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# DEVELOPMENT OF LEARNING TRAJECTORY ON THE SET TOPIC FOR 7TH GRADE IN THE CONTEXT OF *SEDEKAH LAUT* TRADITION

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## *ABSTRACT*

Set is an important topic to be mastered by students because it influences the development of mathematics in daily life. However, many students still have difficulty learning the topic. Therefore, it is necessary to design a learning trajectory using the appropriate approach, context, and media. This research resulted in the learning development using *Sedekah Laut* context to create meaningful learning and increase students' understanding of sets. The method used in this study was design research proposed by Gravemeijer & Cobb with three stages: preliminary design, experimental design (pilot experiments and teaching experiments), and retrospective analysis. However, this article only presented the results from the Preliminary design stage. The participants involved in this study were 7th-grade students of SMP Negeri 6 Semarang. The resulting hypothetical learning trajectory consists of a series of learning processes: observing context videos to find the concepts of sets, non-sets, empty sets, universal sets, and Venn diagrams; explaining the properties of the set; defining set operations; and solving problems related to sets.

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## INTRODUCTION

Set is a topic that forms a basis and foundation in the development of mathematics (Ferreiros, 2008) and has a close relationship in daily life (Manurung et al., 2018). That is, set influences the development of other mathematical materials such as algebra and geometry. Since the set topic is crucial, overseas schools have taught it from the elementary level, but in Indonesia, it has started to be taught at the junior high school level (BSNP, 2006). Although the set topic is essential to learn and master, it is considered difficult for students (Dwidarti et al., 2019).

Difficulties experienced by students in learning the set topic are related to understanding, interpretation, and problem solving (Pratiwi & Khotimah, 2016). In addition, solving contextual problems and using operations that are not the same as operations often used in elementary school are the main difficulties in this topic (Dwidarti et al., 2019). The other is the difficulties in understanding concepts, applying principles and skills. Harahap (2019) research found difficulties in set learning, such as understanding intersection and union problems, drawing Venn diagrams, understanding contextual problems, and converting contextual problems into formal mathematical forms. Based on the explanation above, students' learning difficulties in the set topic can vary widely.

Several factors can affect learning difficulties in the set topic; namely, students have not been able to master the prerequisite topic, such as a lack of understanding of the concept of various numbers (Ratnasari & Setiawan, 2019). In addition, the difficulty in understanding the set topic is contributed by many students who make mistakes in solving set operations (Asnidar, 2014), insufficient practice in solving problems, limited understanding of the topic, inaccuracy in performing set operations, and lack of students' ability to interpret solutions into real contexts. (Adilistiyo & Slamet, 2017). Harahap (2019) stated that two factors influence the difficulty: 1) internal factors, lack of students' interest and motivation; and 2) external factors, nonoptimal use of learning aids.

These difficulties make the learning objectives unattainable. Many teachers have not done the initial design of learning before teaching to create effective, meaningful learning and facilitate students in understanding concepts. Learning design is the main factor in classroom learning activities (Putrawangsa, 2018). From the above problems, it is necessary to design mathematics learning related to daily life (Lestari et al., 2021) with an appropriate approach

for learning mathematics that can generate students' motivation and understanding of the concepts. Wahidin & Sugiman (2014) revealed that one approach applied in learning mathematics is the Indonesian Realistic Mathematics Education (IRME).

IRME is an approach oriented towards the mathematization of experience and is applied in everyday life (~~Hadi, 2005~~) and emphasizes the usefulness of concepts (Wijaya, 2012). IRME, which has been going on since 2001, has five main characteristics (Widyawati et al., 2016), namely the use of context, models, student contributions, linkages, and interactivity, that can facilitate students in understanding the concepts well. The use of IRME in this study is drawn upon the results of previous studies, which revealed that IRME could increase students' motivation in learning (Nursyahidah et al., 2018; Fahrurozi et al., 2018; Hartono et al., 2021), improve students' understanding (Sari et al., 2015), ease students to understand concepts (Fitri & Prahmana, 2018; Lestari et al., 2021), direct students' understanding from the informal stage to the formal stage, and create meaningful learning (Hartono et al., 2021).

Learning with IRME starts from the context used as a starting point and source for learning mathematics (Zukardi & Ilma, 2006). The context used in this approach is not only real objects but also things that can be imagined by students (Afriansyah, 2016). There have been many contexts used in learning mathematics, such as folklore, legends (Widyawati et al., 2016), traditions and habits of society (Farida Nursyahidah et al., 2020; F Nursyahidah et al., 2021), historic buildings (Fahrurozi et al., 2018; F. Nursyahidah et al., 2020; Hartono et al., 2021) and formal forms of mathematics (Puspasari et al., 2015). In this study, the context that will be used is the *Sedekah Laut* tradition of Central Java. The application of tradition for the set topic includes activities carried out in this tradition that can represent the set, and the interest of each activity can be represented in a Venn diagram. There are still many sets sub-topics that can be explored from this tradition. This context provides an opportunity for students to comprehend and cultivate a love of local wisdom that exists in certain regions and can also be used to understand the set topic. Therefore, the context of the *sedekah laut* tradition is suitably used to learn the set topic.

Based on the background described above, the author conducted "Learning Design Using the Context of the *Sedekah Laut* Tradition" research which is a set of learning innovation using a tradition to develop a learning trajectory for mathematics learning.

## METHOD

This study used a design research method to prove learning theories and develop local instructional theory (Nieveen, McKenney & Akker, 2006). This study involved 7$^{th}$-grade students of SMP Negeri 6 Semarang. Design Research consists of three stages (Gravemeijer & Cobb, 2006). First, preliminary design; at this stage, several activities were carried out, such as conducting a literature review to formulate an early learning strategy and examining basic abilities possessed by students. The results of the initial activity were used to formulate a Hypothetical Learning Trajectory (HLT), which contains a series of learning activities such as goals, activities, and student thinking assumptions. Second, design of the experiment, consisting of several activities, namely: 1) pilot experiment, HLT testing on six students with heterogeneous abilities: high, medium, and low; 2) teaching experiment, HLT which had been tested in the previous stage, pilot experiment, was revised and then tested to the research target class. Third, retrospective analysis, analyzing the data obtained in the previous stage to develop designs for further learning activities and Local Instructional Theory. Then, HLT was compared with actual learning to answer the research objectives. Data were collected through observation, research notes, recordings, student work, pretest and posttest results, and interviews. In this article, the researcher only explains the first stage of design research, preliminary design, such as reviewing the basic competencies that students have and need to study the set topic and describing a hypothetical learning trajectory with the context of *Sedekah Laut* Tradition for the set topic. The final result of preparing for the experiment stage was HLT with a series of learning processes in the set topic. In addition, other instruments were also produced at this stage, such as lesson plans, syllabus, a teacher guide, student activity sheets which had been validated by the validator and were feasible to be tested at the experimental design stage.

## RESULT AND DISCUSSION

In the first stage of design research, i.e., preliminary design, the learning design was carried out in several activities, including conducting a literature review by studying previous research related to IRME and design research to formulate initial learning strategies. After that, the researcher examined the basic competencies students have and need to learn the set topic to determine students' understanding of the prerequisite to the topic. Then, the researcher

developed a Hypothetical Learning Trajectory with the context of the *Sedekah Laut* Tradition for the topic, which contained the student learning trajectory, learning activities, objectives, and reflection activities.

***Assessing the basic competencies possessed and needed by students.***

The basic competencies that have been possessed and needed by students to study the set topic are: solving problems involving arithmetic operations on whole numbers, writing symbols of numbers up to two digits that state the number of members of an object collection, sorting numbers up to two digits from the smallest to the largest using concrete objects, explaining and performing arithmetic operations on integers and fractions by utilizing various properties of operations, and solving problems related to arithmetic operations on integers and fractions. The aforementioned basic competencies are the basis for formulating initial learning strategies and knowing students' prerequisite abilities.

***Developing a Hypothetical Learning Trajectory (HLT)***

After conducting a literature review and assessing the abilities students possess and need, the information obtained was used to compile the HLT, which contains a series of learning processes consisting of four activities to create meaningful learning and increase students' understanding of the topic. The following is an explanation of a series of learning processes in the HLT.

***Activity 1***

*Activity Goal*

Determine a group of objects that includes a set, not a set, an empty set, a universal set, and a Venn diagram by observing the context of *Sedekah Laut* tradition.

*Activity Description*

In this first activity, students were given a video with the context of *Sedekah Laut* Tradition as a starting point and learning resource for group material. The videos provide situations that allow students to understand *Sedekah Laut* Tradition and its application to the set topic. Previously, students were given Activity sheet 1 and asked to read the activity sheet first before observing and exploring the video to complete activity sheet 1. Then, students were asked to classify the data obtained into a group according to its type. After grouping, students identified members of the group whether they could be clearly defined/characterized

or not. In this activity, students are expected to understand the concept of a set. After understanding the set, students were given the groups of things existing in the *Sedekah Laut* tradition, then asked to identify which ones are included in the set and non-set. In identifying sets and non-sets, students initially identified group members that can be defined or not. If the members of a set can be defined, then it is said to be a set and preferably. Parts of videos and pictures explored by students in learning sets are presented below.

DAFTAR KEGIATAN / PERTUNJUKAN
SEDEKAH LAUT & BUMI TAHUN 2019
DESA BENDAR KECAMATAN JUWANA

| NO. | HARI | TANGGAL PERTUNJUKAN | JENIS HIBURAN | TEMPAT / LOKASI | JAM |
|---|---|---|---|---|---|
| 1 | Minggu | 9 Juni 2019 | - Lomba Anak - Anak | Depan Balai Desa | 06.30 WIB |
| 2 | Kamis | 13 Juni 2019 | - Houl Syekh Datuk Lodang<br>- Wayang Kulit Dalang "BAYU AJI" | Pulau Seprapat<br>Depan Balai Desa | 13.00 WIB<br>20.00 WIB |
| 3 | Minggu | 16 Juni 2019 | - Prosesi Larung Sesaji<br>- OM. Dangdut<br>- Lomba Perahu dan Tangkap Itik<br>- Barongan Ngablak<br>- Ketoprak | Depan Balai Desa<br>Tepi Sungai<br>Sungai Silugonggo<br>Bendar Utara<br>Depan Balai Desa | 06.30 WIB<br>10.00 WIB<br>10.00 WIB<br>10.00 WIB<br>10.00 WIB |
| 4 | Kamis | 20 Juni 2019 | Dangdut ADELLA Jawa Timur | Bendar Lor | 20.00 WIB |
| 5 | Sabtu | 22 Juni 2019 | Santunan Yatim Piatu<br>( KH. Rhoma Irama ) | Lap. Kendali Sodo | 10.00 WIB |

wartaphoto.net/ revan zaen

Figure 1. Context of *Sedekah Laut*
Source: https://www.qureta.com/post/tradisi-sedekah-laut-dan-kekerasan-atas-nama-tuhan https://wartaphoto.net/2019/05/15/jadwal-lengkap-agenda-budaya-sedekah-laut-dan-bumi-desa-bendar-juwana-2019/

Activity 1 was continued by providing the situation of the *Sedekah Laut* tradition in the form of a context condition see Figure 1. Students are expected to identify each member of the set from the condition of the Sedekah Laut tradition. To introduce the empty set to students, the researcher designed the question by giving a set with no members. At the same time, students are also expected to recognize the universal set from the condition given. This fulfills one of the characteristics of IRME, namely the intertwinement, where each concept relates to another and allows students to learn more than one concept simultaneously. Through worksheets and instructions from the teacher, students are expected to understand empty sets and the universe and define them well. At the end of the activity sheet, students were asked to make a Venn diagram based on the instructions and steps on the activity sheet.

In learning, the teacher acted as a facilitator to achieve learning objectives. Throughout the activity, the teacher asked several questions to determine the students' mindset in doing activities to build interactivity characteristics. The conjecture of students' thinking is explained

as follows.

Table 1. Conjecture of students' thinking in Activity 1

| No | Learning Activities | Assumption |
|---|---|---|
| 1 | Observing context videos | Students can find groups of objects or events<br>• Students are able to understand the concept of set and non-set |
| 2 | Doing Activity 1 | • Students are able to recognize empty sets and universes<br>• Students are expected to be able to draw Venn diagrams from the data provided. |

*Activity Reflection*

In Activity 1 see Table 1, a real context situation is needed by students to imagine and obtain any necessary information to complete Activity 1. In addition, assistance in presenting data in Venn diagrams is needed because most students still inaccurately drew Venn diagrams. The teacher guided and gave direction to students and provided them stimuli to achieve learning objectives.

***Activity 2***

*Activity Goal*

Students are able to explain the properties of sets

*Activity Description*

After students understood the concept of a set in Activity 1, they continued with Activity sheet 2. This second activity began by giving the situation to students through the story of the context of *Sedekah Laut*. Students were asked to identify the set and members of the set from the given context story. Besides, students were given a condition where students analyzed whether the members of a set are also members of other sets to find the concept of subsets. From the two conditions above, students are expected to understand the complement set and the difference between one set and another with a combination of activity sheets. The following is a context story used to help students understand subsets, complements, and differences of sets.

"*Sedekah Laut* is routinely carried out by fishermen every *Muharram*. The offering consists of several elements, such as coconut, goat, snacks, *tumpeng*, and *setaman*. It is also equipped with a variety of fruits. The offerings are floated towards the middle of the sea, a place where fishermen look for fish. At the moment of *larung*, it is hoped to bring blessings to the community, especially for those who rely on life from the sea, such as fishermen. Several fishermen bring offerings in the *larung* offerings ceremony at sea, namely fishermen A, B, and

C. Fisherman A brings *larung* offerings containing goat's head, traditional food, rice, and side dishes. Fisherman B brings an *larung* offering consisting of a goat's head, vegetables, fruit, and palawija. Fisherman C brings an *larung* offering containing a goat's head, a scarf, *jarik*, a bun, and a woman's kebaya."

Based on the given context situation and instructions from the worksheet, students were able to understand the subset, complement, and difference of sets. The teacher provided direction and stimulus to students to achieve the goals in each activity. The stimulus was provided through questions, discussions, arguments, and explanations. This fulfills one of the characteristics of IRME, namely interactivity. The conjecture of students' thinking in Activity 2 is presented as follows:

Table 2. Conjecture of students' thinking in Activity 2

| No | Learning Activities | Assumption |
|---|---|---|
| 1 | Observing context pictures/stories | Students can find several sets and members of the set |
| | Doing Activity 2 | Students are able to understand subsets |
| 2 | | Students are able to understand the complement of sets |
| | | Students are able to understand the difference between sets |

*Activity Reflection*

Activity 2 see table 2 emphasized understanding of the set difference. Good understanding and accuracy are needed to avoid errors in determining the difference in the set. The role of the teacher is essential to guide the students if misconceptions appear from students.

***Activity 3***

*Activity Goal*

Students are able to determine set operations

*Activity Description*

Activity 3 began with giving several sets and their members that are still related to the given context. Next, students were asked to identify members and non-members of the set, according to the instructions on Activity sheet 3. To easily understand and achieve the activity goal, i.e., set operations, students were first requested to draw a Venn diagram from the data provided. Using the Venn diagram, students are expected to be able to determine the same members in several sets and determine all members of all given sets. After that, students will understand the intersection and union of sets through the instructions on the activity sheet and the Venn diagram. In the end, students could conclude the material that has been studied in Activity 3. The following are the assumptions of students' thinking in Activity 3 in Table 3.

Table 3. Conjecture of students' thinking in Activity 3

| No | Learning Activities | Assumption |
|---|---|---|
| 1 | Observing contextual pictures/stories | Students can find several sets and their members and draw a Venn diagram |
| 2 | Doing Activity 3 | Students are able to understand set operations: intersections and unions |

*Activity Reflection*

In Activity 3, students emphasized understanding of operations on sets. Students must understand the operation of intersections and unions thoroughly; thus, there are no errors in solving problems related to set operations. Teachers should always accompany students to get a complete understanding.

***Activity 4***

*Activity Goal*

Students are able to solve problems related to sets

*Activity Description*

After completing the previous activities, students were given Activity 4, namely solving daily problems related to the set material. Students can use the knowledge and experience gained in previous activities to do Activity 4. In this activity, the interactivity between the teacher and students occurred through a discussion which helps investigate students' strategies. One of the problems given in Activity 4 is described as follows.

"There was a group of fishermen consisting of 40 people at the *Sedekah Laut* event. Among them, 15 people took part in the boat racing competition, 13 took part in the duck catching competition, and seven participated in both. How many fishermen did not participate in boat racing or duck catching?"

The conjecture of students' thinking is illustrated as follows in table 4.

Table 4. Conjecture of students' thinking in Activity 4

| No | Learning Activities | Assumption |
|---|---|---|
| 1 | Doing Activity 4 | Students are able to solve problems related to sets. |

*Activity Reflection*

In Activity 4, students focused more on understanding questions, interpreting questions, and solving problems with guidance from the teacher. In this activity, students applied their knowledge from the previous activities.

Each activity ended with a presentation by one of the groups to show their ideas and strategies in completing the activity while other students were allowed to respond. Based on

the explanations above, it can be summarized into a chart containing a series of activities in an HLT as follows.

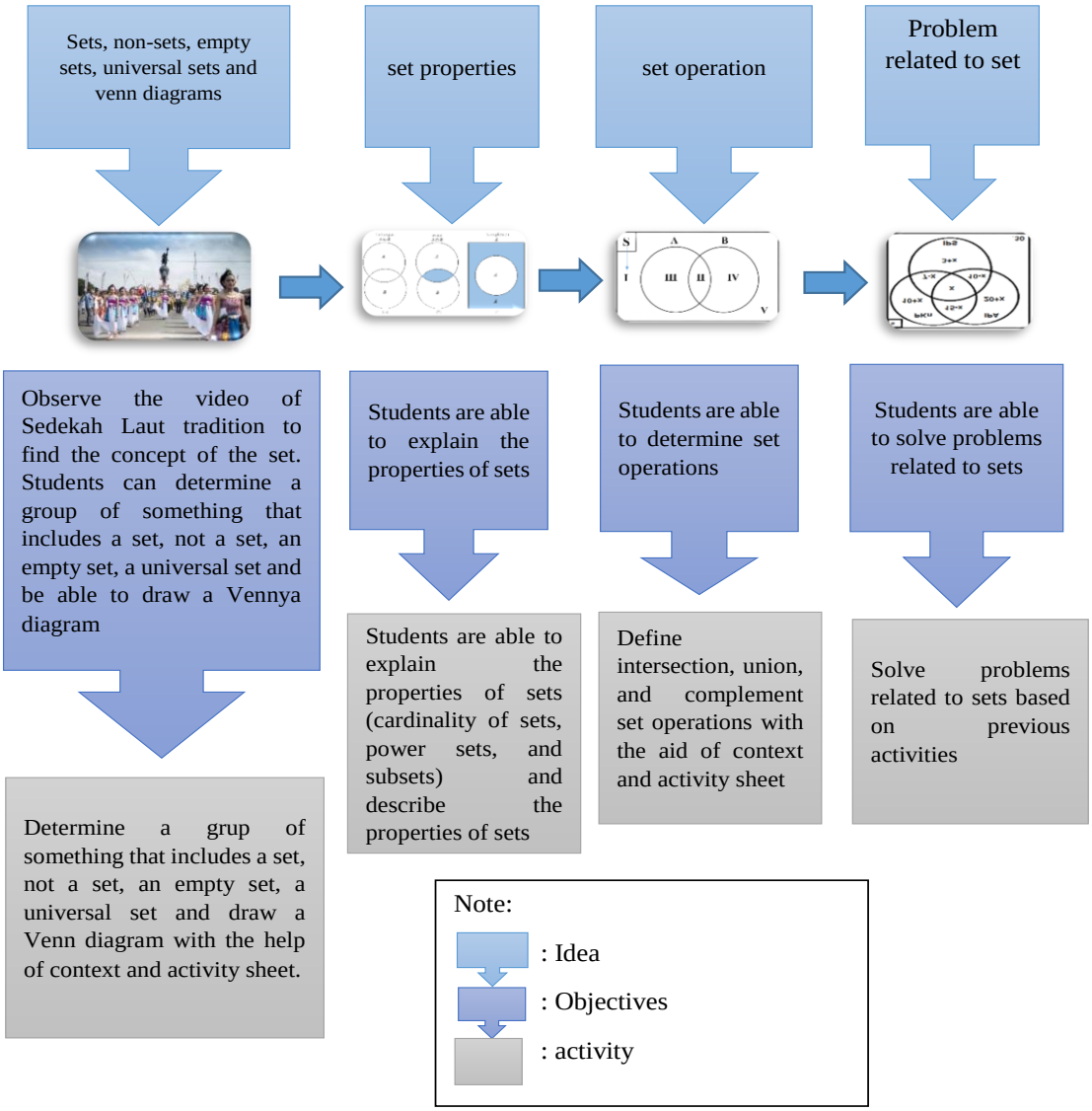


Figure 2. HLT of Sets

Based on Figure 2 the results that have been described, in the first stage of the design research, several activities were carried out, such as literature review, reviewing the basic competencies possessed and needed by students for the set topic, and compiling an HLT. In preparing the set learning design, it is adjusted to the five characteristics of IRME (Widyawati et al., 2016). First is the use of context; the context used in this study is *Sedekah Laut* Tradition, which can be used as a starting point to introduce the set concept to students.

Zukardi & Ilma (2006) suggested that in the learning process, context can be used as a starting point to understand the material. Second is the use of models; students used modeling of informal information from the context to formal mathematics. Similarly, Nursyahidah et al. (2021) conveyed that the use of the model to bridge informal to formal information with four levels: situational, referential, general, and formal level. The third is student contribution; students were given the freedom to explore the context and express ideas when answering questions during the learning. All opinions, questions, ideas, and answers are greatly appreciated. The fourth is interactivity; in this design, there are several forms of interactivity, such as discussion, explanation, responses, collaboration, and evaluation. The fifth is intertwinement; each activity carried out by students was interrelated, allowing them to learn more than one concept at once.

The learning design is expected to facilitate students in understanding the set topic from the informal stage to the formal stage. By using the context of the *Sedekah Laut* Tradition, students can find and construct an understanding of the concept of set and create meaningful learning. This idea follows (Nursyahidah et al., 2021), which suggests that the traditional context can be used in the mathematics learning process to support meaningful learning. Learning sets by employing a learning design that adapts to IRME can stimulate students to understand the concept of the lesson. Several studies also suggest that learning with appropriate contexts will create meaningful learning, understand concepts, and motivate students (Nursyahidah et al., 2021). This series of activities resulted in a hypothetical learning trajectory through four activities: observing context videos to find the concepts of sets, non-sets, empty sets, universe sets, and Venn diagrams; explaining the properties of sets; defining set operations; and solving problems related to sets.

## CONCLUSION

In this study, a Hypothetical Learning Trajectory was produced on the set topic using the *Sedekah Laut* tradition context to facilitate students' understanding of the topic and create meaningful learning. Hypothetical Learning Trajectory consists of a series of processes in four activities: observing context videos to find the concepts of sets, non-sets, empty sets, universe sets, and Venn diagrams; explaining the properties of sets; defining set operations; and solving problems related to sets. Since the article only discusses the preliminary stage, the product produced is an HLT that is later tested in the pilot and teaching experiment stage.

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