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Learning Circle Using Gobak Sodor Game Context In Eighth Grade

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Abstrak

Penelitian ini memiliki tujuan untuk menghasilkan sebuah lintasan pembelajaran yang dapat membantu peserta didik memahami konsep lingkaran dengan menggunakan pendekatan Pendidikan Matematika Realistik Indonesia (PMRI). Penelitian ini mengambil konteks dari permainan tradisional "gobak sodor" yang berkembang dari bentuk informal menjadi bentuk formal. Metode penelitian yang digunakan adalah penelitian design research yang melibatkan tiga tahap, yaitu persiapan untuk eksperimen, perancangan eksperimen, dan analisis retrospektif. Penelitian ini dilaksanakan di kelas VIII salah satu SMP Negeri di Palembang dengan melibatkan 34 siswa. PMRI yang menjadi dasar bagi konteks dan aktivitas pembelajaran dalam penelitian ini. Pengumpulan data melibatkan pengambilan hasil kerja siswa, wawancara, dan observasi yang dianalisis secara deskriptif. Hasil penelitian menghasilkan sebuah lintasan pembelajaran yang mendukung pemahaman konsep lingkaran dari bentuk informal ke bentuk formal, yang melibatkan satu aktivitas bermain "gobak sodor," pengumpulan data melalui pengamatan dan pengukuran, serta interpretasi data dan pengamatan. Hasil dari kegiatan pembelajaran menunjukkan bahwa serangkaian aktivitas yang dilakukan dapat membantu peserta didik memahami konsep lingkaran.

Kata kunci: Design Research, Gobak Sodor, Lingkaran, PMRI

Abstract

This research aims to produce a learning trajectory that can help students understand the concept of circles using the Indonesian Realistic Mathematics Education (PMRI) approach. This research takes the context of the traditional game "gobak sodor" which developed from an informal form to a formal form. The research method used is a research design that involves three stages, namely preparing for the experiment, experimental design, and retrospective analysis. This research was carried out in eighth grade class in one of Junior High School in Palembang involving 34 students. PMRI is the basis for the learning context and activities in this research. Data collection includes taking student work results, interviews, and observations. The results of the research produced a learning trajectory that supports understanding the concept of circles from informal to formal form, which involves one activity of playing "gobak sodor," collecting data through observation and measurement, as well as interpreting data and observations. The results of the learning activities show that the series of activities carried out can help students understand the concept of circles.

Keywords: Circle; Design Research; Gobak Sodor, PMRI

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INTRODUCTION

Mathematics is the queen of knowledge and is needed in everyday life. Several branches of mathematics, one of which is circle. According to (Emilya et al., 2010; Nizar et al., 2016) stated that The circle is a common material frequently utilized in our daily routines.

The concept of a circle was important for students because if the concept of a circle had been mastered by students, students will easily understand other materials such as curved side spaces (Rikanah & Winarso, 2016). The correct understanding of the concept of a circle is essential to enable students to effectively tackle problems related to this geometric shape (Azizah, 2013). According to the 2013 curriculum in Indonesia, circle-related lessons are incorporated into the syllabi for grades 5, 6, 8, and 11. Proficiency in grasping and comprehending the concept of circles holds great significance, not only as a mathematical topic but also due to its practical applications in everyday life. Mastering the concept of circles, along with articulating its connections to other mathematical concepts, aligns with one of the primary goals of learning mathematics (Kemendikbud, 2014). According to (Bruner, 1966; Tjiptiany et al., 2016) stated that the learning process can be effective and innovative when educators create chances for students to discover concepts.

The importance of providing mathematics subjects to all students from elementary school, middle school, to higher levels of education cannot be denied. This aims to provide benefits to students in developing logical, systematic, analytical, critical and creative thinking abilities, in addition to the ability to work together (Bernard, 2015; Manalu et al., 2020). Even though mathematics has a very important role, unfortunately, many students find estimating difficult and scary, as expressed by (Yusuf & Fitriani, 2020). The main reason mathematics is difficult is because there are many formulas that have to be memorized. Among the many topics that are considered difficult, one of them is geometry. Geometry is an integral part of mathematics and has strong relevance to everyday life. According to (Nur'aini et al., 2017), geometry is one of the branches of mathematics that is considered the most difficult compared to other branches. One of the geometry topics that has significant application in everyday life is circles, so it is important to teach it to students so that they can apply the concept of circles to solve everyday problems. However, in reality, students often still have difficulty understanding the concept of circles properly. This can be seen from the mistakes that often occur when they work on questions regarding the circumference and area of circles, in particular. According to (Lestari et al., 2016), errors that commonly occur among students when solving word problems about the circumference and area of circles can be divided into four types: (1) context errors, namely errors in applying the circle formula; (2) factual errors, namely errors in arranging the unit area of a circle and making final conclusions; (3) principle errors, namely errors in interpreting the questions; and (4) procedural errors, namely student errors in calculating multiplication and exponentiation. In schools, the teaching of circles often involves presenting concepts and formulas to students without actively engaging them

in the process of discovering these concepts themselves (Lakare, 2015). According to (Zulkardi, 2006) mathematics learning could become more meaningful and captivating for students when teachers introduce contextual and practical problems, specifically those that are familiar and relevant to students' everyday lives.

The game possessed an entertaining aspect that could serve as a source of motivation for students in their learning journey, resulting in an enhancement of students' comprehension of the concepts embedded within the game (Nizar et al., 2018a, 2018b; Wijaya, 2008). Gobak Sodor is a traditional Indonesian game. According to (Ekawati et al., 2015) The game of "Gobak Sodor" can help foster cooperation among participants. Furthermore, such games can also enhance students' mathematical skills (Ariyanti & Muslimin, 2015). In addition, according to (Fad, 2014) the game of Gobak Sodor can also contribute to the development of dexterity and leadership skills among its participants. Gobak Sodor is one of the traditional games most often played by children because this game really demands cooperation both when being a guard team and an attacking team (Shobikhah & Sari, 2024). In the Gobak Sodor regulations, when they are a guard team, the limit allowed to catch an opponent is to stretch both hands to the maximum. This stretching of both hands to the maximum when being on the guard team is used as a concept in understanding circle material.

Teaching by simply providing formulas without engaging students in active thinking and problem-solving can be less effective because it may not encourage students to develop a deep understanding of the underlying concepts. Encouraging students to think critically and apply their knowledge is often a more effective approach to learning (Atmojo, 2013). Whereas according to (NCTM, 2000) students in order to understand a concept of learning mathematics, the learning process must be meaningful for students. To attain profound learning in mathematics, the focus of mathematics education should be on nurturing the ability to establish connections between different mathematical concepts, grasping the interrelationships among mathematical ideas to construct a holistic understanding, and applying mathematical principles in real-world contexts beyond the realm of mathematics itself. Utilizing contextual examples in mathematics education necessitates teachers to demonstrate innovative and creative thinking in identifying real-world situations that align with the subject matter being taught.

One of the educational approaches that consistently incorporates context relevant to the material in each activity is the Indonesian Realistic Mathematics Education (*Pendidikan Matematika Realistik Indonesia* or PMRI). According to (Jayanti et al., 2023; Zulkardi et al., 2020; Zulkardi & Putri, 2010) PMRI is an educational theory that commences with tangible,

real-life experiences of students. It places significant emphasis on nurturing process skills such as 'engaging in mathematical activities,' encouraging discussion and collaboration, promoting peer argumentation, enabling students to discover concepts independently (student-led discovery), and ultimately applying mathematical knowledge to solve problems, both individually and in group settings. According to (Putri, 2014) The PMRI (Pendidikan Matematika Realistik Indonesia) approach was aligned with the 2013 curriculum, where Mathematics should be closely linked to students and pertinent to their everyday life situations. The circumstances of a student's life extended beyond their immediate reality and encompassed everything they could envision, exploring the bounds of their imagination.

Eighth-grade students in Junior High School are typically teenagers, with an average age ranging from 13 to 14 years old. According to (Widyastuti, 2009), from a social perspective, adolescents aged 13-14 years often seek to assert their independence from family authority and establish their own identity. They tend to prefer socializing with their peers. Given this psychological development characteristic, the researcher believed that the Gobak Sodor game, which is typically played in groups, could effectively fulfill students' desire to socialize with their peers.

Based on the explanation above, the researcher intended to produce a learning trajectory that could help students understand the concept of a circle with the PMRI (Pendekatan Matematika Realistik Indonesia) approach using the context of the Gobak Sodor game that developed from an informal to a formal form.

METHOD

This research was included in the DR research (Design Research). Design Research was research that aims to develop theoretical instruction about student learning activities and to develop teaching materials designed to support learning activities (Plomp et al., 2013). Design research also aimed to design an innovation in education (Eerde, 2013). In this study, design research was used to design circular learning materials with the Indonesian Realistic Mathematics Education (PMRI) approach using the context of the Gobak Sodor game.

Design research in its implementation has a cyclic (repetitive) process in its development (Eerde, 2013). There are two cyclic processes in Design research, namely Macro and Micro. The Macro cycle consists of three stages, namely: Design, Teaching Experiment, and Retrospective Analysis. Micro cycle refers to a collection of problems and activities during learning (Akker, 2006) . The illustration of the cycle proposed by Akker could be seen in the Figure 1 below:

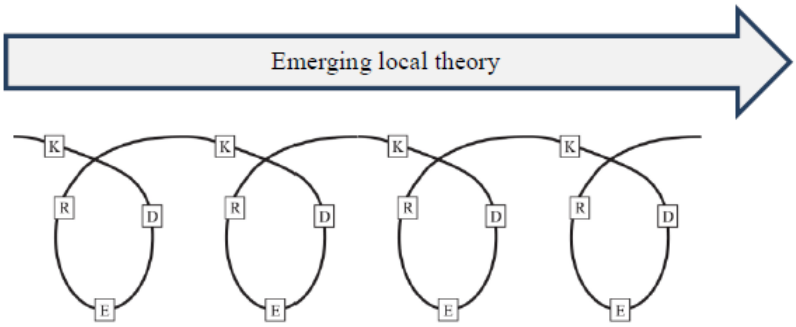


Figure 1. Cyclic process of knowledge, design, experimentation, reflection, and new knowledge

The subjects in this study were eighth grade students of State Junior High School in Palembang involving 34 students. Collecting data through collecting student work, interviews, observations. Data analysis techniques are descriptive.

RESULTS

The study took place at Junior High School in Palembang. Researchers took a sample of 1 class, namely class VIII, totaling 34 students. This research went through three stages, namely Preliminary Design, Design Experiment and Retrospective Analysis. In the Preliminary Design stage, the researcher designs the equipment used for the research which consists of HLT, LKPD, Teacher's Guide, lesson plans, pre-test questions, post-test questions. The following is the HLT designed by the researcher in Figure 2.

In the design experiment stage, it consists of pilot experiment and teaching experiment**.** At the teaching experiment stage, it was carried out in class VIII.9 which consisted of 34 students divided into 6 groups so that each group consisted of 5 or 6 people. The division of groups based on students' abilities, each group consisting of students with high, medium and low abilities. The learning process takes place starting with the activity of playing Gobak Sodor and working on the LKPD. In this initial activity, students who have been divided into 6 groups play Gobak Sodor. Groups 1,2, and 3 are groups where all members are male and groups 4,5, and 6 are all female members. Before playing Gobak Sodor in the field they were given instructions in class and a game rule sheet.

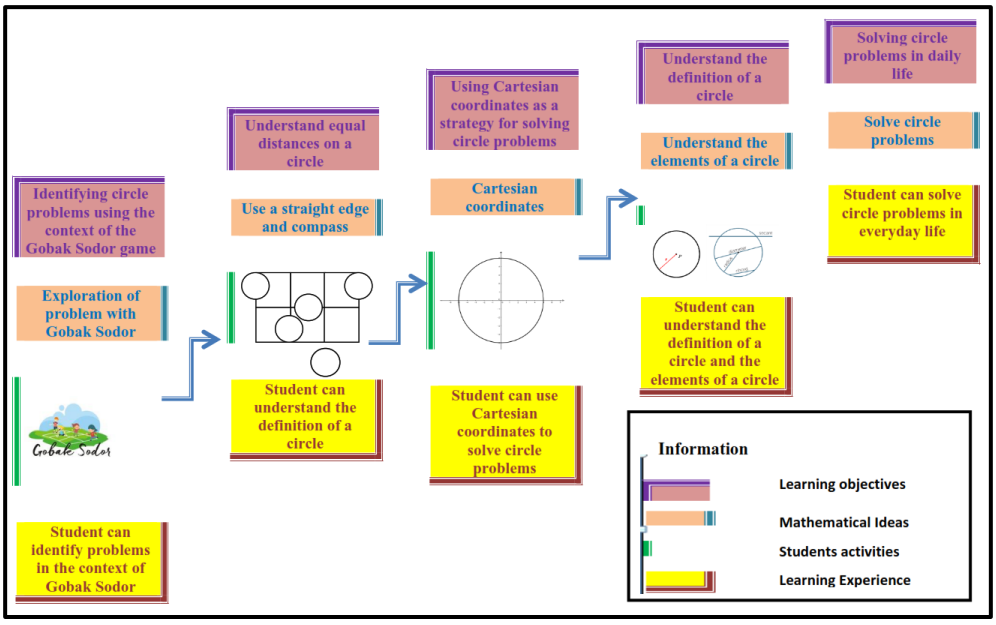


Figure 2. HLT (Hypothetical Learning Trajectory)

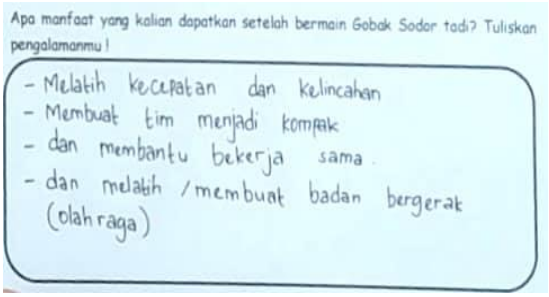
Gobak Sodor game consists of 4 matches. Match 1 is group 1 against group 2, Match 2 is the group that wins in match 1 against group 3, Match 3 is group 4 against group 5, Match 4: the group that wins in match 3 against group 6. In the picture below, it looks like students are playing Gobak Sodor with the referee being the teacher himself.

Figure 3. Students playing gobak sodor

To direct students to the concept of a circle, the teacher asks students when they are a group of guards to stretch their arms maximally.

Figure 4. Guard stretches maximum hand

After playing Gobak Sodor the students returned to class and did the LKPD. It begins by answering the question "what are the benefits after playing Gobak Sodor?"



Translated into English

What benefits did you get after playing Gobak Sodor? Write your experience!

- Train speed and agility
- Make the team united
- and help work together
- and train/make the body move (sports)

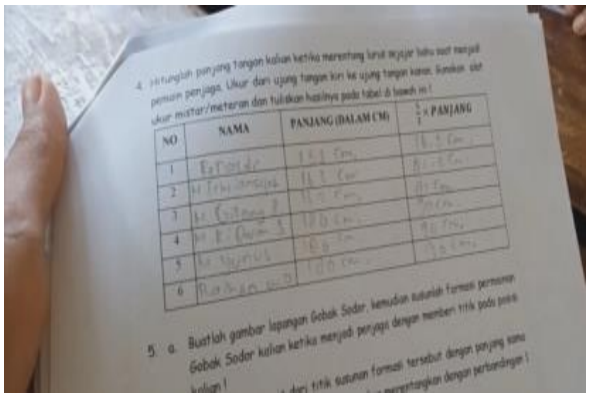
Figure 5. Answer from student

From the students' answers that the benefits of playing Gobak Sodor can train speed and agility, make the team compact, help work together, and make the body exercise.

One of the activities of the LKPD is measuring the length of the hand when being a guard in playing Gobak Sodor. In the picture below, it appears that students are measuring in several ways, some are using a tape measure, a wooden ruler and a plastic ruler.

Figure 6. Student measures hand length

After measuring the length of their hands in various ways, they write the results in the LKPD



Translated into English

4. Calculate the length of your arms when stretched straight out parallel to your shoulders when playing guard. Measure from the tip of your left hand to the tip of your right hand. Use a measuring ruler/meter and write down the results in the table below!

Number	Name	Length (In cm)	$\frac{1}{2}$ ×Length
1	Renaldi	153 cm	76,5 cm
2	M. Febriansyah	163 cm	81,5 cm
3	M. Gilang P.	163 cm	81,5 cm
4	M. Ridwan S.	180 cm	90 cm
5	M. Yunus	180 cm	90 cm
6	Raihan W.D.	180 cm	90 cm

Figure 7. Students write measurement results

The next activity is to make a picture of the Gobak Sodor field and make the range of the guard players based on the table that has been filled.

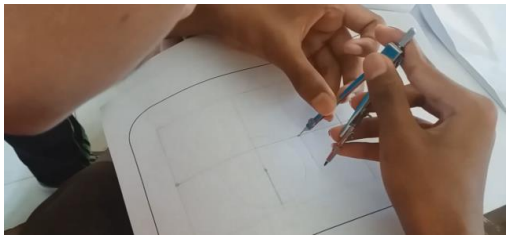


Figure 8. Students create reach area

After working on the LKPD, the group representatives came forward for presentations and the other groups responded.

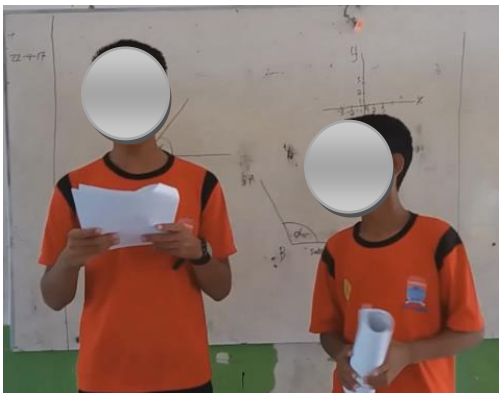


Figure 9. Presentation student

When presenting, they read the results of their group discussion from the beginning to the conclusion. Students were able to make conclusions about the definition of a circle. By using the context of gobak sodor they can learn about circles.

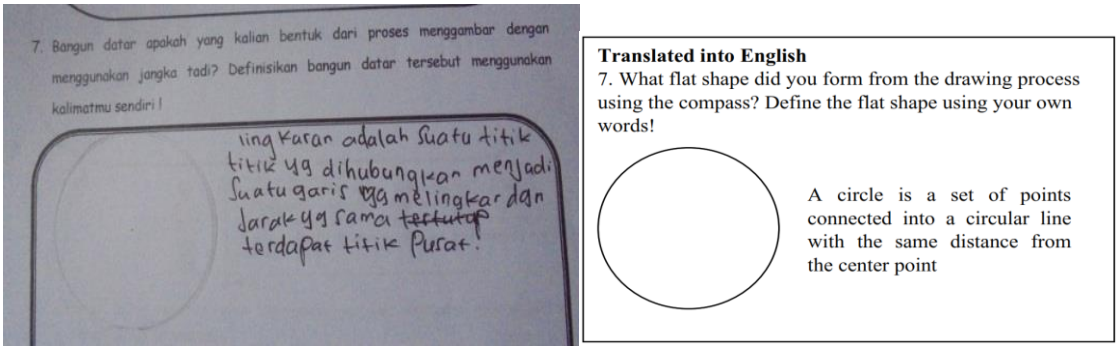


Figure 10. Student make conclusion

DISCUSSION

The implementation of PMRI with the Gobak Sodor game as a context for learning the concept of a circle was as follows: The first Use of Context, namely learning mathematics was seen as a daily activity, so that it solves problems life problems faced or experienced by

students. By using the context of the Gobak Sodor game, students are directly involved actively to play the game but can also grow students' motivation and interest in learning mathematics, besides that it can make students healthy because the Gobak Sodor game is a traditional game that requires speed and agility. The second, the use of models, namely the model in realistic mathematics was a connecting bridge from the situation/context to the formal stage of mathematics through the mathematization process. Students write their answers on student worksheets so that they can determine the concept of a circle through measurements and cartesian coordinates. The third, Utilization of student construction results, namely under the guidance of the teacher, students were provided with opportunities to explore mathematical concepts. With the teacher's support, students were able to grasp the concept of a circle, and they were encouraged to independently develop their problem-solving strategies, leading to the emergence of diverse approaches. Of the various strategies used by students, students will realize for themselves which strategy is the most effective in solving a problem, especially in determining the concept of a circle. The fourth, Interactivity between students and teachers, namely the form of interaction can be in the form of discussion, giving explanations, communication, cooperation and evaluation. In this study, the learning process is student-centred (Student Center Learning) so that interactions between students and teachers occur. This could be seen from the activities that students did in the LKPD work and at the presentation stage. The fifth, Intertwinement (linkage), which is making connections between topics or between subjects, because basically mathematical concepts are not partial, many mathematical concepts are related. The context and activities designed in this study are not only related to the concept of a circle, but also have a close relationship with the measurement material, lines, and angle segments.

This research also reflects the three principles of PMRI in the learning process those are guided reinvention, didactical phenomenology, and self-developed models (Rahmawati & Ranti, 2021; Zulkardi & Putri, 2010). The first Guided reinvention and progressive mathematizing. In line with this principle, students in the process of learning the concept of a circle were afforded the chance to undergo a similar process where mathematics was discovered with the guidance of the teacher, employing the context of the Gobak Sodor game. The second Didactical phenomenology. Didactical phenomenology of mathematical concepts is an analysis was conducted on mathematical concepts in conjunction with their connection to other intriguing phenomena. The challenge in applying this principle lies in identifying phenomena that can be correlated with mathematical concepts. In this particular research, the game Gobak Sodor was utilized as the phenomenon to facilitate the learning of the circle

concept. The third Self – developed models. Students developed models from informal situations to the formal stage. This could be seen when students measure the length of their hands when they were guards and present them in the form of Cartesian coordinates.

The circular learning trajectory using the context of the Gobak Sodor game produced in this study includes learning activities, namely starting from playing the Gobak Sodor game, then measuring the length of the hands when being a guard group then continuing by drawing the range area of the guard group on the Gobak Sodor field. In the informal stage, the result of playing the game of Gobak Sodor, namely the movement of the guard group to stop the attacking team, is used as a reference to assist students in comprehending the circle concept. By using the movement as a guard group, students can immediately determine their coverage area. The use of movement as a guard group could be a means for students to describe Cartesian coordinates and extend the coverage area. Then the movement as a guard group could be a bridge of student knowledge to the next stage. At the formal stage, students were guided to grasp the concept of a circle.

By using the traditional game gobak sodor, students can train students to learn circles. This is in line with research (Kamsurya & Masnia, 2021; Muslimin et al., 2012; L. R. Widyastuti et al., 2020) which uses traditional games to improve students' mathematics learning outcomes.

CONCLUSION

HLT that was implemented in this study has evolved into a Learning Trajectory capable of enhancing students' comprehension of the circle concept. A meaningful and fun learning experience was provided by learning circle using the context of Gobak Sodor proved to be effective in facilitating students' comprehension of the circle concept. The learning trajectory employed in this research represents a valuable contribution to the advancement of Local Instructional Theory (LIT) within the circle's learning domain. Researcher suggests that teachers can apply learning of circle using Gobak Sodor game context, so that mathematics learning so far can take place more varied.

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