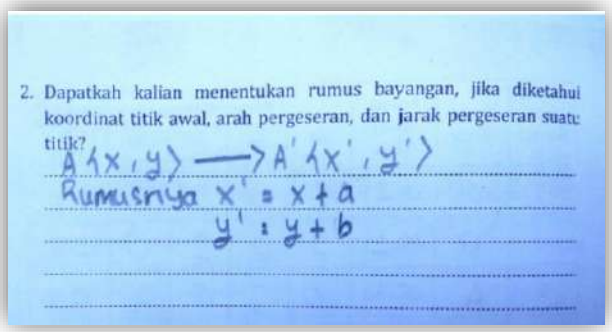
Look at the table that you have completed!
1. What do you get about the relationship between the position of the starting point and the end point after sliding?

If the starting point is shifted to the right and upward, the position of the end point increases as much as the shift, whereas if

Figure 6. Students writing the results of their related interpretations translational concepts in student worksheets (Model for

Formal Stages

At this stage, students make mathematical modeling in the form of translational formulas according to their understanding. The results of students' mathematical modeling can be seen in Figure 7.



2. Can you determine the shadow formula, if you know the coordinates of the starting point, the direction of the shift and the distance of the shift of a point?

A<x,y> → A'<x',y'>
The formula x' = x+a

Figure 7. The results of students' mathematical modeling related to the translation formula (formal)

To classify the results of student answers listed in student worksheets, class discussions are needed. Therefore, the teacher invites each group to present their work. In Figure 8, students are presenting with the concept of translation.

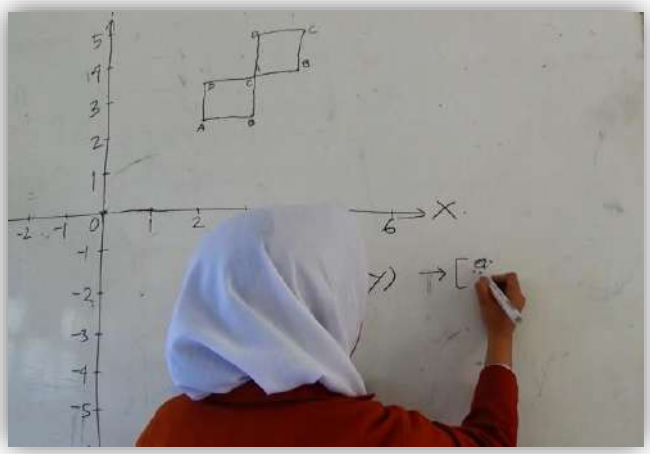


Figure 8. Students are presenting with the concept of translation.

During the discussion process, it seemed that the participants of the discussion were very enthusiastic about expressing their opinions and ideas towards the work done by each group's worksheet. This is caused by the position of the ornamental starting point that is different from each discussion group so that the location of the ornamental endpoint will also be different. Next, the teacher guides students to have a common perception of the concept of translation, that is, if it's a point $A(x,y)$ is shifted to the right by a unit and up to b unit, the shadow point becomes $A'(x+a,y+b)$, whereas if a point $A(x,y)$ is shifted to the left by a unit and down by b unit, the shadow point becomes $A'(x-a,y-b)$.

In addition, some researchers have also made mathematics learning design using IRME approaches and cultural contexts, such as designing reflective learning using the motifs of Batik (Novrika, Putri, & Hartono, 2016), designing rotation learning using the motifs od Batik Kawung (Risdiyanti & Prahmana, 2018), designing transformation learning using the motifs of Batik Sidoarjo (Lestariningsih, 2017). Therefore, the role taken from the results of this study is to add to the study of the design of mathematics learning, namely designing translation learning using the motifs of *Anyaman Bambu*.

CONCLUSION

Learning trajectories that can support the concept of translation from informal to formal include the activity of recording the starting point and the endpoint, analyzing and interpreting the change of the starting point into an endpoint using one's language, and writing the translation formula. The results of the teaching experiment show that through a series of activities that have been carried out, it can help students understand the translation concept easily, fun, and affordable by students' imagination.

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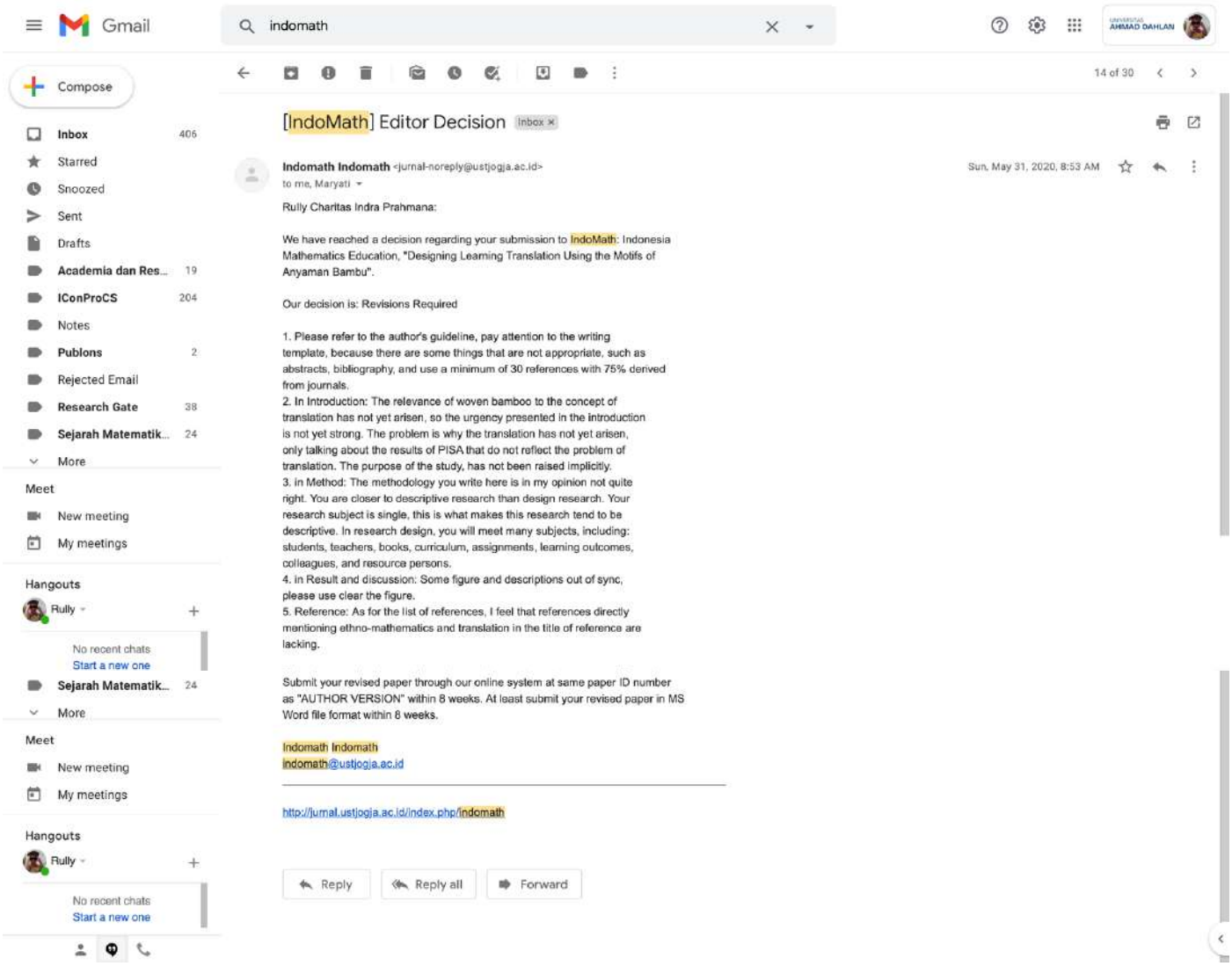
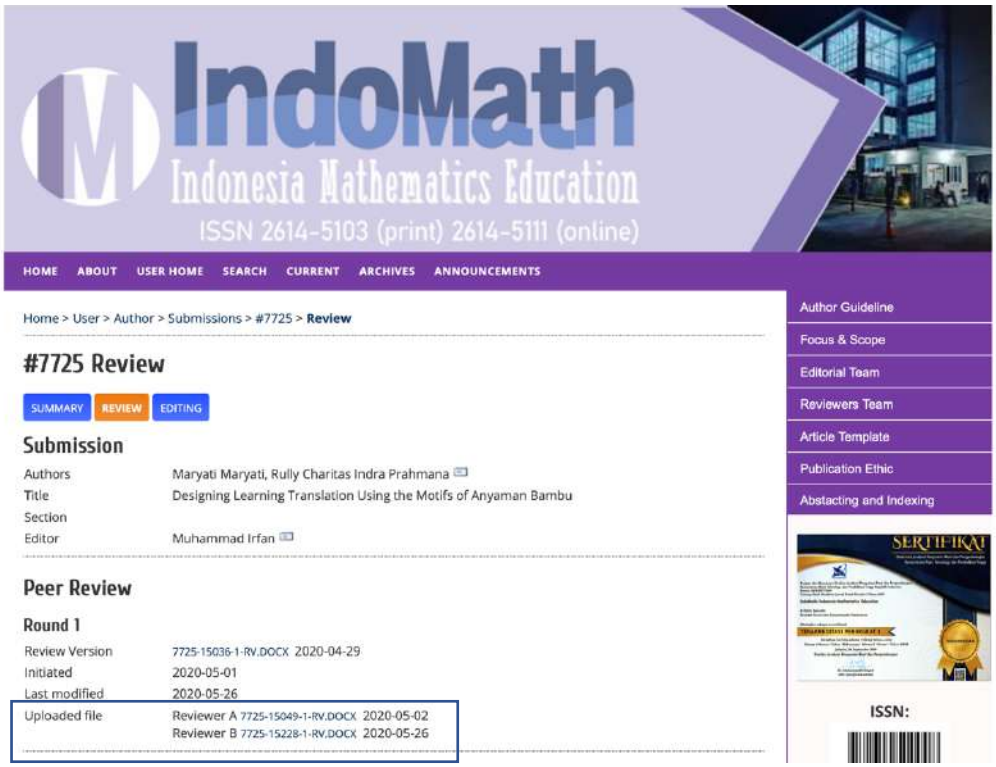


Artikel mendapatkan komentar dari 2 orang reviewer.



Hasil review oleh 2 orang reviewer, yang semuanya memberikan catatan perbaikan pada artikel nya secara langsung.

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Designing Learning Translation Using the Motifs of *Anyaman Bambu*

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General Comment

Commented [ADN1]: Please use past tense. There are so many slipped structure here.

ABSTRACT

Indonesia has many cultures, one of which is in the form of traditional crafts namely Anyaman Bambu. It's a form of traditional craft in the community that uses bamboo as its basic material. However, people only see these crafts as only a form of traditional craft, even though there are many motifs in these crafts that can be used as a starting point in learning mathematics, namely geometry transformations. Therefore, this research aims also to produce the learning trajectory of students in learning one subject in geometry transformations namely translation, which develops from informal to formal level through the Indonesian Realistic Mathematics Education (IRME) approach. The research method used is design research starting from preliminary design, design experiments, and retrospective analysis. This study explores how the motifs of Anyaman Bambu make a real contribution for ninth-grade students to understand the concept of translation. The results of design experiments show that the context of the motifs of Anyaman Bambu can stimulate students to understand their knowledge of the concept of translation. All the strategies and models that students find, describe, and discuss that show how students' constructions or contributions can be used to help their initial understanding of the translation.

Keywords: Translation, Indonesian Realistic Mathematics Education, The motifs of *Anyaman Bambu*, Design Research

ABSTRAK

Indonesia memiliki banyak kebudayaan, salah satunya dalam bentuk anyaman tradisional yang diberi nama Anyaman Bambu. Ini merupakan salah satu kerajinan tradisional masyarakat yang mana menggunakan bambu sebagai bahan dasarnya. Namun, masyarakat hanya melihat kerajinan ini sebagai kerajinan tradisional semata, padahal pada kerajinan tersebut terdapat banyak motif yang dapat dilihat sebagai titik awal dalam pembelajaran matematika, yaitu transformasi geometri. Oleh karena itu, penelitian ini bertujuan untuk menghasilkan lintasan belajar siswa dalam pembelajaran salah satu bagian materi transformasi geometri, yaitu translasi, yang dikembangkan dari level informal ke level formal melalui pendekatan Pendidikan Matematika Realistik (PMR). Metode penelitian yang digunakan adalah design research yang dimulai dari *preliminary design, design experiments,* sampai *retrospective analysis*. Penelitian ini mengeksplorasi tentang bagaimana motif pada anyaman bambu memberikan kontribusi nyata bagi siswa kelas IX untuk memahami konsep translasi. Hasil penelitian menunjukkan bahwa konteks motif pada anyaman bambu dapat menstimulasi siswa untuk memahami pengetahuan mereka akan konsep translasi. Seluruh strategi dan model yang siswa temukan, deskripsikan, dan diskusikan yang menunjukkan bagaimana konstruksi atau kontribusi siswa dapat digunakan untuk membantu pemahaman awal mereka tentang topik translasi.

Kata Kunci: Translasi, Pendidikan Matematika Realistik Indonesia, Motif Anyaman Bambu, *Design Research*

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INTRODUCTION

The translation is a transformation that moves each point on a plane according to a certain distance and direction (Ditasona, 2018; Maryati & Prahmana, 2019). Furthermore, the concept of translation is widely applied in daily life (Kriegeskorte & Kievit, 2013; Francken & Slors, 2018). In Indonesia, translation subject begins to be taught at the junior high school level. On the other hands, this concept underlies other concepts such as function, symmetry, and other aspects of higher mathematics (Hollebrands, 2003). Therefore, understanding the concept of translation is very crucial in learning geometry transformations.

The results of the PISA study (Program for International Student Assessment) analyzed by Stacey (2011) shows that Indonesian students still have difficulty in solving problems related to daily life. One contributing factor is the process of learning mathematics, which tends to use practical formulas and has not linked mathematical concepts with students' daily activities (Naidoo, 2012; Arisetyawan, Suryadi, Herman, & Rahmat, 2014). Therefore, meaningful learning activities are needed, so that students can understanding the concepts of translation quickly, fun, and meaningful.

In Indonesia, mathematics educators are motivated to find learning methods that connect learning material with everyday life (Sembiring, Hadi, & Dolk, 2008). One of them is Indonesian Realistic Mathematics Education (IRME), which is an adaptation of Realistic Mathematics Education (RME) and has been developed by the contexts, cultural values, or local wisdom in Indonesia (Prahmana, Zulkardi, & Hartono, 2012; Lestariningsih, Putri, & Darmawijoyo, 2015). IRME is not only concerned with the final results, but emphasizes the process that occurs during the learning process (Sembiring et al., 2008). Thus, IRME would be able to use in learning mathematics that connect in daily activities of students.

Realistic mathematics education reforms are carried out based on two pillars, firstly, the ability of teachers to create a problem-oriented classroom culture and inviting students in interactive learning and secondly, designing learning activities that can encourage the rediscovery of mathematics (Heuvel-panhuizen & Drijvers, 2014). In addition, one of the developments in IRME was carried out with research aimed at improving classroom learning practices through an interactive analysis of the allegations of what would happen in the classroom and its implementation, and the research was design research (Cobb & Gravemeijer, 2006).

Therefore, as an innovation in learning mathematics which is oriented to the relationship of mathematics to the conditions of reality and culture of students, researchers design a translation learning trajectory using the context of the motifs of Anyaman Bambu through the PMRI approach. This context was chosen because it is close to students and easily found in students' daily activities. Through this design, it is expected to be an innovation in learning mathematics that can facilitate students in understanding the concept of translation and be able to solve everyday problems related to the concept and have a cultured character.

RESEARCH METHOD

The research method used in this research is design research, which is an appropriate way to answer research questions and achieve research objectives starting with the preliminary design,

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experimental design, and retrospective analysis (Prahmana, 2017). The subjects in this study were ninth-grade students of SMP Negeri 1 Tepus consisting of 31 students. Data collection techniques used in this study include video recording, documentation, written data, and observation. Data analysis conducted in this study was to compare the observations during the learning process with the Hypothetical Learning Trajectory (HLT) that had been designed at the preliminary design stage.

RESULTS AND DISCUSSION

The results obtained in this study in the form of learning trajectories in learning translation using the context of the motifs of *Anyaman Bambu* through the IRME approach. The following is an explanation of the learning process of translational material in ninth-grade.

The Beginning of Learning Stages

Learning begins with assigning tasks in groups (4 - 5 people every group), namely working on the student worksheets "Activity 1". Before working on a worksheet, the teacher first remembers the prerequisite material by asking questions related to coordinate points. All students look active in this question and answer activity, such as the dialogue excerpt at the beginning of the lesson below.

Teacher : For example, there is a coordinate point A (0,1), if my point A moves upwards as far as two units, then point A located in the coordinates? (Teacher while drawing the coordinate axis on the blackboard like Figure 1)

Student: (0,3)" (Some students answer in unison)

Teacher : For example, point A moved to the right as far as six units, then point A located in the coordinates

Student: (6,1)" (Some students answer in unison)

Figure 1. The teacher explains the coordinate points

The conversation in the dialog above shows that most students still remember how to read coordinates. It will make it easier for students to record the starting point and endpoint after they are translated.

After students recall the prerequisite material, the teacher divides students into seven discussion groups. The teacher instructs all students to count from 1 to 7, starting with the student sitting front. Next, students gather with their respective groups, and the teacher gives assignments to each group to work on the student worksheets "Activity 1" about the concept of translation.

Informal Stages

At this stage, students do activities based on the steps or instructions in student worksheets "Activity 1," which starts from making of *Anyaman Bambu* the motifs of two axes single from manila paper. Before students make *Anyaman Bambu*, the teacher facilitates the process of class discussion by asking questions related to the motifs of *Anyaman Bambu*. All students look active in this discussion activity, such as the dialogue quotation at the beginning of the lesson below.

Teacher : Does anyone know and have ever made of Anyaman Bambu the motifs of two axes single? (Teacher while showing pictures of the motifs of Anyaman Bambu on student worksheets)

Student: Never, Miss ... (All students answer in unison)

Students' answers in the dialog above show that students are the familiar making of Anyaman Bambu the motifs of two axes single, making it easier and faster to make, as shown in Figure 2.

Figure 2. Students making *Anyaman* paper from Manila

Next, students make the coordinate axis on *Anyaman* that has been made with markers, as shown in Figure 3. Then students prepare a square-shaped ornament that is used as a tool to record the starting point and endpoint after translating.

Figure 3. Students making coordinate axis in the *Anyaman* field

After all, students are ready with their *Anyaman* and ornaments, and the teacher instructs each group to record the starting point and endpoint after they are translated according to the instructions on the worksheet. In Figure 4, students are seen shifting ornaments according to the instructions in student worksheets "Activity 1" and list the coordinates.

Figure 4. Students shifting the ornaments and listing the coordinates (Informal)

The stage of "Model Of"

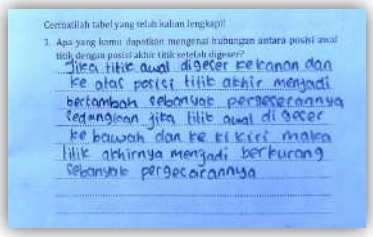
At this stage, students write the coordinates that have been obtained at an informal stage in a table, as shown in Figure 5.

Soal Nomor	Nama Titik	Posisi Awal Titik	Pergeseran				Posisi Akhir Titik
			Ke atas	Ke bawah	Ke kanan	Ke kiri	
	C	(1,2)	2	0	2	0	(3,4)
	D	(0,2)	2	0	2	0	(2,4)
5	A	(0,1)	0	2	0	2	(-2,-1)
	B	(1,1)	0	2	0	2	(-1,-1)
	C	(1,2)	0	2	0	2	(-1,0)
	D	(0,2)	0	2	0	2	(-2,0)

Figure 5. Student work results list the starting and ending points translation results in a table (Model of)

The stage of "Model For"

At this stage, students analyze the change from the starting point to the endpoint and make interpretations related to the concept of translation with their language, as shown in Figure 6.



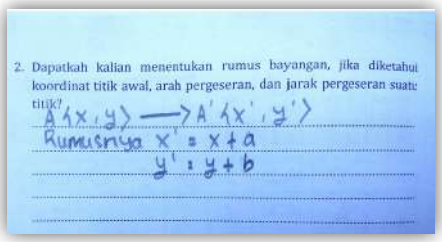
Look at the table that you have completed!
1. What do you get about the relationship between the position of the starting point and the end point after sliding?

If the starting point is shifted to the right and upward, the position of the end point increases as much as the shift. whereas if

Figure 6. Students writing the results of their related interpretations translational concepts in student worksheets (Model for

Formal Stages

At this stage, students make mathematical modeling in the form of translational formulas according to their understanding. The results of students' mathematical modeling can be seen in Figure 7.



2. Can you determine the shadow formula, if you know the coordinates of the starting point, the direction of the shift and the distance of the shift of a point?

A<x,y> → A'<x',y'>
The formula x' = x+a

Figure 7. The results of students' mathematical modeling related to the translation formula (formal)

To classify the results of student answers listed in student worksheets, class discussions are needed. Therefore, the teacher invites each group to present their work. In Figure 8, students are presenting with the concept of translation.

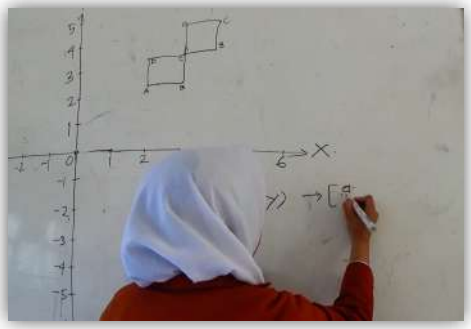


Figure 8. Students are presenting with the concept of translation.

During the discussion process, it seemed that the participants of the discussion were very enthusiastic about expressing their opinions and ideas towards the work done by each group's worksheet. This is caused by the position of the ornamental starting point that is different from each discussion group so that the location of the ornamental endpoint will also be different. Next, the teacher guides students to have a common perception of the concept of translation, that is, if it's a point $A(x, y)$ is shifted to the right by a unit and up to b unit, the shadow point becomes $A'(x + a, y + b)$, whereas if a point $A(x, y)$ is shifted to the left by a unit and down by b unit, the shadow point becomes $A'(x - a, y - b)$.

In addition, some researchers have also made mathematics learning design using IRME approaches and cultural contexts, such as designing reflective learning using the motifs of Batik (Novrika, Putri, & Hartono, 2016), designing rotation learning using the motifs od Batik Kawung (Risdiyanti & Prahmana, 2018), designing transformation learning using the motifs of Batik Sidoarjo (Lestariningsih, 2017). Therefore, the role taken from the results of this study is to add to the study of the design of mathematics learning, namely designing translation learning using the motifs of *Anyaman Bambu*.

CONCLUSION

Learning trajectories that can support the concept of translation from informal to formal include the activity of recording the starting point and the endpoint, analyzing and interpreting the change of the starting point into an endpoint using one's language, and writing the translation formula. The results of the teaching experiment show that through a series of activities that have been carried out, it can help students understand the translation concept easily, fun, and affordable by students' imagination.

ACKNOWLEDGEMENTS

The author would like to thank Universitas Ahmad Dahlan that supported this research. Furthermore, thanks to all participated students and teachers for their participation in this study. Lastly, thanks to the management of the IndoMath: Indonesia Mathematics Education who helped to review, give comments, and publish this article.

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REFERENCES

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The problem is why the translation has not yet arisen, only talking about the results of PISA that do not reflect the problem of translation

The purpose of the study, has not been raised implicitly

INTRODUCTION

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Commented [A4]: Between images and image descriptions out of sync

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Figure 3. Students making coordinate axis in the *Anyaman* field

After all, students are ready with their *Anyaman* and ornaments, and the teacher instructs each group to record the starting point and endpoint after they are translated according to the instructions on the worksheet. In Figure 4, students are seen shifting ornaments according to the instructions in student worksheets "Activity 1" and list the coordinates.

Figure 4. Students shifting the ornaments and listing the coordinates (Informal)

The stage of "Model Of"

At this stage, students write the coordinates that have been obtained at an informal stage in a table, as shown in Figure 5.

Soal Nomor	Nama Titik	Posisi Awal Titik	Pergeseran				Posisi Akhir Titik
			Ke atas	Ke bawah	Ke kanan	Ke kiri	
	C	(1,2)	2	0	2	0	(3,4)
	D	(0,2)	2	0	2	0	(2,4)
5	A	(0,1)	0	2	0	2	(-2,-1)
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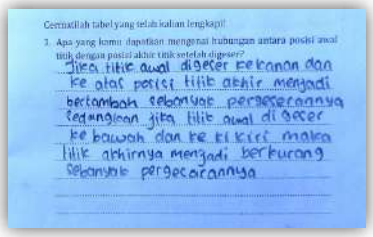

Look at the table that you have completed!
1. What do you get about the relationship between the position of the starting point and the end point after sliding?

If the starting point is shifted to the right and upward, the position of the end point increases as much as the shift. whereas if

Figure 6. Students writing the results of their related interpretations translational concepts in student worksheets (Model for

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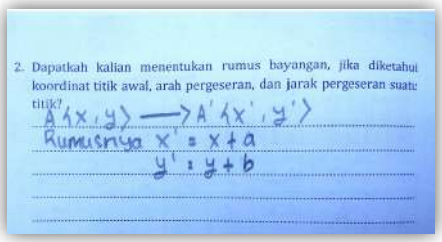
At this stage, students make mathematical modeling in the form of translational formulas according to their understanding. The results of students' mathematical modeling can be seen in Figure 7.

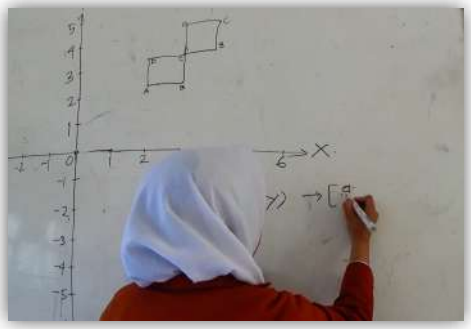


2. Can you determine the shadow formula, if you know the coordinates of the starting point, the direction of the shift and the distance of the shift of a point?

A<x,y> → A'<x',y'>
The formula x' = x+a

Figure 7. The results of students' mathematical modeling related to the translation formula (formal)

To classify the results of student answers listed in student worksheets, class discussions are needed. Therefore, the teacher invites each group to present their work. In Figure 8, students are presenting with the concept of translation.



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During the discussion process, it seemed that the participants of the discussion were very enthusiastic about expressing their opinions and ideas towards the work done by each group's worksheet. This is caused by the position of the ornamental starting point that is different from each discussion group so that the location of the ornamental endpoint will also be different. Next, the teacher guides students to have a common perception of the concept of translation, that is, if it's a point $A(x, y)$ is shifted to the right by a unit and up to b unit, the shadow point becomes $A'(x + a, y + b)$, whereas if a point $A(x, y)$ is shifted to the left by a unit and down by b unit, the shadow point becomes $A'(x - a, y - b)$.

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CONCLUSION

Learning trajectories that can support the concept of translation from informal to formal include the activity of recording the starting point and the endpoint, analyzing and interpreting the change of the starting point into an endpoint using one's language, and writing the translation formula. The results of the teaching experiment show that through a series of activities that have been carried out, it can help students understand the translation concept easily, fun, and affordable by students' imagination.

ACKNOWLEDGEMENTS

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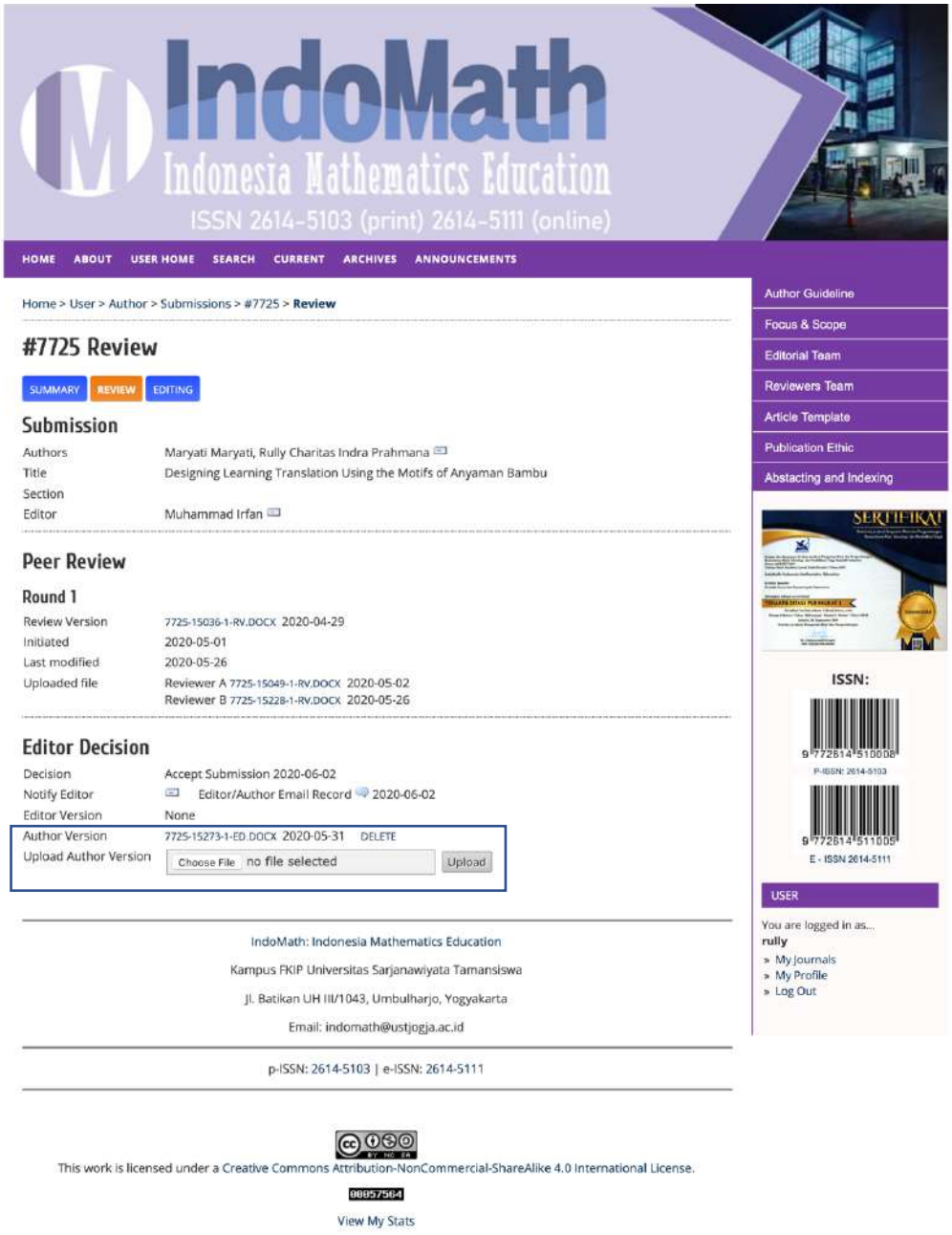

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#7725 Review

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Editor	Muhammad Irfan

Peer Review

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Designing Learning Translation using the Motifs of *Anyaman Bambu*

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ABSTRACT

Indonesia has many cultures, one of which is in the form of traditional crafts, namely Anyaman Bambu. It's a form of traditional art in the community that uses bamboo as its primary material. However, people only see these crafts as merely a form of conventional work, even though there are many motifs in these crafts that can be used as a starting point in learning mathematics, namely geometry transformations. Therefore, this research aims also to produce the learning trajectory of students in learning one subject in geometry transformations, namely translation, which develops from informal to formal level through the Indonesian Realistic Mathematics Education (IRME) approach. The research method used is design research, starting from preliminary design, design experiments, and retrospective analysis. This study explores how the motifs of Anyaman Bambu make a real contribution for ninth-grade students to understand the concept of translation. The results of design experiments show that the context of the motifs of Anyaman Bambu can stimulate students to understand their knowledge of the idea of translation. All the strategies and models that students find to describe and discuss that show how students' constructions or contributions can be used to help their initial understanding of the translation.

Keywords: Translation, Indonesian Realistic Mathematics Education, The motifs of *Anyaman Bambu*, Design Research

ABSTRAK

Indonesia memiliki banyak kebudayaan, salah satunya dalam bentuk anyaman tradisional yang diberi nama Anyaman Bambu. Ini merupakan salah satu kerajinan tradisional masyarakat yang mana menggunakan bambu sebagai bahan dasarnya. Namun, masyarakat hanya melihat kerajinan ini sebagai kerajinan tradisional semata, padahal pada kerajinan tersebut terdapat banyak motif yang dapat dilihat sebagai titik awal dalam pembelajaran matematika, yaitu transformasi geometri. Oleh karena itu, penelitian ini bertujuan untuk menghasilkan lintasan belajar siswa dalam pembelajaran salah satu bagian materi transformasi geometri, yaitu translasi, yang dikembangkan dari level informal ke level formal melalui pendekatan Pendidikan Matematika Realistik (PMR). Metode penelitian yang digunakan adalah design research yang dimulai dari *preliminary design, design experiments,* sampai *retrospective analysis*. Penelitian ini mengeksplorasi tentang bagaimana motif pada anyaman bambu memberikan kontribusi nyata bagi siswa kelas IX untuk memahami konsep translasi. Hasil penelitian menunjukkan bahwa konteks motif pada anyaman bambu dapat menstimulasi siswa untuk memahami pengetahuan mereka akan konsep translasi. Seluruh strategi dan model yang siswa temukan, deskripsikan, dan diskusikan yang menunjukkan bagaimana konstruksi atau kontribusi siswa dapat digunakan untuk membantu pemahaman awal mereka tentang topik translasi.

Kata Kunci: Translasi, Pendidikan Matematika Realistik Indonesia, Motif Anyaman Bambu, *Design Research*

INTRODUCTION

The translation is a transformation that moves each point on a plane according to a certain distance and direction (Ditasona, 2018; Maryati & Prahmana, 2019). Furthermore, the concept of

translation is widely applied in daily life (Kriegeskorte & Kievit, 2013; Francken & Slors, 2018). In Indonesia, translation subject begins to be taught at the junior high school level. On the other hand, this concept underlies other concepts such as function, symmetry, and other aspects of higher mathematics (Hollebrands, 2003). Therefore, understanding the concept of translation is very crucial in learning geometry transformations.

One contributing factor is the process of learning mathematics, which tends to use practical formulas and has not linked mathematical concepts with students' daily activities (Naidoo, 2012; Arisetyawan, Suryadi, Herman, & Rahmat, 2014). There are several learning approaches that relate to daily activities (D'Ambrosio, 2007; Freudenthal, 2006). Muhtadi et al. (2017) and Abdullah (2017) explore Sundanese culture which has mathematical values for mathematics teaching and learning activities in class, namely ethnomathematics. On the other hand, several researches have been documented their research stated that the context that is close to students is able to emerge mathematical understanding of the concepts of number operations (Prahmana, Zulkardi, & Hartono, 2012), measurement (Wijaya, 2008; Haris & Putri, 2011), and geometry (Jupri, 2017; Kristanti et al. 2018; Risdiyanti & Prahmana, 2018). Therefore, meaningful learning activities are needed so that students can understanding the mathematical concepts more useful.

In Indonesia, mathematics educators are motivated to find learning methods that connect learning material with everyday life (Sembiring, Hadi, & Dolk, 2008). One of them is Indonesian Realistic Mathematics Education (IRME), which is an adaptation of Realistic Mathematics Education (RME) and has been developed by the contexts, cultural values, or local wisdom in Indonesia (Prahmana, Zulkardi, & Hartono, 2012; Lestariningsih, Putri, & Darmawijoyo, 2015). IRME is not only concerned with the final results but emphasizes the process that occurs during the learning process (Sembiring et al., 2008). Thus, IRME would be able to use in learning mathematics that connects in the daily activities of students.

Realistic mathematics education reforms are carried out based on two pillars, firstly, the ability of teachers to create a problem-oriented classroom culture and inviting students in interactive learning and secondly, designing learning activities that can encourage the rediscovery of mathematics (Heuvel-panhuizen & Drijvers, 2014). Besides, one of the developments in IRME was carried out with research aimed at improving classroom learning practices through an interactive analysis of the allegations of what would happen in the classroom and its implementation, and the investigation was design research (Cobb & Gravemeijer, 2006).

Therefore, as an innovation in learning mathematics, which is oriented to the relationship of mathematics to the conditions of reality and culture of students, researchers design a translation learning trajectory using the context of the motifs of *Anyaman Bambu* through the PMRI approach. This context was chosen because it is close to students and easily found in students' daily activities. Through this design, it is expected to be an innovation in learning mathematics that can facilitate students in understanding the concept of translation and be able to solve everyday problems related to the idea and have a literary character.

RESEARCH METHOD

The research method used in this research is design research, which is an appropriate way to answer research questions and achieve research objectives starting with the preliminary design, experimental design, and retrospective analysis (Prahmana, 2017). In the preliminary design, the researcher implements the initial idea of using the context of the motifs of *Anyaman Bambu* in learning translation by studying the literature. After reviewing the several researches, the researcher does observations at SMP N 1 Tepus to see the students' initial abilities that were used as the basis for designing the prototype hypothetical learning trajectory (HLT). Next, in the experimental experiment, researchers tested the learning activities that have been designed at the preliminary design stage. Lastly, retrospective analysis is a part of data analysis conducted in this study was to compare the remarks during the learning process with the Hypothetical Learning Trajectory (HLT) that had been designed at the preliminary design stage. The subjects in this study were ninth-grade students of SMP Negeri 1 Tepus consisting of 31 students. Data collection techniques used in this study include video recording, documentation, written data, and observation.

RESULTS AND DISCUSSION

The results obtained in this study in the form of learning trajectories in learning translation using the context of the motifs of *Anyaman Bambu* through the IRME approach. The following is an explanation of the learning process of translational material in ninth-grade.

The Beginning of Learning Stages

Learning begins with assigning tasks in groups (4 - 5 people every group), namely working on the student worksheets "Activity 1". Before working on a worksheet, the teacher first remembers the prerequisite material by asking questions related to coordinate points. All students look active in this question and answer activity, such as the dialogue excerpt at the beginning of the lesson below.

Teacher : For example, there is a coordinate point A (0,1), if my point A moves upwards as far as two units, then point A located in the coordinates? (Teacher while drawing the coordinate axis on the blackboard like Figure 1)

Student : (0,3)" (Some students answer in unison)

Teacher : For example, point A moved to the right as far as six units, then point A located in the coordinates

Student : (6,1)" (Some students answer in unison)

Figure 1. The teacher explains the coordinate points

The conversation in the dialog above shows that most students still remember how to read coordinates. It will make it easier for students to record the starting point and endpoint after they are translated.

After students recall the prerequisite material, the teacher divides students into seven discussion groups. The teacher instructs all students to count from 1 to 7, starting with the student sitting front. Next, students gather with their respective groups, and the teacher gives assignments to each group to work on the student worksheets "Activity 1" about the concept of translation.

Informal Stages

At this stage, students do activities based on the steps or instructions in student worksheets "Activity 1," which starts from making of *Anyaman Bambu* the motifs of two axes single from manila paper. Before students make *Anyaman Bambu*, the teacher facilitates the process of class discussion by asking questions related to the motifs of *Anyaman Bambu*. All students look active in this discussion activity, such as the dialogue quotation at the beginning of the lesson below.

Teacher : Does anyone know and have ever made of Anyaman Bambu the motifs of two axes single? (Teacher while showing pictures of the motifs of Anyaman Bambu on student worksheets)

Student : Never, Miss ... (All students answer in unison)

Students' answers in the dialog above show that students are the familiar making of *Anyaman Bambu* the motifs of two axes single, making it easier and faster to make, as shown in Figure 2.

Figure 2. Students making *Anyaman* paper from *Manila* papers

Next, students make the coordinate axis on *Anyaman* that has been made with markers, as shown in Figure 3. Then students prepare a square-shaped ornament that is used as a tool to record the starting point and endpoint after translating.

Figure 3. Students making coordinate axis in the *Anyaman* field

After all, students are ready with their *Anyaman* and ornaments, and the teacher instructs each group to record the starting point and endpoint after they are translated according to the instructions on the worksheet. In Figure 4, students are seen shifting ornaments according to the instructions in student worksheets "Activity 1" and list the coordinates.

Figure 4. Students shifting the ornaments and listing the coordinates (Informal)

The stage of "Model Of"

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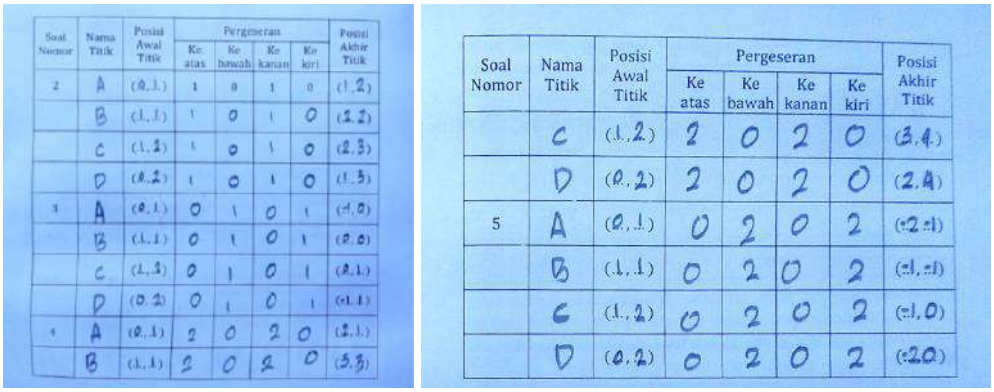

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	B	(1, 1)	0	2	0	2	(−1, −1)
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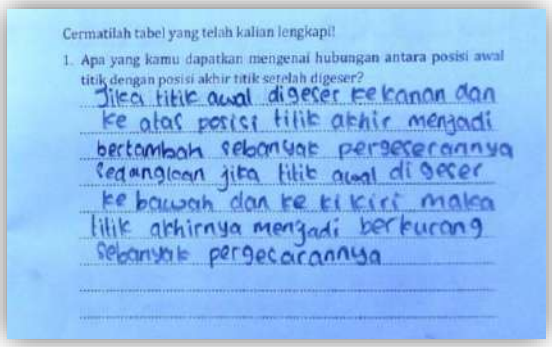

Cermatilah tabel yang telah kalian lengkapi!

1. Apa yang kamu dapatkan mengenai hubungan antara posisi awal titik dengan posisi akhir titik setelah digeser?

Jika titik awal digeser ke kanan dan ke atas posisi titik akhir menjadi bertambah sebanyak pergeserannya sedangkan jika titik awal di geser ke bawah dan ke ki kiri maka titik akhirnya menjadi berkurang sebanyak pergeserannya

Look at the table that you have completed!
1. What do you get about the relationship between the position of the starting point and the end point after sliding?

If the starting point is shifted to the right and upward, the position of the end point increases as much as the shift, whereas if the starting point is shifted down and left, the end point decreases as much as the shift

Figure 6. Students writing the results of their related interpretations translational concepts in student worksheets (Model for

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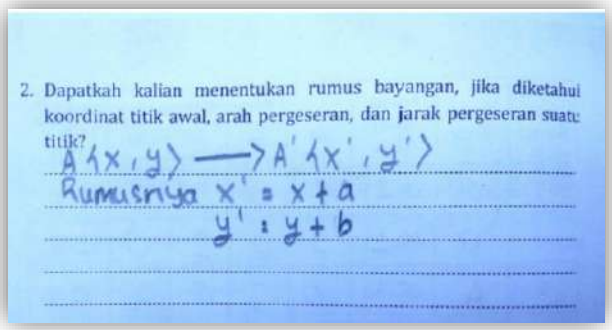
At this stage, students make mathematical modeling in the form of translational formulas according to their understanding. The results of students' mathematical modeling can be seen in Figure 7.



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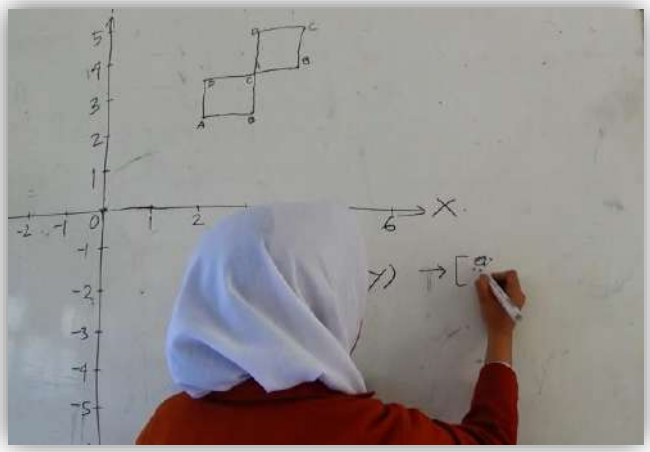

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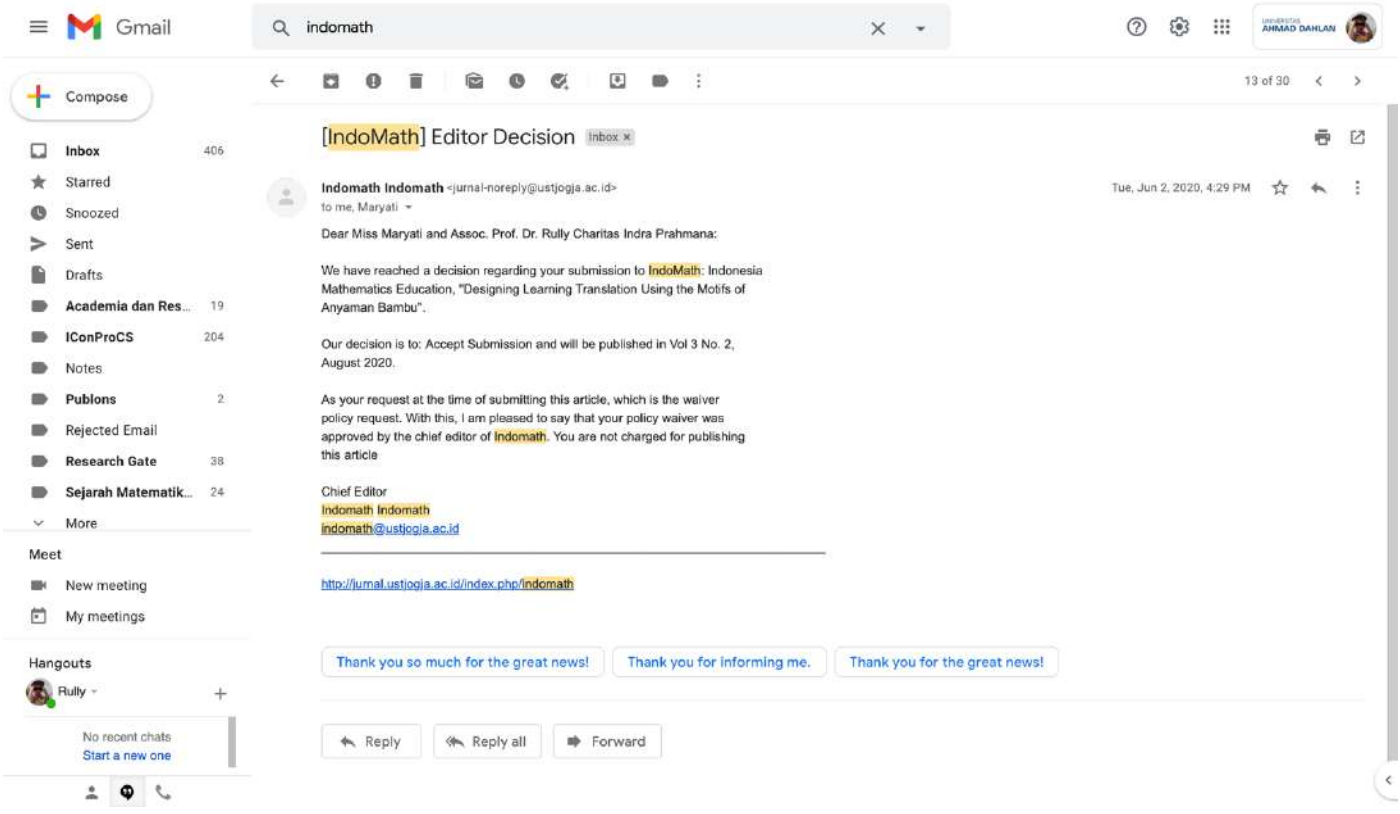

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Designing Learning Translation Using the Motifs of Anyaman Bambu

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Abstract

Indonesia has many cultures, one of which is in the form of traditional crafts namely Anyaman Bambu. It's a form of traditional craft in the community that uses bamboo as its basic material. However, people only see these crafts as only a form of traditional craft, even though there are many motifs in these crafts that can be used as a starting point in learning mathematics, namely geometry transformations. Therefore, this research aims also to produce the learning trajectory of students in learning one subject in geometry transformations namely translation, which develops from informal to formal level through the Indonesian Realistic Mathematics Education (IRME) approach. The research method used is design research starting from preliminary design, design experiments, and retrospective analysis. This study explores how the motifs of Anyaman Bambu make a real contribution for ninth-grade students to understand the concept of translation. The results of design experiments show that the context of the motifs of Anyaman Bambu can stimulate students to understand their knowledge of the concept of translation. All the strategies and models that students find, describe, and discuss that show how students' constructions or contributions can be used to help their initial understanding of the translation.

Keywords

Translation; Indonesian Realistic Mathematics Education; The motifs of Anyaman Bambu; Design Research

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Designing Learning Translation using the Motifs of *Anyaman Bambu*

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ABSTRACT

Indonesia has many cultures, one of which is in the form of traditional crafts, namely Anyaman Bambu. It's a form of traditional art in the community that uses bamboo as its primary material. However, people only see these crafts as merely a form of conventional work, even though there are many motifs in these crafts that can be used as a starting point in learning mathematics, namely geometry transformations. Therefore, this research aims also to produce the learning trajectory of students in learning one subject in geometry transformations, namely translation, which develops from informal to formal level through the Indonesian Realistic Mathematics Education (IRME) approach. The research method used is design research, starting from preliminary design, design experiments, and retrospective analysis. This study explores how the motifs of Anyaman Bambu make a real contribution for ninth-grade students to understand the concept of translation. The results of design experiments show that the context of the motifs of Anyaman Bambu can stimulate students to understand their knowledge of the idea of translation. All the strategies and models that students find to describe and discuss that show how students' constructions or contributions can be used to help their initial understanding of the translation.

Keywords: Translation, Indonesian Realistic Mathematics Education, The motifs of *Anyaman Bambu*, Design Research

ABSTRAK

Indonesia memiliki banyak kebudayaan, salah satunya dalam bentuk anyaman tradisional yang diberi nama Anyaman Bambu. Ini merupakan salah satu kerajinan tradisional masyarakat yang mana menggunakan bambu sebagai bahan dasarnya. Namun, masyarakat hanya melihat kerajinan ini sebagai kerajinan tradisional semata, padahal pada kerajinan tersebut terdapat banyak motif yang dapat dilihat sebagai titik awal dalam pembelajaran matematika, yaitu transformasi geometri. Oleh karena itu, penelitian ini bertujuan untuk menghasilkan lintasan belajar siswa dalam pembelajaran salah satu bagian materi transformasi geometri, yaitu translasi, yang dikembangkan dari level informal ke level formal melalui pendekatan Pendidikan Matematika Realistik (PMR). Metode penelitian yang digunakan adalah design research yang dimulai dari *preliminary design, design experiments,* sampai *retrospective analysis*. Penelitian ini mengeksplorasi tentang bagaimana motif pada anyaman bambu memberikan kontribusi nyata bagi siswa kelas IX untuk memahami konsep translasi. Hasil penelitian menunjukkan bahwa konteks motif pada anyaman bambu dapat menstimulasi siswa untuk memahami pengetahuan mereka akan konsep translasi. Seluruh strategi dan model yang siswa temukan, deskripsikan, dan diskusikan yang menunjukkan bagaimana konstruksi atau kontribusi siswa dapat digunakan untuk membantu pemahaman awal mereka tentang topik translasi.

Kata Kunci: Translasi, Pendidikan Matematika Realistik Indonesia, Motif Anyaman Bambu, *Design Research*

INTRODUCTION

The translation is a transformation that moves each point on a plane according to a certain distance and direction (Ditasona, 2018; Maryati & Prahmana, 2019). Furthermore, the concept of

translation is widely applied in daily life (Kriegeskorte & Kievit, 2013; Francken & Slors, 2018). In Indonesia, translation subject begins to be taught at the junior high school level. On the other hand, this concept underlies other concepts such as function, symmetry, and other aspects of higher mathematics (Hollebrands, 2003). Therefore, understanding the concept of translation is very crucial in learning geometry transformations.

One contributing factor is the process of learning mathematics, which tends to use practical formulas and has not linked mathematical concepts with students' daily activities (Naidoo, 2012; Arisetyawan, Suryadi, Herman, & Rahmat, 2014). There are several learning approaches that relate to daily activities (D'Ambrosio, 2007; Freudenthal, 2006). Muhtadi et al. (2017) and Abdullah (2017) explore Sundanese culture which has mathematical values for mathematics teaching and learning activities in class, namely ethnomathematics. On the other hand, several researches have been documented their research stated that the context that is close to students is able to emerge mathematical understanding of the concepts of number operations (Prahmana, Zulkardi, & Hartono, 2012), measurement (Wijaya, 2008; Haris & Putri, 2011), and geometry (Jupri, 2017; Kristanti et al. 2018; Risdiyanti & Prahmana, 2018). Therefore, meaningful learning activities are needed so that students can understanding the mathematical concepts more useful.

In Indonesia, mathematics educators are motivated to find learning methods that connect learning material with everyday life (Sembiring, Hadi, & Dolk, 2008). One of them is Indonesian Realistic Mathematics Education (IRME), which is an adaptation of Realistic Mathematics Education (RME) and has been developed by the contexts, cultural values, or local wisdom in Indonesia (Prahmana, Zulkardi, & Hartono, 2012; Lestariningsih, Putri, & Darmawijoyo, 2015). IRME is not only concerned with the final results but emphasizes the process that occurs during the learning process (Sembiring et al., 2008). Thus, IRME would be able to use in learning mathematics that connects in the daily activities of students.

Realistic mathematics education reforms are carried out based on two pillars, firstly, the ability of teachers to create a problem-oriented classroom culture and inviting students in interactive learning and secondly, designing learning activities that can encourage the rediscovery of mathematics (Heuvel-panhuizen & Drijvers, 2014). Besides, one of the developments in IRME was carried out with research aimed at improving classroom learning practices through an interactive analysis of the allegations of what would happen in the classroom and its implementation, and the investigation was design research (Cobb & Gravemeijer, 2006).

Therefore, as an innovation in learning mathematics, which is oriented to the relationship of mathematics to the conditions of reality and culture of students, researchers design a translation learning trajectory using the context of the motifs of *Anyaman Bambu* through the PMRI approach. This context was chosen because it is close to students and easily found in students' daily activities. Through this design, it is expected to be an innovation in learning mathematics that can facilitate students in understanding the concept of translation and be able to solve everyday problems related to the idea and have a literary character.

RESEARCH METHOD

The research method used in this research is design research, which is an appropriate way to answer research questions and achieve research objectives starting with the preliminary design, experimental design, and retrospective analysis (Prahmana, 2017). In the preliminary design, the researcher implements the initial idea of using the context of the motifs of *Anyaman Bambu* in learning translation by studying the literature. After reviewing the several researches, the researcher does observations at SMP N 1 Tepus to see the students' initial abilities that were used as the basis for designing the prototype hypothetical learning trajectory (HLT). Next, in the experimental experiment, researchers tested the learning activities that have been designed at the preliminary design stage. Lastly, retrospective analysis is a part of data analysis conducted in this study was to compare the remarks during the learning process with the Hypothetical Learning Trajectory (HLT) that had been designed at the preliminary design stage. The subjects in this study were ninth-grade students of SMP Negeri 1 Tepus consisting of 31 students. Data collection techniques used in this study include video recording, documentation, written data, and observation.

RESULTS AND DISCUSSION

The results obtained in this study in the form of learning trajectories in learning translation using the context of the motifs of *Anyaman Bambu* through the IRME approach. The following is an explanation of the learning process of translational material in ninth-grade.

The Beginning of Learning Stages

Learning begins with assigning tasks in groups (4 - 5 people every group), namely working on the student worksheets "Activity 1". Before working on a worksheet, the teacher first remembers the prerequisite material by asking questions related to coordinate points. All students look active in this question and answer activity, such as the dialogue excerpt at the beginning of the lesson below.

Teacher : For example, there is a coordinate point A (0,1), if my point A moves upwards as far as two units, then point A located in the coordinates? (Teacher while drawing the coordinate axis on the blackboard like Figure 1)
Student: (0,3)" (Some students answer in unison)
Teacher : For example, point A moved to the right as far as six units, then point A located in the coordinates
Student: (6,1)" (Some students answer in unison)

Figure 1. The teacher explains the coordinate points

The conversation in the dialog above shows that most students still remember how to read coordinates. It will make it easier for students to record the starting point and endpoint after they are translated.

After students recall the prerequisite material, the teacher divides students into seven discussion groups. The teacher instructs all students to count from 1 to 7, starting with the student sitting front. Next, students gather with their respective groups, and the teacher gives assignments to each group to work on the student worksheets "Activity 1" about the concept of translation.

Informal Stages

At this stage, students do activities based on the steps or instructions in student worksheets "Activity 1," which starts from making of *Anyaman Bambu* the motifs of two axes single from manila paper. Before students make *Anyaman Bambu*, the teacher facilitates the process of class discussion by asking questions related to the motifs of *Anyaman Bambu*. All students look active in this discussion activity, such as the dialogue quotation at the beginning of the lesson below.

Teacher : Does anyone know and have ever made of Anyaman Bambu the motifs of two axes single? (Teacher while showing pictures of the motifs of Anyaman Bambu on student worksheets)
Student: Never, Miss ... (All students answer in unison)

Students' answers in the dialog above show that students are the familiar making of *Anyaman Bambu* the motifs of two axes single, making it easier and faster to make, as shown in Figure 2.

Figure 2. Students making *Anyaman* paper from *Manila* papers

Next, students make the coordinate axis on *Anyaman* that has been made with markers, as shown in Figure 3. Then students prepare a square-shaped ornament that is used as a tool to record the starting point and endpoint after translating.

Figure 3. Students making coordinate axis in the *Anyaman* field

After all, students are ready with their *Anyaman* and ornaments, and the teacher instructs each group to record the starting point and endpoint after they are translated according to the instructions on the worksheet. In Figure 4, students are seen shifting ornaments according to the instructions in student worksheets "Activity 1" and list the coordinates.

Figure 4. Students shifting the ornaments and listing the coordinates (Informal)

The stage of "Model Of"

At this stage, students write the coordinates that have been obtained at an informal stage in a table, as shown in Figure 5.

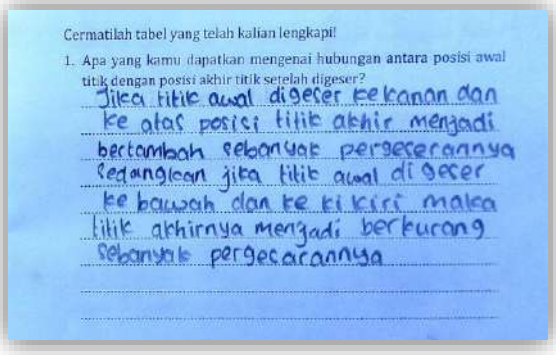
Soal Nomor	Nama Titik	Posisi Awal Titik	Pergeseran				Posisi Akhir Titik
			Ke atas	Ke bawah	Ke kanan	Ke kiri	
2	A	(2,1)	1	0	1	0	(1,2)
	B	(1,1)	1	0	1	0	(2,2)
	C	(1,2)	1	0	1	0	(2,3)
	D	(2,2)	1	0	1	0	(1,3)
3	A	(2,1)	0	1	0	1	(-1,2)
	B	(1,1)	0	1	0	1	(2,0)
	C	(1,2)	0	1	0	1	(2,1)
	D	(0,2)	0	1	0	1	(-1,1)
4	A	(2,1)	2	0	2	0	(2,1)
	B	(1,1)	2	0	2	0	(3,3)

Soal Nomor	Nama Titik	Posisi Awal Titik	Pergeseran				Posisi Akhir Titik
			Ke atas	Ke bawah	Ke kanan	Ke kiri	
	C	(1,2)	2	0	2	0	(3,4)
	D	(0,2)	2	0	2	0	(2,4)
5	A	(2,1)	0	2	0	2	(-2,-1)
	B	(1,1)	0	2	0	2	(-1,-1)
	C	(1,2)	0	2	0	2	(-1,0)
	D	(0,2)	0	2	0	2	(-2,0)

Figure 5. Student work results list the starting and ending points translation results in a table (Model of)

The stage of "Model For"

At this stage, students analyze the change from the starting point to the endpoint and make interpretations related to the concept of translation with their language, as shown in Figure 6.



Cermatilah tabel yang telah kalian lengkapi!

1. Apa yang kamu dapatkan mengenai hubungan antara posisi awal titik dengan posisi akhir titik setelah digeser?

Jika titik awal digeser ke kanan dan ke atas posisi titik akhir menjadi bertambah sebanyak pergeseranya begangkan jika titik awal di geser ke bawah dan ke kiri maka titik akhirnya menjadi berkurang sebanyak pergeseranya

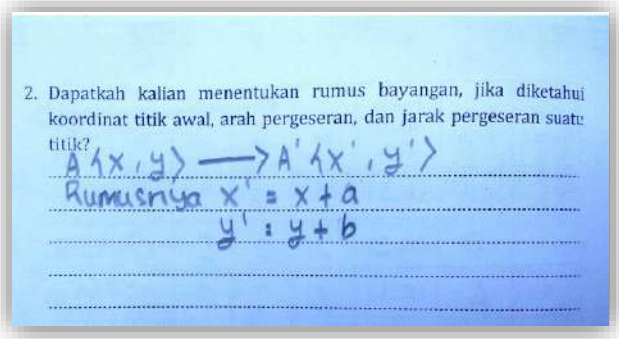
Look at the table that you have completed!
1. What do you get about the relationship between the position of the starting point and the end point after sliding?

If the starting point is shifted to the right and upward, the position of the end point increases as much as the shift, whereas if the starting point is shifted down and left, the end point decreases as much as the shift

Figure 6. Students writing the results of their related interpretations translational concepts in student worksheets (Model for)

Formal Stages

At this stage, students make mathematical modeling in the form of translational formulas according to their understanding. The results of students' mathematical modeling can be seen in Figure 7.



2. Can you determine the shadow formula, if you know the coordinates of the starting point, the direction of the shift and the distance of the shift of a point?

A<x,y> → A'<x',y'>
The formula x' = x+a
y' = y +b

Figure 7. The results of students' mathematical modeling related to the translation formula (formal)

To classify the results of student answers listed in student worksheets, class discussions are needed. Therefore, the teacher invites each group to present their work. In Figure 8, students are performing with the concept of translation.

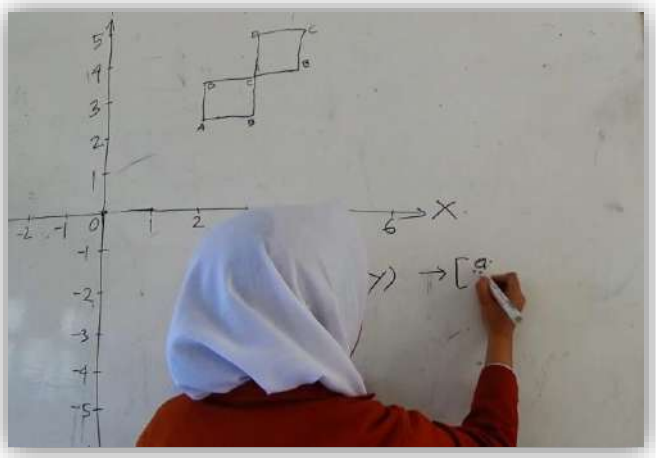


Figure 8. Students are presenting with the concept of translation.

During the discussion process, it seemed that the participants of the discussion were very enthusiastic about expressing their opinions and ideas towards the work done by each group's worksheet. This is caused by the position of the ornamental starting point that is different from each discussion group so that the location of the ornamental endpoint will also be different. Next, the teacher guides students to have a common perception of the concept of translation, that is, if it's a point $A(x, y)$ is shifted to the right by a unit, and up to b unit, the shadow point becomes$A'(x + a, y + b)$, whereas if a point $A(x, y)$ is shifted to the left by a unit and down by b unit, the shadow point becomes $A'(x - a, y - b)$.

Also, some researchers have also made mathematics learning design using IRME approaches and cultural contexts, such as designing reflective learning using the motifs of Batik (Novrika, Putri, & Hartono, 2016), creating rotation learning using the motifs od Batik Kawung (Risdiyanti &

Prahmana, 2018), designing transformation learning using the motifs of Batik Sidoarjo (Lestariningsih, 2017). Therefore, the role taken from the results of this study is to add to the study of the design of mathematics learning, namely designing translation learning using the motifs of *Anyaman Bambu*.

CONCLUSION

Learning trajectories that can support the concept of translation from informal to formal include the activity of recording the starting point and the endpoint, analyzing and interpreting the change of the starting point into an endpoint using one's language, and writing the translation formula. The results of the teaching experiment show that through a series of activities that have been carried out, it can help students understand the translation concept easily, fun, and affordable by students' imagination.

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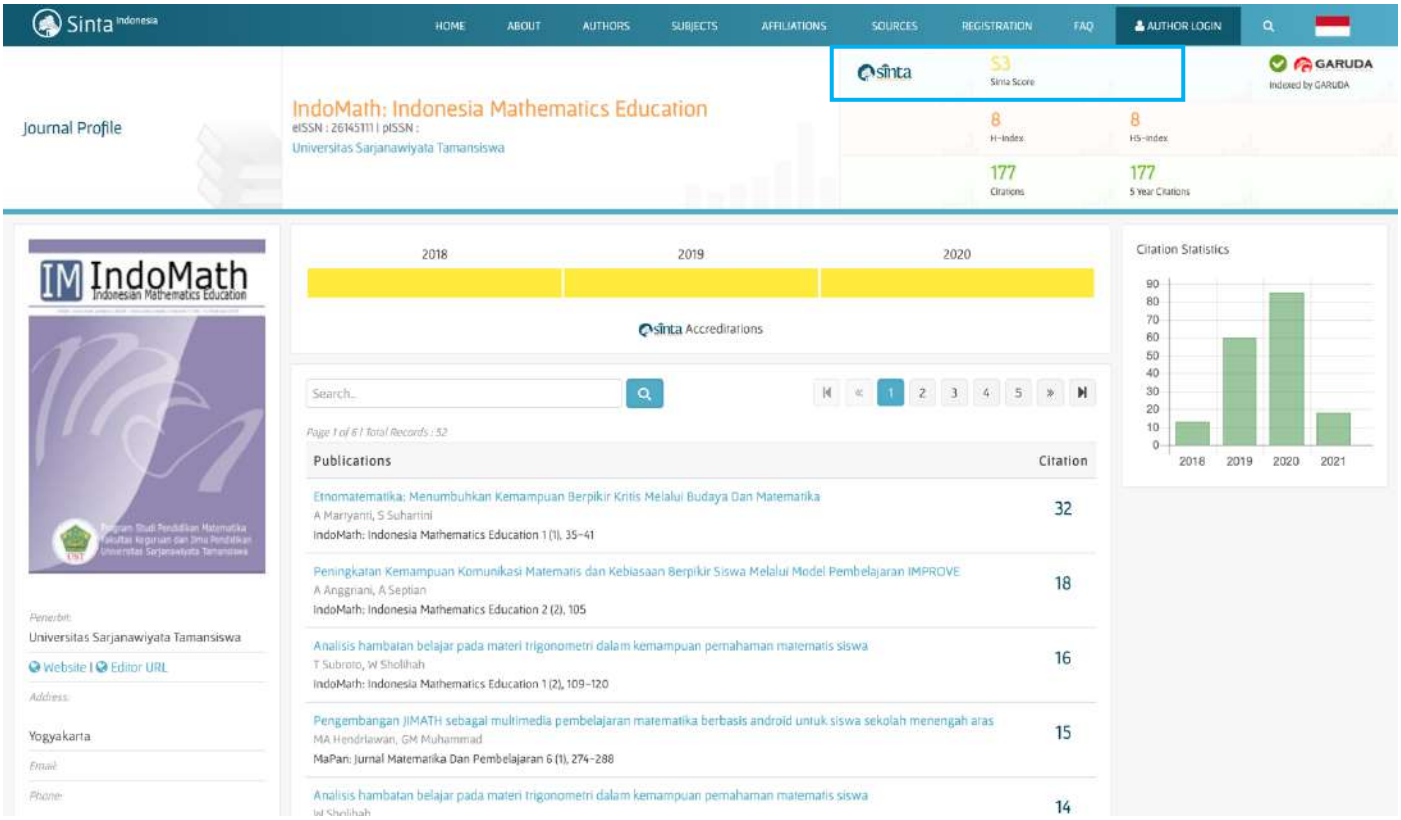

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