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Designing a Hypothetical Learning Trajectory Using Prezi Presentation and GeoGebra Application on Flat-Shaped Triangle Geometry Materials

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Abstract.
Technology plays a crucial role in enhancing the quality of math learning. In addition to adapting to the rapid advancement of ICT, technology serves as a visualization aid for abstract mathematical concepts, facilitating understanding. Prezi presentations and GeoGebra application are technological tools that can be used as a medium for learning math. Prezi Presentation is used as a presentation medium, while GeoGebra functions as a dynamic tool to enhance the understanding of geometry. They both positively impact the development of mathematical thinking, facilitate meaningful learning experiences, and can be used as alternatives in designing a hypothetical learning trajectory for concepts related to triangle types. This study aims to design a Hypothetical Learning Trajectory (HLT) using Prezi presentation and GeoGebra for the material related to triangle types. The HLT tailored to suit the characteristics of students, making it easier to construct independent understanding related to triangle types through the use of dynamic technology such as Prezi and GeoGebra. This study uses a design research approach consisting of three phases: introduction, design experiments, and retrospective analysis. This was carried out solely in the preliminary phase to develop the initial prototype of the HLT focusing on the concept of triangle types. The HLT will be further examined in subsequent research and retrospectively analyzed to develop the Learning Instructional Theory (LIT) as the final product.

Keywords: flat-shaped triangle geometry materials, geogebra application, hypothetical learning trajectory, prezi presentation.

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1. INTRODUCTION

Geometry is one of important materials in Indonesian curriculum [1]. Lines and shapes of geometry can be many found in the students' environment such as in buildings houses, mosques, cloth motifs and others. This thing shows that activity geometry

there is in various corner life man so that rated important for studied because used on work construction as architecture, engineering and design [2]. Due to geometry is part of mathematics, so abstract becomes first impression from students' view. Therefore, teacher must think smart learning solution in order it could change the method of student look at learning geometry especially on flat shape triangle which is firstly introduced in class VII of junior high school.

Learning geometry on a flat-shaped triangle would be a better match for contemporary settings, which involve students as learners and their psychomotor abilities. Hwang [3] states that learning geometry emphasizes representation exploration, such as virtual manipulation, writing mathematical formulas and explanations orally, and thus guides students toward developing mathematics drafts and critical thinking. Additionally, relationships with peers of the same age affects one's comprehension of math and geometric problem solving. Interaction with peers also directs students to learn and experiment independently. Teachers' involvement is limited to acting as a facilitator or mediator and delivering students in the formal mathematics classroom. This procedure is supposed to enable students to retain their memories for an extended amount of time, possess the ability to recall longer, explain ideas effectively and simply in their own way, and improve their enthusiasm in mathematics.

Previous research results indicate that teachers and students often face problems in learning because geometry involves more abstract thinking than concrete learning [4]. Learning geometry is still limited to knowledge transfer, so there is no experience of meaningful learning and no impact on the power of students' memories, and they find it difficult to recall back as a result of a lack of flat-shaped triangle geometry understanding. Students' lack of ability in geometry could be seen from the ability of students who are not capable of precise visual representation, math expression that is presented has no variation, or is still verbally expressed so that no problem posed has its own correct solution, difficulty expressing mathematical ideas in the math expression aspect, and not being capable of drawing a conclusion to a given statement [5–7]. The students' low ability condition in understanding geometry concepts is also possibly caused by the teachers' limitations in operating learning as suggested by the curriculum [8, 9].

Based on the explanation above, innovation learning to improve the students' understanding of geometry becomes a need [10]. Innovation and solutions in today's learning are more focused on using technology as useful aids in improving mathematical students' understanding, preparing students to welcome fast advancement in science and technology and creating an effective study experience [11]. A lot of research states that

technology utilization in learning is a supporting tool and can be part of role taking in learning transformation to a better direction [11, 12]. It helps students explore concepts that lead to improving mathematics understanding, analyzing data and performing calculations [11]. Research results from Ghavifekr, Turgut and Turgut [13, 14] state that the use of technology has high effectiveness for teachers and students. Aside from that, good preparation in teaching with technology is a key factor in improving learning quality. Based on a number of opinions, it could be concluded that the use of technology in learning nowadays is a need that has become a priority.

Prezi Presentation and GeoGebra are parts of technology that can be used in learning math. Even the use of GeoGebra applications as tools for visualizing abstract geometry becoming concrete is occasionally used. GeoGebra is properly used in learning geometry [15]. whereas the use of Prezi presentation is a unique, interactive and dynamic presentation tool, which is different from the common presentation. Integration between Prezi presentation and GeoGebra will produce interesting math learning and support students' comprehension of learning flat-shaped geometry. This study aims at designing a Hypothetical Learning Trajectory (HLT) by using Prezi Presentation and GeoGebra on the flat-shaped triangle geometry material. HLT is designed in accordance with students' character so that they can easily build their understanding independently of flat-shaped by utilizing dynamic technology like Prezi presentation and GeoGebra. Such a process will create a living learning trajectory where students will be involved directly in discovering and building comprehension of the flat-shaped triangle geometry concept. Besides, the HLT design will be the first prototype to be tested to obtain Learning Instructional Theory (LIT).

2. RESEARCH METHOD

This study uses a design research approach, which is the appropriate approach for overcoming complex problems in educational practice [16]. Design research focuses on designing interventions in real-world education, which is combined with efforts to understand and improve interventions, develop or validate theories, and develop LIT [16, 17]. LIT is developed through the design of a HLT, which is then experimented with and revised in cycles until the final prototype is obtained.

Design research has three phases: the introductory phase, the experimental design phase, and the retrospective phase. This study is carried out in the preliminary phase of producing the first prototype, which will be tested in the experimental design phase. A prototype is the first version, whole or part, of an intervention to construct and develop

a final product [16]. The preliminary stage is problem and context analysis activity and the goal is to develop a base conceptual framework through literature review [18]. It is used as information for developing the learning track order in the form of HLT. The development of a prototype is still carried out as one prototype for testing, which later will produce LIT as a final product.

3. RESULTS AND DISCUSSION

In the preliminary phase, the researcher analyses literature related to flat-shaped triangle theory in the seventh grade and learning appropriateness as suggested by the curriculum. Next analysis is done by conducting observations and discussions with teachers at MTsS Jabal Nur Paloh Lada to identify students' characteristics and technology applied in learning math at that school. Based on the discussion results, it is evident that students have diverse abilities and their ability to learn flat-shaped triangles is still low. They are only able to repeat what was said by the teacher and are disabled from developing ideas. Utilization of technology in learning is already done, but it is limited to using gadgets to only search for certain things, while the implementation of applications like GeoGebra and Prezi presentation is not done yet.

Next, those analysis results are used as guidelines to design a HLT on the material flat-shaped triangle by using dynamic technology such as Prezi presentation and GeoGebra. The HLT is developed based on the compiled learning trajectory to achieve the learning objectives. The learning trajectory is the path or process of providing students with experience for them to change through stimulus interactions and responses that include the starting point (experience and student circumstances), the middle point (tiered activity), and the final point (learning goal). The learning trajectory that is used in this study is understanding the concept of flat-shaped triangle kinds using the GeoGebra application. To achieve the expected learning objectives, students are asked to understand a flat-shaped triangle based on the size of the angles and sides, which means finally the students could explain various types of triangles based on the size of the angles and sides. The following presents the learning trajectory of triangle-type concepts:

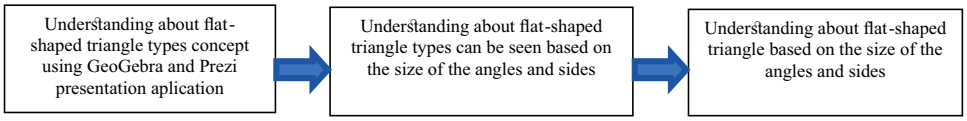

Figure 1: Learning trajectory for triangle types concept.

Based on the learning trajectory and the student's thinking ability, it is then created the learning activity which next is used to guess students' response (conjecture). The

learning conjecture of triangle types concept is presented in the Table 1. Based on Table 1 above, it can be seen that the learning trajectory is designed around the seven learning activities. Conjecture is developed based on activities arranged in the learning trajectory when students do the experiments by making various triangles, investigating the triangle types based on the sizes of angles and sides using the GeoGebra application, and explaining the triangle types. Prezi presentation is currently only used as a medium that visualizes students' framework, resembling a simple game, but it is still conditioned in accordance with learning experiences related to flat-shaped triangles that will investigate the truth. The presented statements are not all true and will direct students to conduct investigations to prove which statements are true and which are false. By putting together, the conjecture, the teacher can think about how to deal with different types of responses from students so that the learning process can go as planned, which is to achieve the learning goal.

Using GeoGebra as an application will help students carry out the process of constructing, exploring, validating, and justifying the research results when solving problems [19], fixing understanding of concepts and mathematics procedures [20, 21]. learning design, as this will provide convenience for teachers and students. The learning experience makes students active in exploring concepts independently, develops thinking ability and increases the students' curiosity for math. The teachers' job is to become better at three things at the same time: pedagogy, content, and technology, not just as content experts or technology experts [22].

Every time a teacher helps a student who has problems, they try to find, investigate, and convince that student to be able to build or construct their own knowledge. Besides that, using technology is a need and trend [23]. This thing occurs because current globalization is more dominant in involving technology as a solution to real-world, complex problems, so the potential human resources should be prepared for it. Hence, the use of Prezi presentations and GeoGebra applications has a positive impact on learning math, trains the thinking ability of math, has a meaningful learning experience, and can be used as an alternative in designing a hypothetical learning trajectory on the triangle types of concepts. This research result will be the first prototype that can be used to build the LIT.

4. CONCLUSION

Designing a HLT using Prezi Presentation and GeoGebra on the flat-shaped triangle geometry materials are made based on the analysis carried out at the first stage, which

Table 1: Learning conjecture of triangle types concept using geoebra and prezi presentation.

Stage	Learning Activity	Conjecture
Observing and Questioning	Activity 1 Observing various triangle picture and taking notes important thing related to triangle from beginning to the sub and sub point from the Prezi Presentation slide that must be investigated the truth by using GeoGebra.	
Trying	Activity 2 Experimenting a number of different types of triangles using GeoGebra application.	Student is already familiar with GeoGebra application and able to draw triangle in a number of various forms. Students are not yet too familiar with GeoGebra application so that they do not could draw yet triangle smoothly. Students are not yet known about GeoGebra application so that they could not draw triangle yet.
Reasoning and associating	Activity 3 Investigating the size of the angle using GeoGebra application and grouping them based on angle	Student could find and group triangle based on the size of the angle. Students could not find and group, yet the triangle based on big the size of the angle.
	Activity 4 Investigating the lengthy side of triangle using GeoGebra application and group them based on the sides.	Students could find and group triangle based on the side. Students could not find and group, yet the triangle based on side.
	Activity 5 Checking the truth of statements in Prezi Presentation based on investigation results.	
Communicating	Activity 6 Explaining the triangle types based on the angle size.	Students could explain the triangle types based on its angle size. Students could not explain yet the triangle based on its angle size.
	Activity 7 Explain types of triangles based on side.	Students could explain the triangle types based on its side. Students could not explain yet the triangle types based on its side.

aims to ease students' understanding of the flat-shaped triangle based on the size of angles and sides using dynamic technology. The use of GeoGebra and Prezi presentations will train students to learn independently and construct their understanding of triangle types. Furthermore, the learning experience is designed to be more vivid because it involves students doing exploration directly. In the end, through learning activities like this, it will not only improve understanding but also the student's curiosity. This HLT design will be used at the next stage until the LIT-on triangle type materials is created.

References

[1] Jelatu S, Sariyasa S, Ardana IM. Sariyasa, and I. Made Ardana, "Effect of GeoGebra-aided REACT strategy on understanding of geometry concepts.,". Int J Instr. 2018;11(4):325–36.

[2] Abdullah AH, Zakaria E. "The effects of Van Hiele's phases of learning geometry on students' degree of acquisition of Van Hiele Levels," *Procedia - Social and Behavioral Sciences*. vol. 102, no. Ifee. 2013;2012:251–66.

[3] Hwang WY, Hu SS. Analysis of peer learning behaviors using multiple representations in virtual reality and their impacts on geometry problem solving. Comput Educ. 2013;62(March):308–19.

[4] Faruk Tutkun O, Ozturk B. The effect of GeoGebra mathematical software to the academic success and the level of Van Hiele geometrical thinking. Int J Acad Res. 2013;5(4):22–8.

[5] Amaliyah AR R, Mahmud N; R.A. AR and N. Mahmud. Analisis kemampuan representasi matematis dalam pemecahan masalah geometri serta faktor-faktor yang mempengaruhinya [Jurnal Review Pembelajaran Matematika]. JRPM. 2018;3(2):146–60.

[6] Muslimin M, Sunardi S. Analisis kemampuan penalaran matematika siswa SMA pada materi geometri ruang. Kreano, Jurnal Matematika Kreatif-Inovatif. 2019;10(2):171–8.

[7] Hikmawati NN, Nurcahyono NA, Balkist PS. Kemampuan Komunikasi matematis siswa dalam menyelesaikan soal geometri kubus dan balok. Prisma. 2019;8(1):68.

[8] N. Nuraini and Z. Abidin, "Kesulitan guru dalam mengimplementasikan pembelajaran tematik terintegratif di sekolah dasar.," *Premiere Educandum : Jurnal Pendidikan Dasar dan Pembelajaran*. vol. 10, no. 1, p. 49, 2020. https://doi.org/10.25273/pe.v10i1.5987.

[9] In'am A, Hajar S. Learning geometry through discovery learning using a scientific approach. Int J Instr. 2017;10(1):55–70.

[10] Gargrish S, Mantri A, Kaur DP. "Augmented reality-based learning environment to enhance teaching-learning experience in geometry education.," *Procedia Computer Science*. vol. 172, no. 2019, pp. 1039–1046, 2020. https://doi.org/10.1016/j.procs.2020.05.152.

[11] Saha RA, Ayub AF, Tarmizi RA. The effects of GeoGebra on mathematics achievement: enlightening coordinate geometry learning. Procedia Soc Behav Sci. 2010;8(5):686–93.

[12] Hillmayr D, Ziernwald L, Reinhold F, Hofer SI, Reiss KM. "The potential of digital tools to enhance mathematics and science learning in secondary schools: A context-specific meta-analysis.," *Computers and Education*. vol. 153, no. September 2018, p. 103897, 2020.

[13] Ghavifekr S, Rosdy WA. Teaching and learning with technology: effectiveness of ICT integration in schools. International Journal of Research in Education and Science. 2015;1(2):175–91.

[14] Turgut iG, Turgut S. "The effects of visualization on mathematics achievement in reference to thesis studies conducted in Turkey: A meta-analysis.," *Universal Journal of Educational Research*. vol. 6, no. 5, pp. 1094–1106, 2018.

[15] Turgut M, Smith JL, Andrews-Larson C. Symbolizing lines and planes as linear combinations in a dynamic geometry environment. J Math Behav. 2022;66(March):100948.

[16] van den Akker J, Bannan B, Nieven N, Plomp T. "An introduction to Educational Design Research.," Presented at the (2010).

[17] Risdiyanti I, Prahmana RC. Ethnomathematics (Teori dan Implementasinya : suatu pengantar). Yogyakarta: UAD Press; 2020.

[18] Prahmana RC. Design research (Teori dan Implementasinya: Suatu Pengantar). Depok: Raja Grafindo Persada; 2018.

[19] Özen D, Köse NY. Investigating pre-service mathematics teachers' geometric problem solving process in dynamic geometry environment. Turkish Online Journal of Qualitative Inquiry. 2013;4(3):61–74.

[20] Hutkemri and E. Zakaria. The effect of geogebra on students'conceptualand procedural knowledge of function. Indian J Sci Technol. 2012;5(12):3802–8.

[21] Zulnaidi H, Zamri SN. The effectiveness of the geogebra software: the intermediary role of procedural knowledge on students' conceptual knowledge and their achievement in mathematics. Eurasia J Math Sci Technol Educ. 2017;13(6):2155–80.

[22] Richardson JC. Book Review: A practical guide to problem-based learning online. Interdiscip J Probl Based Learn. 2009;3(1):90–2.

[23] Azizul SM, Din R. Teaching and learning geometry using GeoGebra sostware via MOOC. Journal of Personalized Learning. 2016;2(1):40–51.