Advances in Social Science, Education and Humanities Research, volume 417
2nd International Conference on Education and Social Science Research (ICESRE 2019)

Didactic Design of Geometry Learning: A Congruent Case

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ABSTRACT
The obstacles in learning geometry are especially the concepts of congruence and harmony that students often experience. The type of obstacle is that students do not understand the difference between the concept of congruence and the harmony of a two-dimensional figure. Another obstacle is that students often find it difficult to imagine that the similarity of triangles applies to all types of triangles. Difficulties experienced by students, especially in understanding the concept of "side" and the concept of "angle". Students often cannot distinguish that two congruent flat shapes are not necessarily congruent and two congruent flat shapes are not necessarily congruent. The purpose of this research is to make a didactic design on congruence and harmony. The research method used is a mixed-methods. Specifically this research includes making a design, following the three stages of the Didactical Design Research (DDR) namely didactic situation analysis before learning (prospective analysis), methadactic analysis and retrospective analysis. Furthermore, based on students' learning obstacles designed mathematics learning with a realistic approach to mathematics education.
Keywords: *learning obstacles, congruent, realistic mathematics education*

1. INTRODUCTION
Geometry is one branch of mathematics that deals with statements of shape, size, relative position of images and the nature of space. Mastery of necessary geometric abilities, skills in proving, both students and teachers must possess skills in painting basic geometry, logic, and applications. Mistakes that often occur when students are confronted with geometry problems are concept errors, principle errors, and operating errors. These mistakes result in low learning outcomes in solving congruence problems at each step of the process [1]. The error will also increase if students give inaccurate information when working on congruence problems. The dominant interaction that occurs in the classroom is the interaction between students. It is likely for students who lack the concept of congruence to give incorrect information to their peers [2].

Classahan mistakes that occur cause a barrier to student learning. There are three types of obstacles that were found related to the topic of congruence discussion; the first is the obstacle in visual ability, then the obstacle in identifying and comparing the corresponding sides, and the obstacle in connecting the concepts needed [3]. The concept of congruence requires students' ability to identify the corresponding sides in solving problems. The role of the teacher must be improved; one of the ways is by creating a fun learning design without ignoring the students' understanding of concepts.

The results showed that deductive design could improve students' understanding of concepts [4]. Increased understanding of students' concepts of the material provided, even students can find patterns for fraction operations [5]. Besides improving students 'understanding of the concept of deductive design, it is also able to improve students' mathematical communication [6]. Where before using didactic designs students were not able to classify flat shapes, after deductive designs were made students were able to group them, even were able to mention, write and were able to make a flat shape.

The role of the teacher must be improved; one of the ways is by creating a fun learning design without putting aside students' understanding of concepts [7], [8]. There are already many who prove that the results of applying DDR in the classroom can improve student understanding. DDR begins with an analysis of learning obstacles (student learning barriers) including; ontogenic obstacle, didactical obstacle, and epistemological obstacle.

The ontogenic obstacle is a condition where a student should be able to think abstractly, but in reality, he is not able. A didactical obstacle is a situation where students have not been able to accept concepts well. This happens because of several factors including; curriculum factors, teaching materials, environment, teacher's ability to manage learning, learning methods. Obstacle epistemological is a condition where students are only able to work on problems in the same context as what the

teacher explained, but when using different contexts students have difficulty working on the problem.
From the description above shows that it is necessary to design a Didactic Research (DDR) design on the congruence and alignment of flat fields.

2. METHODS

The purpose of this research is to make a didactic design on congruence and harmony material so that this research is included in the didactic mathematical research. Specifically, didactical mathematical research was conducted to create a didactic design (DDR). The DDR has three stages, namely didactic situation analysis before learning (prospective analysis), methadactic analysis and retrospective analysis. This DDR tends to make designs from a qualitative point of view.
The instruments in this study were data collection including (1) a set of diagnostic test questions to diagnose student learning barriers at the didactic situation analysis stage before learning; (2) a set of questions for pretest and posttest. The study was conducted following a modified DDR procedure with the addition of pretest and posttest.

2.1. Metaphorical notation analysis

Hypothetical didactic designs that have been made need to be trialled in classroom learning (experiments) to find out what happens. Based on trials, it can be seen the responses that arise and the anticipations made. This is to confirm what is predicted and reality. The result can be used as consideration for design revisions. The design process is the most essential activity in this study, but it is also essential that the erased design can lead students to achieve learning objectives. In this case, the new design can be said to be effective.

2.2. Retrospective Analysis

The first activity carried out in a retrospective analysis was to analyse the interrelationship between plans and implementation related to teaching materials, ADP and its scenario. The second activity is analysing the likelihood of learning obstacles appearing. Third, analysing the achievement of learning objectives in terms of the results of the pre-test and post-test. The results of these three steps are used to revise the hypothetical didactic design so that it becomes an experimental didactic design.

3. LITERATURE REVIEW

Two flat shapes are said to be congruent if they have the same shape and size, the corresponding sides are the same length, and the corresponding angles are equal. Two triangles are said to be congruent if they meet one of the conditions: firstly the three pairs of sides that correspond to the same length (sides), the two pairs of sides that correspond to the same length and the angle between them is equal (the sides of the sides), the third two pairs the corresponding angles are equal and the sides connecting the two angles are the same length (angles-sides), or the four two pairs of angles that correspond equally and match the sides of the corresponding lengths (angles). Especially for right-angled one-sided right elbows. Illustration of a congruent right triangle can be seen in Figure 1

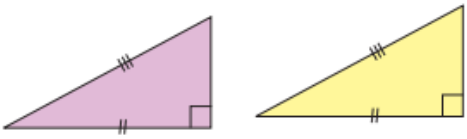

Figure 1 Congruent right triangle

Two flat fields are said to be congruent if they have the same shape. The two flat conditions are said to be congruent: first, the ratio of the corresponding side lengths is worth $(\frac{AB}{EF} = \frac{BC}{FG} = \frac{CD}{GH} = \frac{AD}{EH})$, and the corresponding angle is the same. Illustration of many congruent flat shapes can be seen in Figure 2.

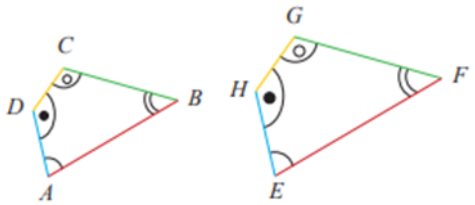

Figure 2 Dimension two are congruent

4. DISCUSSION

Given an equilateral triangle as in Figure 3. If the values of a, b, c, and d, find the value f.

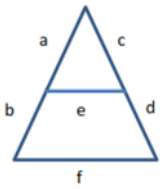

Figure 3 Equilateral Triangle

Analysis of student answers showed that some students still say that the value of “f” is obtained from the relationship "a / c = e / f". This answer was not the desired answer as the correct answer. Thus there was a problem why most students answer so. This student answer error arises because of didactical obstacles and ontogenic obstacles. Ontogenic obstacles arise because students feel able and able to solve these problems, but when writing

the results of their thoughts on paper, the answer is not right. Meanwhile, Didactical obstacles occur because students do not understand the concept of congruence. He did not ask questions with other students or with his teacher. So the answers that students wrote on the paper were not correct. Student mistakes in answering are more Didactic rather than pedagogical. Students can express their opinions in oral or written form, but the answer is still wrong. Students can do various ways to find answers to the questions above, including by using paper and sticking with different colours and separated as in Figure 4. Furthermore, the results of the separation were confirmed with the original object. This shows that there are obstacles in learning students, in this case the ontogenic obstacles.

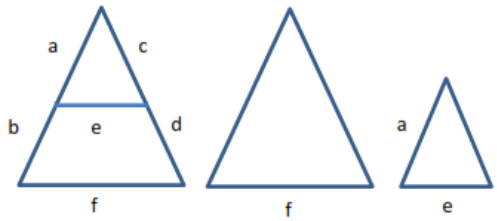

Figure 4 Students separate the triangle

In the case of other mathematical problems. When students are given the task of observing a photo in the frame in their class, as in Figure 5, the photo in the frame will look the same as what happened. For example, there is a picture of a car. The car must be exactly the original. The difference is in size. The original car is not possible in the frame. Thus the image of the car in the frame is reduced in size. The similarity is essentially a reduction or enlargement process of an object of a specific size. So, the comparison of the elements that have changed with the original one has the same value.

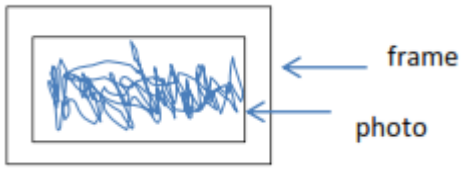

Figure 5 Photo in the frame

By using the concept of congruence concerning the corresponding sides and the corresponding angle of the angle, the size of the photo in the frame will be obtained, as in Figure 6.

Figure 6 Congruent

The problem of photo size in the frame in Figure 5 is a problem that is often found by students. However, it was found that students still did not understand this problem. Mathematical problems in flat areas will be easy to solve, as in Figure 7.

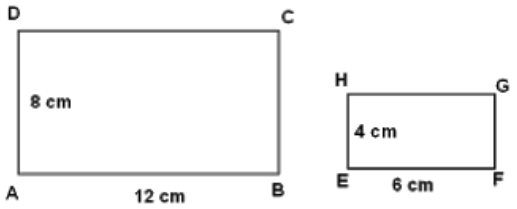

Figure 7 Congruent

In Figure 7, there are ABCD and EFGH squares. The AB side corresponds to the EF side, while the AD side corresponds to the EH side. By using the corresponding side-by-side relationship, we got:

$$EG/B=6/12 = 1/2, \text{ and}$$
$$EH/AD = 4/8 = 1/2.$$

Students have difficulty solving problems as in Figure 5. Whereas to solve problems in Figure 7, students have no difficulty. This shows that some students in the class experience obstacles in learning. Students have difficulty solving mathematical problems when the context of the problem is transformed into a form of a problem story. This learning obstacle is included in the category of epistemological obstacles.

5. CONCLUSION

Student mistakes in solving math problems caused by learning obstacles. Student mistakes in answering the problem of didactic congruence. This means that students can provide solutions to congruence problems, but the students' answers are less precise. This error is caused by students' learning obstacles, namely ontogenic obstacles, didactic obstacles, and epistemological obstacles. Thus learning the concept of congruence in the classroom does not only pay attention to theories that are standard as written in textbooks in school. Teachers and students need

to modify the presentation of flat fields in the classroom, the presentation of congruence theorems. So that the presentation of geometric shapes more and more varied. As a result, students are rich in congruence concept.

REFERENCES

[1] Rahayu, S. (2016). ANALISIS Kesalahan Siswa Dalam Menyelesaikan Soal-Soal Kesebangunan. *Jurnal E-Dumath*, Vol. 2 No.1 Hal 1-9.

[2] Ilmah, M., & Rosyidi, A. (2013). Penerepan Pembelajaran Kooperatif Tipe NHT (Numbered Head Together) Dengan Tugas Pengajuan Soal Pada Materi Kesebangunan Dan Kekongruenan Segitiga. *Jurnal Mahasiswa Unesa*, Vol. 3 No. 2.

[3] Anwari, R. (2017). Desain Didaktis Interaktif Problem Solving Matematis Pada Pokok Bahasan Kesebangunan. *Jppm*, Vol. 10. No.1.

[4] Suryana, (2012). Desain Didaktis Pengenalan Konsep Pecahan Sederhana Pada Pembelajaran Matematika Untuk Siswa Kelas Iii Sekolah Dasar, Nopember 2012

[5] Nur'aeni & Sakinatussa'adah (2012). Model Disain Didaktis Pembagian Pecahan Berbasis Pendidikan Matematika Realistik Untuk Siswa Kelas V Sekolah Dasar. Nopember 2012

[6] Aprianti, D. A., Karlimah, & Hidayat, &. S. (2016). *Desain Didaktis Pengelompokan Bangun Datar Untuk* Mengembangkan *Komunikasi Matematis Siswa Kelas II Sekolah Dasar*. Retrieved Agustus 23, 2019, From Http://Ejournal.Upi.Edu/Index.Php/Pedadidaktika/Article/View/5102

[7] Setiadi, D. R., Suryadi, D., & Mulyana, &. E. (2017). Didactical Design Enrichment of Angle in Geometry . *Journal of Physics: Conf. Series 895*.

[8] Heuvel-Panhuizen, M. V. (2003). *The Didactical Use Of Models In Realistic Mathematics Education: An Example From A Longitudinal Trajectory On Percentage.* Retrieved Agustus 23, 2019, from http://www.fi.uu.nl/publicaties/literatuur/2003_heuvel_panhuizen_model.pdf