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Problem-Based Differentiation Learning Design in Class X High School Exponent Material

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Abstract

Problem-based differentiation learning is learning that begins with real-world problems (real problems), which students can then solve real problems guided by problem-based steps. With the use of problem-based differentiation learning students can foster interest in learning Mathematics. Not only that, this problem-based differentiation learning design is also associated with learning styles, where there are three learning styles used, namely: audio learning styles, visual learning styles, and kinesthetic learning styles. The method used in this research was the design research method type of validation studies, which was a form of qualitative approach. Design research was aimed to develop Local Instructional Theory (LIT) with the collaboration of researchers and teachers to improve the quality of learning. The implementation of differentiation learning at the beginning of learning makes students excited and be able to recall about the exponents and also when the learning process takes place they learn with their own learning style so that learning becomes active, by applying their own learning style it makes them more relaxed during learning and more focused. The results of this study show that problem-based learning plays a role during the learning process because activities are carried out using real contexts so that they can help students to understand and analyze the properties of exponents. In addition, the steps in problem-based learning can make students accustomed to analyzing.

Keywords: Differentiation Learning, Problem Based Learning (PBL), Learning Style

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INTRODUCTION

The implementation of the independent curriculum is felt to be very important in the framework of post-Covid 19 pandemic recovery, where one of the interventions is student-centered learning. One method of learner-centered learning is by implementing differentiated learning. Differentiated learning is a form of effort in a series of learning that pays attention to the needs of students in terms of learning readiness, student learning profiles, interests and talents (Aprima & Sari, 2022; Fitra, 2022; Prasetyo & Suciptaningsih, 2022; Sarie, 2022). One way that can be done to achieve this goal is continuous renewal in the field of education, especially mathematics. Mathematics as one of the basic sciences has an important and beneficial role for the development of science and technology (Indriani & Imanuel, 2018; Febriana, Leonard, & Astriani, 2020; Susanti, 2020; Agry & Kartono, 2021) . Mathematics subject matter taught in schools plays a role in training students to think logically, critically and practically, reason effectively, be scientific, disciplined, responsible, confident accompanied by faith and piety (Ramadhani, 2016; Kusumawardani & Maryatun, 2018; Jayanti, Arifin, & Nur, 2020). A problem in mathematics is a problem that he himself is able to solve without using routine methods or algorithms (Tanjung & Nababan, 2019).

There two link between problem-based differentiation learning. First, in differentiation learning students are more flexible during learning by using everyday problems so that they can foster self-confidence and students' interest in learning. Second, problem-based differentiation learning can find solutions to problems that use real-world contexts (real problems) (Hadi et al., 2022).

Differentiated learning is not individual learning but classical learning but in its activities prioritizes differentiation in class, pays attention to existing differences, carries out all supporting activities to achieve maximum learning goals without changing the individual student personality in accordance with the principles of Ki Hajar Dewantara growing and developing the child's nature creating education that liberates (Jenyana, 2022). There are three approaches to differentiated learning, namely from content, process and product. 1) Differentiation of content is what is learned by students, related to curriculum and learning materials. 2) Process differentiation is a way for students to process ideas and information, which includes how students choose their learning style 3) Product differentiation, namely students show what they have learned (Wasih et al., 2020).

Differentiation is a pedagogical approach, not an organization (Stradling & Saunders, 1993). It is a way for teachers to modify teaching and learning routines to meet the needs of students' readiness levels, interests, and ways of learning (Tomlinson, 1999, 2001). Differentiation can be defined as an approach to teaching in which the teacher modifies the curriculum, teaching methods, resources, learning activities, and student outcomes to address the diverse needs of each student and small groups of students in order to maximize learning opportunities for each student in the classroom (Bearne, 1996; Tomlinson , 1999). The process of differentiating lessons is carried out to answer the learning needs, styles, or interests of each student. Differentiated learning is motivated by the different learning needs of students. In other words, differentiation learning is creating a diverse class by providing opportunities to acquire content, process an idea and improve the results of each student, so that students will be able to learn more effectively.

There are 3 important elements that are differentiated, including: (1) Content, content relates to what students will know, understand and what they will learn. In this case the teacher will modify how each student will learn a learning topic; (2) Process, the process is the way students get information or how they learn. In another sense, it is student activity in gaining knowledge, understanding and skills based on the content to be studied; (3) Products, products are proof of what they have learned and understood. Students will demonstrate or apply what they already understand. The product will change students from "consumers of knowledge to producers with knowledge".

The research process is guided by two very important instruments, namely the hypothetical learning trajectory (HLT) and local instruction theory (LIT). HLT is used as a guide in the learning process where HLT develops when teaching experiments are carried out. The goal is to find out to what extent the actual learning trajectory is similar to the alleged learning trajectory that has been made (Gravemeijer, 2004). Simon (2013: 17) describes the relationship between HLT and LIT as a journey where LIT offers a "Travel Plan" and HLT as an actual "journey" with its students (Bakker, 2004). The idea is that researchers use their knowledge through LIT to choose appropriate learning activities and design HLT which are then tried out in the class of research subjects.

METHODS

The method used in this research was the design research method type of validation studies, which was a form of qualitative approach. Design research was a systematic but

flexible methodology aimed at improving teaching practice through repeated analysis, repeated design, and its implementation leads to collaboration between researchers and practitioners and refers to design principles and theory (Simon, 2017). Design research aims to develop Local Instructional Theory (LIT) with the collaboration of researchers and teachers to improve the quality of learning (Gravemeijer & van Eerde, 2009).

The implementation of this research through a process directed by a hypothetical learning trajectory (HLT). If at the time the learning was carried out it was not in accordance with the design that had been planned, then a re-design (throught experiment) would be carried out on the HLT and then re-tested on the HLT. The cyclic process was a design improvement activity that had been made due to a discrepancy between the HLT that had been designed and the results of the learning process that had been carried out. The cyclic process in design research consists of experimenting with ideas or ideas (throught experiment) and learning experiments (instruction experiment). For more details, these stages will be presented in Figure 1 (Gravemeijer & Cobb., 2006).

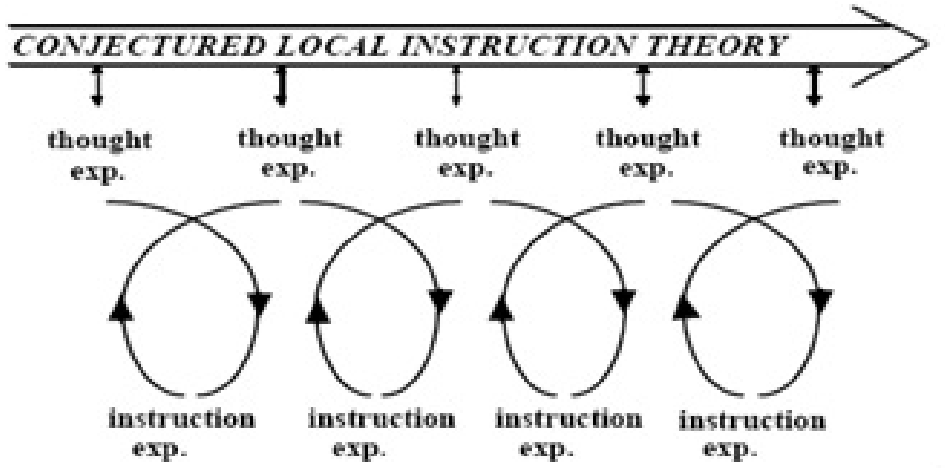


Figure 1. Conjectured Local Instruction Theory

There are three stages in design research, namely: (a) preparing for experiment, (b) the design experiment, and (c) retrospective analysis (Gravemeijer & Cobb., 2006; Simon., 2017).

RESULTS & DISCUSSION

Results

Preparing for Experiment

At this stage, the researcher implemented the initial idea by reviewing the literature on differentiation learning, the Problem Based Learning (PBL) model and the high school Mathematics curriculum. Next, the researchers designed the initial Hypothenical Learning Trajectory (HLT) as a learning process flow consisting of 2 activities. Each activity describes students' prior knowledge, learning objectives, descriptions of student activities and student thinking assumptions. HLT is defined by researchers as the goal of achieving meaningful learning according to the stages of thinking, a series of tasks to achieve goals, and predicting students' way of thinking in understanding concepts by conducting

retrospective analysis after learning activities (Sion., 2017). The initial HLT that has been designed is a problem-based differentiation learning trajectory consisting of learning objectives, mathematical ideas and student activities. The following HLT that has been designed by researchers is presented in the figure below.

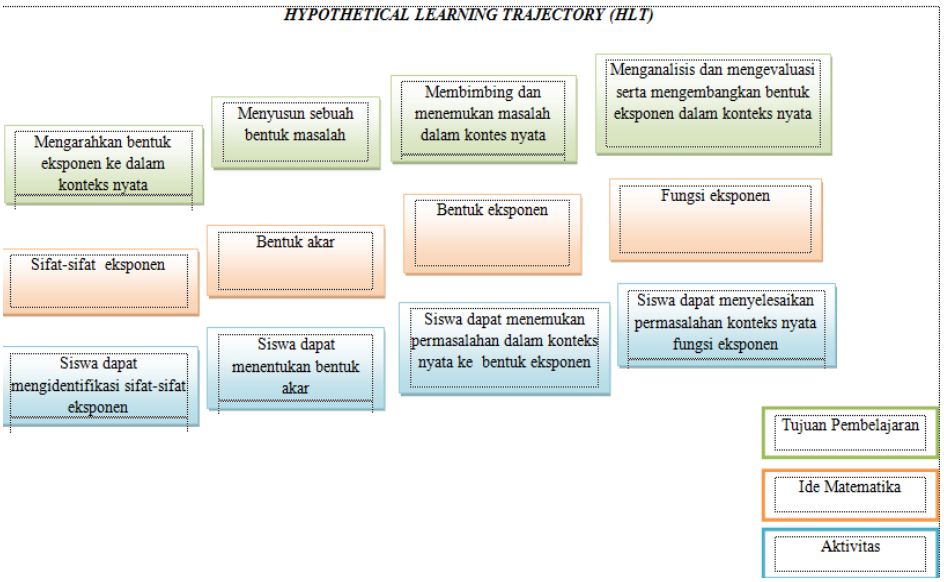


Figure 2. Hypotenichal Learning Teaching (HLT)

In the HLT that has been designed, the researchers use problem-based steps combined with differentiation learning. Grouping students to study, to guide, to develop and to present the results of the answers, and to analyze and to evaluate the learning process. The process of sequence of student's activities that has been designed related to exponential material in the alleged learning trajectory is described as follows.

Design Eksperiment

1. Pilot Eksperiment (Siklus I)

In the pilot experiment stage, the problem-based differentiation learning design trial was conducted with 8 students in class X.6 (Phase E) in a teaching experiment. Students were selected with 2 students with low abilities, 4 students with moderate abilities, and 2 students with high abilities.

In detail, the learning trials at the pilot experiment stage (cycle I) can be described as follows

When working on LKPD 1, students are allowed to discuss among group members, while the teacher monitors the progress of the discussion. After completing LKPD 1, students are invited to present the results of their group's answers. During the presentation, other groups were asked to focus in order to be able to provide arguments, responses and suggestions if the answers obtained were different from the results that had been presented. If there are differences of opinion from the answers between groups, the teacher will provide an explanation and invite students to draw conclusions from the activities that have been done.

Furthermore, the teacher gives instructions to students to first read the supporting information that has been provided in the LKPD and look at the problems that exist in activity 1.

Harga awal sebuah kain songket adalah Rp. 2.500.000,00. Jika nilai jual kain songket mengalami penyusutan 20% per tahun, berapakah nilai jual kain songket selama tiga tahun kemudian?

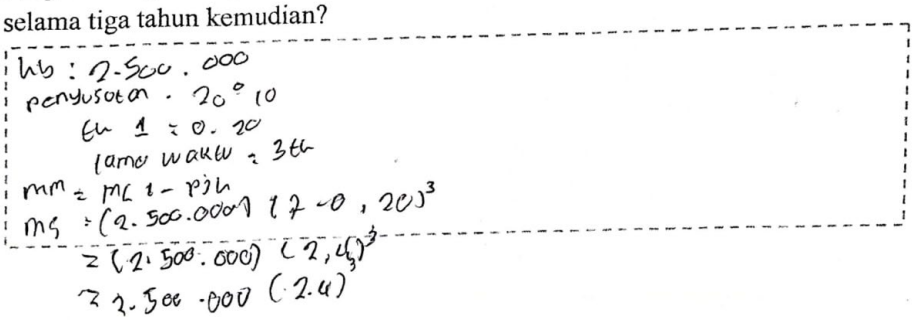


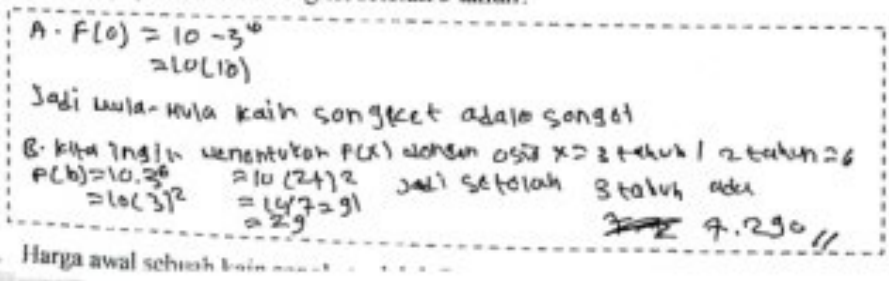
Figure 3. Answers with activity audio learning style I

Berapa jumlah kain songket yang di dapatkan setelah membeli kain songket setelah membeli sebanyak 50 kali? Bagaimana kalian mengetahuinya?

Sebuah toko kain songket menjual 2 buah kain songket terbaik pada hari pertama, pada hari kedua terjual 4 buah kain songket terbaik yang sama, pada hari ketiga terjual 8 buah kain songket terbaru, dan seterusnya kain songket yang terjual hingga hari ke-50?

Penjual kain songket dapat menjual tiga kali lipat setiap setengah tahun dan fungsinya bisa dimodelkan sebagai $f(x) = 10.3^x$, dengan x adalah rasio lamanya waktu terhadap periode setengah tahun.

a. Berapa jumlah kain songket mula-mula?
b. Berapa jumlah kain songket setelah 3 tahun?



Harga awal sebuah kain songket ....

Figure 4. Answers with activity visual learning style I

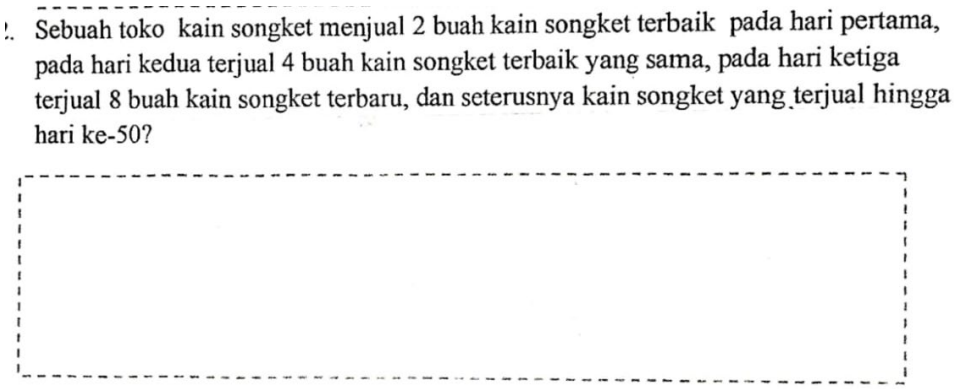


Figure 5. Answers with activity kinesthetic learning style I

Student Thinking Conjecture

The following conjecture of students' thinking in activity 1 can be seen in table 1.

Table 1. Conjecture of students' thinking

Learning Activities	Conjecture of students' thinking
Understand and analyze the properties of exponents	• Students solve problems using problem-based steps • Step 1 knows the learning objectives and organizes students to study in problem solving activities • Step 2 collects appropriate information - Students look at the problems in activity 1 - After looking at the questions in activity 2 students are asked to answer the questions in activity 1 • Step 3 develops and presents the results of the answers - Students provide answers and reasons for the questions given - Students give reasons for the answers given • Step 4 analyze and evaluate the problem solving process • Students evaluate the learning process that has been given

Activity 2

The initial knowledge in activity 2 is that students can apply the exponential properties.

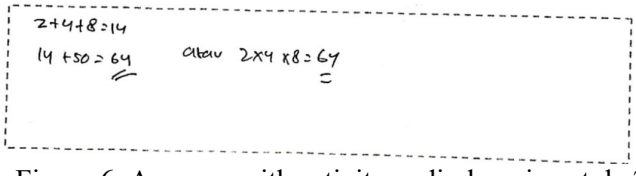


Figure 6. Answers with activity audio learning style 2

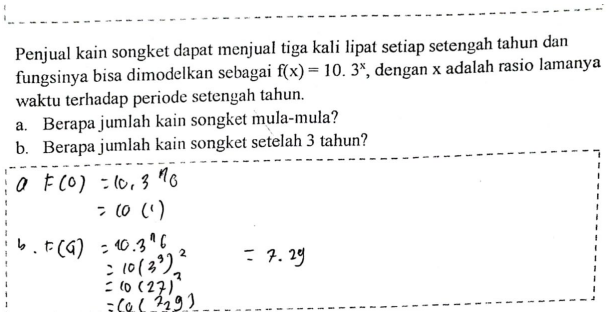


Figure 7. Answers with activity visual learning style 2

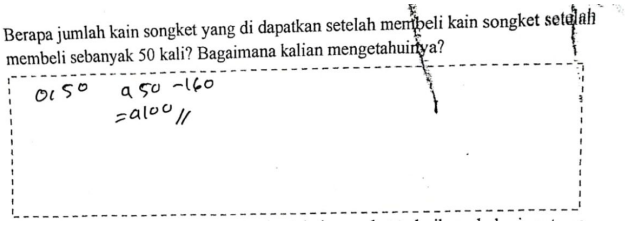


Figure 8. Answers with activity kinesthetic learning style 2

Student thinking conjecture 2

The following conjecture of students' thinking in activity 2 can be seen in table 2.

Table 2. Conjecture of students' thinking

Learning Activities	Conjecture of students' thinking
Understand and analyze the properties of exponents	• Students solve problems using problem-based steps • Step 1 knows the learning objectives and organizes students to study in problem solving activities • Step 2 collects appropriate information - Students look at the problems in activity 2 - After looking at the questions in activity 2 students are asked to answer the questions in activity 2 • Step 3 develops and presents the results of the answers - Students provide answers and reasons for the questions given - Students give reasons for the answers given • Step 4 analyze and evaluate the problem solving process • Students evaluate the learning process that has been given

2. Teaching Experiment (Siklus 2)

At this stage the HLT experimental process that had been designed was carried out on 36 students of class X.7 with heterogeneous abilities. The activities carried out at this stage are still the same as at the pilot experiment stage, namely 2 activities. In addition, pre-tests and post-tests were given to students in the crew and at the end of

the meeting from a series of activities that had been carried out. The description of the implementation of the teaching experiment is explained as follows.

Pre-test and Post-test

The pre-test was given to 36 students with 3 essay questions within 45 minutes. The pre-test was carried out individually.

The post-test consists of 3 questions that will be given to all students to see students' understanding after they have participated in differentiation learning activities with different learning styles. If they succeed in working on the post test questions, then the results of the students' answers indicate their level of understanding.

a. Description of activities in learning

Activity Work I

After revising the learning design based on the first cycle, namely the pilot experiment, then testing it at the teaching experiment stage with class X.7 subjects (Phase E) with a total of 36 students and the model teacher, namely Ib Sri Herawati, S.Pd, in the learning process, namely apperception done ± 7 minutes for students to distribute questionnaires about learning styles that have been given and distribute LKPD to students by collaborating together with different learning styles in solving problems in LKPD. If there are students who don't understand, it's best to ask for help from their group mates and friends who are asked to help teach their group mates until they can. The importance of peer collaboration with mutual learning between students. Researchers only as observers observe the learning process between groups, each student without intervening in the learning process.

In activity I the questions given are in the form of problems of exponential nature to solve problems based on the knowledge students have studied before, then students implement the knowledge gained to solve everyday life problems.

Activity I

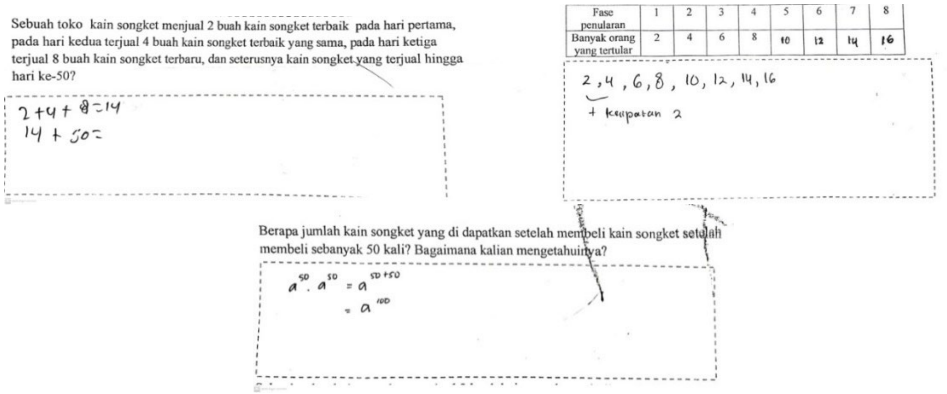


Figure 9. Questions and answers of students in activity I

Retrospective analysis activity I

The results of the implementation of learning in activity I obtained that the learning objectives had been achieved but not optimal. The learning objectives in this activity are students can analyze exponential relationships with everyday life. When discussing between 3 groups with different learning styles, only the audio and visual groups were active while the kinesthetic group was passive. Therefore

during the presentation the passive group was given the opportunity to present the results of their discussion. Based on the answers of each group, it can be concluded that only one group gave answers according to the learning objectives. The suitability of the learning process between the initial HLT and the Actual Learning Trajectory (ALT) can be detailed in table 3.

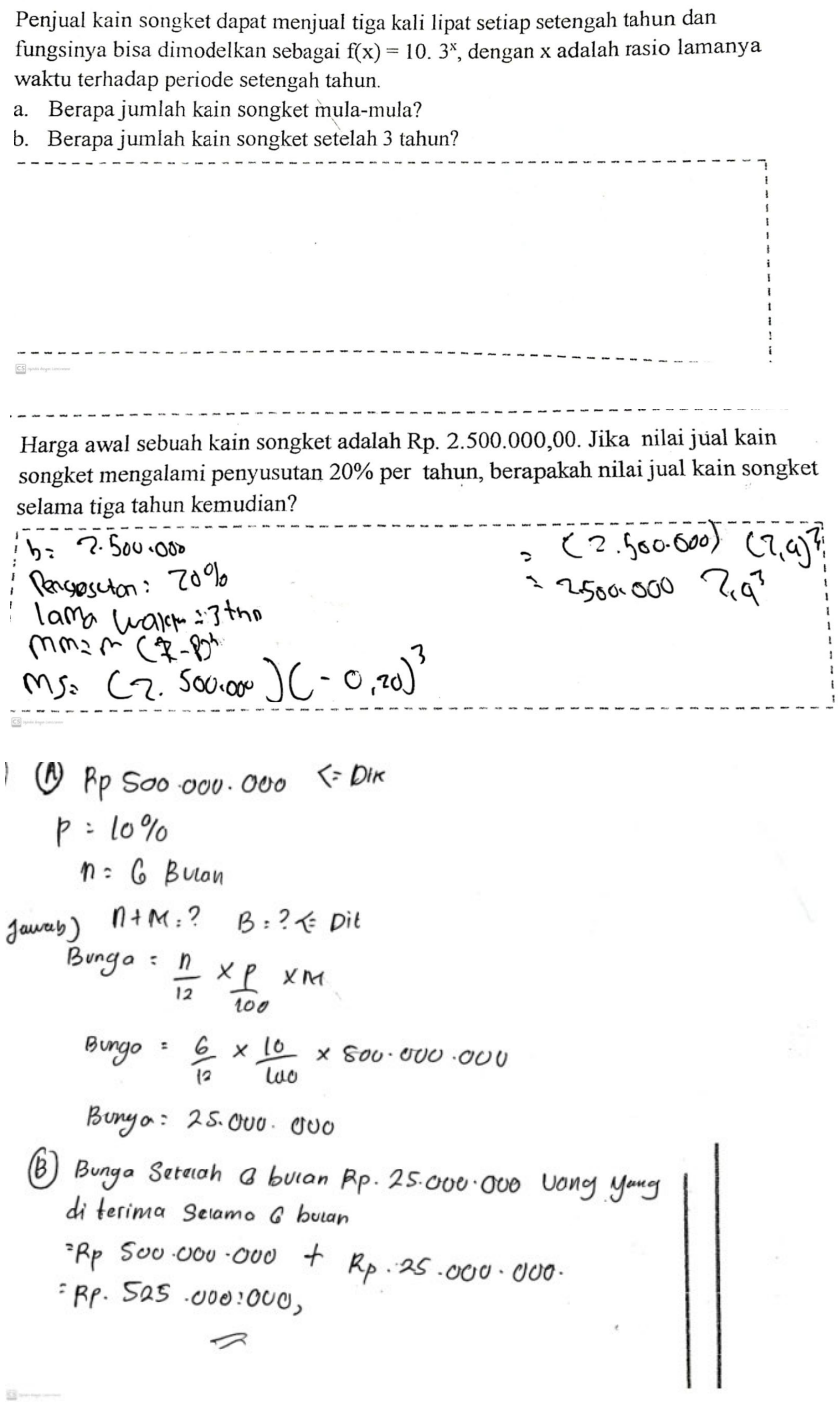
Table 3. Comparison of initial HLT and activity I ALT

Hypothenical Learning Trajectory (HLT)	***Actual Learning Trajectory (ALT)***
Students solve problems using problem-based steps • Step 1 knows the learning objectives and organizes students to study in problem solving activities • Step 2 collects appropriate information - Students are asked to look at the problems in activity I - After looking at the questions in activity I, students are asked to answer the questions in activity I. • Step 3 develops and presents the results of the answers - Students provide answers and reasons for the questions given - Students give reasons for the answers given • Step 4 analyze and evaluate the problem solving process - Students evaluate the learning process that has been given	Students solve problems using problem-based steps • Step 1 knows the learning objectives and organizes students to study in problem solving activities • Step 2 collects appropriate information - Students look at the problems in activity I - After looking at the questions in activity I, students are asked to answer the questions in activity I. • Step 3 develops and presents the results of the answers - Students provide answers and reasons for the questions given - Students give reasons for the answers given • Step 4 analyze and evaluate the problem solving process - Students evaluate the learning process that has been given

Based on the table above, it can be seen that all ALT is in accordance with the HLT that has been designed by the researcher so that revisions do not need to be done. At the time the implementation of the learning process was carried out, almost all of the student thinking assumptions that were designed were met. Next, evaluate today's lesson about the properties of exponents. Furthermore, on the second day students prepare and study the next material to be discussed at the next meeting.

Work on activity II (second day)

The teacher monitors students in working on LKPD questions, if anyone doesn't understand, ask their group mates. So that there is collaboration between group friends. The teacher as a facilitator monitors student work without disturbing the learning process.



Penjual kain songket dapat menjual tiga kali lipat setiap setengah tahun dan fungsinya bisa dimodelkan sebagai $f(x) = 10.\ 3^x$, dengan x adalah rasio lamanya waktu terhadap periode setengah tahun.

a. Berapa jumlah kain songket mula-mula?
b. Berapa jumlah kain songket setelah 3 tahun?

Harga awal sebuah kain songket adalah Rp. 2.500.000,00. Jika nilai jual kain songket mengalami penyusutan 20% per tahun, berapakah nilai jual kain songket selama tiga tahun kemudian?

b = 2.500.000
Penyusutan : 20%
lama waktu : 3 thn
$M_n = M(x - B)^n$
$M_3 = (2.500.000)(-0,20)^3$
$= (2.500.000)(2,9)^3$
$= 2500.000\ 2,9^3$

(A) Rp 500.000.000 <= Dik
P : 10%
n : 6 Bulan
Jawab) n + M : ? B : ? <= Dit
Bunga : $\frac{n}{12} \times \frac{P}{100} \times M$
Bunga : $\frac{6}{12} \times \frac{10}{100} \times 500.000.000$
Bunga : 25.000.000
(B) Bunga Setelah 6 bulan Rp. 25.000.000 Uang yang di terima Selama 6 bulan
= Rp 500.000.000 + Rp. 25.000.000.
= Rp. 525.000.000,

Figure 10. Student Answers Activity 2

Retrospective Analysis activities 2

This activity aims to enable students to analyze exponential properties in real context. The suitability of the learning process between the initial HLT and ALT can be detailed in the table below.

Table 4. Comparison of initial HLT and activity ALT 2

Hypothenical Learning Trajectory (HLT)	**Actual Learning Trajectory (ALT)**
Students solve problems using problem-based steps • Step 1 knows the learning objectives and organizes students to study in problem solving activities • Step 2 collects appropriate information - Students are asked to look at the problems in activity 2 - After looking at the questions in activity 2 students are asked to answer the questions in activity 2. • Step 3 develops and presents the results of the answers - Students provide answers and reasons for the questions given - Students give reasons for the answers given • Step 4 analyze and evaluate the problem solving process - Students evaluate the learning process that has been given	Students solve problems using problem-based steps • Step 1 knows the learning objectives and organizes students to study in problem solving activities • Step 2 collects appropriate information - Students look at the problems in activity 2 - After looking at the questions in activity 2 students are asked to answer the questions in activity 2. • Step 3 develops and presents the results of the answers - Students provide answers and reasons for the questions given - Students give reasons for the answers given • Step 4 analyze and evaluate the problem solving process - Students evaluate the learning process that has been given

Based on the table above, it can be seen that all ALT is in accordance with the HLT that has been designed by the researcher so that revisions do not need to be done. At the time the implementation of the learning process was carried out, almost all of the student thinking assumptions that were designed were fulfilled. Finally, the teacher evaluates today's learning, based on the materials provided, namely exponents. So that it can make students understand the material about exponents

Discussion

This study aims to produce a learning trajectory of problem-based differentiation. The implementation of differentiation learning at the beginning of learning makes students excited and be able to recall about the exponents and also when the learning process takes place they learn with their own learning style so that learning becomes active, by applying their own learning style it makes them more relaxed during learning and more focused . Differentiation learning challenges students to learn more deeply and gives students the opportunity to become peer tutors (Purba et al., 2021).

Activity I is about how to understand the problem well, students are invited to define and to organize learning tasks related to the problem. Activity 2 after students understand and define the problem and get information and answer the questions given, students plan and prepare the results of their answers by presenting them to the class.

From the learning trajectory that has been designed, problem-based differentiation learning is able to support students' problem abilities. This is in line with Purba (2021) which says that the teacher plans and arranges materials, activities, assignments to be done at school or at home and the final evaluation is adjusted according to students' readiness, interests and preferences. According to Arends (2008) the theory of cognitive development says that students have different learning styles according to the level of cognitive development. The heterogeneity of students in the class is a certainty, they have different abilities in terms of emotion, intelligence, social, academic, parents, and various other abilities.

CONCLUSION

Based on the description of the results and discussion, it can be concluded as the learning trajectories resulting from problem-based differentiation learning are accommodated with learning styles, including the following. The first activity is that students explain and understand the properties of exponents. The second activity of students analyzes the properties of exponents related to the real context. Both of these activities are carried out according to the steps of problem-based learning grouping students to learn, guiding, developing and presenting the results of answers, and analyzing and evaluating the learning process. Problem-based learning plays a role during the learning process because the activities are carried out using a real context so that it can help students to understand and analyze the properties of the exponents. In addition, the steps in problem-based learning can make students accustomed to analyzing.

REFERENCES

Agry, F. P., & Kartono, K. (2021). Implementasi untuk model STEAM (Sains, Technology, Engineering, Art, and Mathematic): Pembelajaran matematika untuk mahasiswa pendidikan guru sekolah dasar. In *Prosiding Seminar Nasional Pascasarjana (PROSNAMPAS)* (Vol. 4, No. 1, pp. 126-129). Retrieved from https://proceeding.unnes.ac.id/index.php/snpasca/article/view/834/734

Ainia, D.K. (2020). Freedom of learning in the view of Ki Hadjar Dewantara and its relevance to the development of character education. *Journal of Indonesian Philosophy*. 3(3), 95-101. https://doi.org/10.23887/jfi.v3i3.24525

Aprima & Sari. (2022). Analysis of the application of differentiated learning in the implementation of the independent curriculum in elementary mathematics *Lessons. Scholar: Educational Scientific Journal Media*, 13(1), 95-101. https://doi.org/10.35335/cendikia.v13i1.2960

Febrina, T., Leonard, L., & Astriani, M. M. (2020). Pengembangan modul elektronik matematika berbasis web. *JKPM (Jurnal Kajian Pendidikan Matematika), 6*(1), 27-36. http://dx.doi.org/10.30998/jkpm.v6i1.8141

Fitra, D. K. (2022). pembelajaran berdiferensiasi dalam perspektif progresivisme pada mata pelajaran IPA. *Jurnal Filsafat Indonesia, 5*(3), 250-258. Retrieved from https://ejournal.undiksha.ac.id/index.php/JFI/article/download/41249/25699

Hadi, W., Wuriyani, E. P., Yuhdi, A., & Agustina, R. (2022). Differentiated learning design containing problem based learning (PBL) supports students' critical thinking skills in the new normal era after the Covid-19 pandemic. *Basastra, 11*(1), 56-68. https://doi.org/10.24114/bss.v11i1.33852

Hockett, J,A. (2018). *Differentiation strategies and examples: grades 6-12*. Tennese Departement Of Education. Alexandria. Va: Ascd (Modul 2.1 Pgp, 2021)

Indriani, M. N., & Imanuel, I. (2018). Pembelajaran matematika realistik dalam permainan edukasi berbasis keunggulan lokal untuk membangun komunikasi matematis. Prisma, *Prosiding Seminar Nasional Matematika, 1*, 256-262. Retrieved from https://journal.unnes.ac.id/sju/index.php/prisma/article/view/19596

Jayanti, I., Arifin, N., & Nur, D. R. (2020). Analisis faktor internal dan eksternal kesulitan belajar matematika kelas V. *SISTEMA: Jurnal Pendidikan, 1*(1), 1-7. https://doi.org/10.24903/sjp.v1i1.602

Jenyana, I, M, R. (2022). Differentiated learning. *Innovation Journal*. 8(17), 31-37. Retrieved from http://www.jurnalinovasi.org/index.php/IJG/article/view/267

Kamal, S. (2021). Implementation of differentiated learning in an effort to increase the activity and results of mathematics learning for XI mipa class students of SMA Negeri 8 Barabai. *Journal of Learning and Educators*. 1(1). Retrieved from https://www.julak.online/index.php/Jurnal/article/view/46/44

Kusumawardani, E. D., & Maryatun, M. (2018). Meningkatkan Kemampuan Menyimpulkan Matematik Dan Percaya Diri Melalui PBL Berbantuan Kartu Soal Siswa kelas X. PRISMA, *Prosiding Seminar Nasional Matematika, 1*, 92-98. Retrieved from https://journal.unnes.ac.id/sju/index.php/prisma/article/view/19579

Ministry of Education and Culture. (2021). Lms module 2.1. *Mobilization Teacher Program.*

Mulbar, U., Bernard, B., & Pesona, R. R. (2018). Application of a problem-based learning model with differentiation learning strategies for class VIII students. *Issues in Mathematics Education (IMED), 1*(1), 1-6.

Prasetyo, R., & Suciptaningsih, O. A. (2022). Penerapan Teori Belajar Humanistik Pada Pembelajaran Berdiferensiasi Di Sekolah Dasar. *Jurnal Ilmiah Global Education, 3*(2), 233-237. https://doi.org/10.55681/jige.v3i2.398

Ramadhani, R. (2016). Pengembangan Perangkat pembelajaran matematika yang berorientasi pada model Problem Based Learning. Kreano. *Jurnal Matematika Kreatif-Inovatif, 7*(2), 116-122. http://dx.doi.org/10.15294/kreano.v7i2.7300

Rezeki, S., (2018). Utilization of Adobe Flash CS6 based on problem based learning on compositional functions and inverse functions. *Tambusai Journal of Education*, 2(4), 856–864.

Sarie, F. N. (2022). Implementasi pembelajaran berdiferensiasi dengan model problem based learning pada siswa sekolah dasar kelas VI. *Tunas Nusantara*, 4(2), 492-498. https://doi.org/10.34001/jtn.v4i2.3782

Simanjuntak & Listiani. (2020). The application of differentiated instruction in improving the understanding of mathematics concepts for grade 2 elementary school students. *Journal of Education and Culture*. Vol. 10 No. 2. Pg. 134–141. https://doi.org/10.24246/j.js.2020.v10.i2.p134-141

Sudana, I. M. (2020). Increasing the activity and learning outcomes of physics through the application of a deductive hypothetical learning cycle learning model. *Indonesian Journal of Educational Development*. 1(1), 112-121. https://doi.org/10.5281/zenodo.3760729

Susanti, Y. (2020). Pembelajaran matematika dengan menggunakan media berhitung di sekolah dasar dalam meningkatkan pemahaman siswa. *Edisi, 2*(3), 435-448. Retrieved from https://www.ejournal.stitpn.ac.id/index.php/edisi/article/download/1122/787

Tanjung, H. S., & Nababan, S. A. (2019). Development of problem-based learning tools to improve problem solving and mathematical communication skills for students of SMA Negeri 3 Kuala, Nagan Raya Regency. *Noble Genta*. 10(2), 178-187. Retrieved from https://garuda.kemdikbud.go.id/documents/detail/1276944

Tomlinson, C. A. (2000). *Differentiation of instruction in the elementary grades*. Eric Digest. Eric Clearinghouse On Elementary And Early Chilhood Education (Modul 2.1 Pgp, 2021)

Tomlinson, C. A. 2001. *How to differentiate instruction in mixed-ability classrooms*. Ascd. Tomlinson. (Modul 2.1 Pgp, 2021)

Tomlinson, C. A. 2014. *The differentiated clasroom responding to the needs of all learner. 2nd Edition*. Alexandria, Va: Ascd (Modul 2.1 Pgp, 2021)