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Research Article

Influence application problem-based learning on students' learning outcomes in chemistry at SMA 1 Tanjung Batu

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Abstract

This study aims to determine whether there is an influence of the problem based learning model on the chemistry learning outcomes of SMA Negeri 1 Tanjung Batu. The research method was using a quasi-experimental design with non-equivalent control group design. The sample used was students of class XI MIPA 1 as the experimental class and class XI MIPA 2 as the control class. From the research results obtained, the average prates value in the experimental class is 29.39 and the average pascates is 68.18. While the average prates in the control class is 22.35 and the pascates average is 54.70. The results of the hypothesis test analysis using the t test at a significance level of 5%, obtained t (count) > t (table), that is (2.988)> (1.997). Thus H0 is rejected, meaning that there is an influence of the problem based learning model on the chemistry learning outcomes of the salt hydrolysis material of students in eleventh grade of SMA Negeri 1 Tanjung Batu. It is recommended for teachers to be able to use the problem based learning model as an alternative learning model in an effort to improve student learning outcomes and activeness.

Keywords: problem based learning (PBL) learning model; salt hydrolysis; student learning outcomes

1. Introduction

In the 21st century, education is the most important thing and is in the spotlight of state officials to strive to make education in Indonesia a quality education, and become Indonesia's advantage. Education in the world is a hot topic to discuss, because education is an important. The world of education has experienced rapid development, information and communication are always developing all the time (Uliyandari et al., 2021). As well as in Indonesia, education in Indonesia is an important part of efforts to educate the nation's life and improve the quality of human resources (Siregar, 2016). In science education, the benchmark is students' knowledge and concern about science in everyday life. Science is related to how to systematically find out about nature, mastery of a collection of knowledge in the form of facts, concepts or principles and is a process of discovery. Agustiana Ramdani revealed that science is a method for finding reliable knowledge (Ramdani, 2018).

In the world of science education, science lessons are often heard with the term Natural Sciences (IPA), for High Schools (SMA) science lessons are divided into 3 branches of science, namely biology, physics, and chemistry. For chemistry lessons, it is a lesson that is included in the category of difficult lessons, this is because learning chemistry in the process does not relate it to everyday life, so that the learning becomes less meaningful for students, and students are not interested and do not want to know more about learning. chemistry. This also has an impact on the minds of students who think that chemistry is an abstract science or does not appear to be implemented.

This problem is caused because in general the teacher is more dominant in using teacher-centered learning, and the teacher as a source of learning is obliged to provide a creative learning environment for students' learning activities in class (Damayanti et al., 2016). This causes teachers to not be able to increase students' attractiveness towards chemistry lessons, and do not connect chemistry in everyday life so that learning becomes meaningless. In fact, based on the current educational curriculum, namely the 2013 curriculum, which prioritizes understanding, skills, and character education. Students are required to understand the material, be active in discussions and presentations, have high manners and discipline, and the learning process of students must be able to develop skills, activities, and creativity through various interactions and learning experiences (Janah et al., 2018). The learning quality can be develop by improving the teacher or instructor ability to transfer the learning materials and quality of teaching and learning process it self will be increased automatically (Kuno et al., 2016; Safaruddin et al., 2020).

Based on the results of interviews with chemistry teachers in class XI at SMA Negeri 1 Tanjung Batu, the teacher has implemented several learning models for the 2013 curriculum, but the problem-based learning model has never been used in Salt Hydrolysis material. The models and methods that are often used vary, sometimes also with lectures, and the media that is often used is PPT. For the implementation of learning material that is considered suitable for practice, it is usually carried out with practicum and the method used in practicum is the teacher demonstrating, then students will carry out according to the teacher's instructions. However, the implementation of learning like this does not invite students to have skills in several competencies such as creativity, innovation, and being able to solve problems, and think critically. For student learning outcomes, the cognitive value of class XI students is quite low, the teacher is still confused about which model is suitable for each material, especially salt hydrolysis material so that it can increase students' cognitive values and skills.

The ability to think and create knowledge (constructivism) is a potential that can be developed (Petchtone, 2014). In achieving an increase in student learning outcomes, it is necessary to apply a learning model that is able to make students able to think critically, creatively and innovatively towards learning. Learning science in the 2013 curriculum has provided a reference in selecting learning models that are in accordance with the scientific approach (Afriana et al., 2016). To be able to build skills critical thinking, teachers can provide learning experiences by designing processes learning (Nafiah & Suyanto, 2014). The teacher designs learning by providing problems that involve students' thinking skills and involve the process of analyzing based on actual problems (Nafiah & Suyanto, 2014). One of the appropriate learning models for teachers to use in the chemistry learning process is Problem Based Learning (PBL). The Problem Based Learning (PBL) Learning Model is a learning that is conveyed by presenting a problem, asking questions, facilitating investigations, and opening dialogue (Sani, 2014). The application of PBL to student critical thinking ability has a positive relation (Oja, 2011). Innovative teaching concepts such as problem-based learning (PBL) can make a difference in an academic setting, particularly when dealing with diversity, and support the successful completion of students' studies (Heuchemer et al., 2020). PBL is among the bestknown teaching concepts that places human experience at the center of learning .In this context, the complexity due in higher education learning is based on three dimensions (Scholkmann, 2016):

- with respect to time, by linking the learning situation to previous knowledge or the learner's own experiences,
- with respect to inter- or transdisciplinary concepts, by describing a problem that involves several disciplines, and
- with respect to naturalism, by selecting a dilemmatic phenomenon for which there is no simple technical or morally unambiguous solution.

Research that refers to the PBL learning model in improving high school student learning outcomes is proven by Mely Cholifatul Jannah in her research entitled "The Effect of Problem Based Learning Models on Learning Outcomes and Science Process Skills", showing that the application of problem based learning models contributes 35, 00% on learning outcomes and 19.36% on science process skills. The achievement of learning outcomes in the attitudes and skills aspects of the experimental class was better than the control class, so the problem based learning model had an effect on learning outcomes and science process skills. In line with another study conducted by Rudi et al., 2019 La Rudi entitled "Implementation of the Problem Based Learning (PBL) Problem learning models based learning (PBL) is a process characteristic learning learning begins with giving problem that has context with real world, group learning active, formulate problems and identify gaps their knowledge, study and search for related material themselves with problems and solutions to problems covered (Amir, 2016). Model with a Scientific Approach to Improve Student Learning Outcomes in Acid-Base Material", that by using the problem-based learning (PBL) model with a scientific approach can improve student learning outcomes as evidenced by the increase in the average value of students.

Effectiveness of learning in conceptual can be interpreted as treatment in the learning process which impact on effort success or action on learning outcomes learners (Rifai, 2013). The purpose of learning by using this problem based learning model is so that students are more sensitive to environmental problems. Based on the agreement with the class XI chemistry teacher at Tanjung Batu 1 Public High School, the material that will be applied with this learning model is salt hydrolysis, because in this material students' cognitive scores are lower than other materials and their scores are still below the KKM. Besides that, in salt hydrolysis material, there is a lot of material that is closely related to everyday life. It is difficult for students to understand if they only receive material without being reflected in everyday life. Based on the description above, the researchers conducted a study to determine "The Influence of the Application of the Problem Based Learning (PBL) Learning Model on Student Learning Outcomes at SMA Negeri 1 Tanjung Batu."

2. Methods

The method used in this study is an experimental research method. This study used a research design, namely quasi-experimental research. The quasi-experimental design used was a non-equivalent (pretest-posttest) control group design. This design consisted of two groups, both of which were determined by purvossive sampling technique. The first group was given treatment and the other group was not, but both were given a pre-test to find out the initial state and a post-test to find out the final state after the learning process.

The location of the research took place at SMA Negeri 1 Tanjung Batu. This research was conducted in the even semester of the 2019/2020 school year with the research subject being class XI MIPA. The independent variable in this study is the Problem Based Learning (PBL) learning model, while the dependent variable is the result of learning chemistry in the material of Chemical Equilibrium. The population in this study is . The sampling technique used is the Random Sampling technique. Two classes were taken from all XI MIPA classes at SMA Negeri 14 Palembang to serve as research samples. From class XI MIPA 1 to XI MIPA 3 it was considered together with the chemistry teacher for class XI SMA Negeri 1 Tanjung Batu then two classes were selected to be sampled, namely XI MIPA 1 and XI MIPA

2. Furthermore, from the two selected classes a re-determination was carried out for class experimental and control class. The determination of the experimental class and control class was also carried out by considering that 33 students were selected for class XI MIPA 1 as the experimental class and class XI MIPA 2 with 34 students as the control class.

The implementation of this research is divided into three stages, namely the preparation stage, the implementation stage, and the evaluation stage. The three stages are described as follows:

1. Preparation
   a. Conducted interviews with class XI chemistry teachers at Tanjung Batu 1 Public High School to obtain information.
   b. Determine the class that will be the research sample with purposive sampling technique.
   c. Developing a Learning Implementation Plan (RPP) for salt hydrolysis material in accordance with the syllabus of the 2013 curriculum implemented in the school.
   d. Develop research instruments in the form of written test questions
   e. Prepare everything related to experiments such as room preparation, learning time and things that support research activities.
   f. Manage research permits
2. Practice
   a. Doing pre-tests by giving pre-tests to students in the experimental class and control class.
   b. Doing learning in the experimental class using the PBL model and for the control class using the direct instruction model.
   c. Conducting final tests by giving post-tests to students in the experimental class and control class.
3. Evaluation
   a. Carry out student assessments.
   b. Carrying out data processing and analysis of the pre-test and post-test results for both the experimental class and the control class. Before the data is analyzed, it is necessary to test for normality to determine whether the data is normal or not.
   c. Calculating homogeneity to find out whether the sample variance is homogeneous or not.
   d. After the data is declared to be normally distributed and homogeneous, the data is tested for the hypothesis by using the t-test
   e. Making interpretations based on the hypothesis testing performed. Based on the hypothesis test, it can be concluded whether H0 is rejected or accepted.
   f. Provide conclusions based on the results obtained from data processing

2.1. Data collection technique

1. Observation, in this study, observations were carried out. Observation is usually done as an evaluation tool and is widely used as a tool to assess individual behavior.
2. Study results test, the tests in this study were in the form of pre-test and post-test written tests given to both the experimental class and the control class. Pre-test is a test given before learning is given and post-test is a test given after the learning process.
3. Documentation, in this study, documentation was used as a source of data to provide information on research, both pictures (photos) and written sources such as test scores, lesson plans for experimental and control classes, and modules.

2.2. Data Analysis Techniques

1. Observational Data Analysis
   The data obtained from the observation sheet is given a score: 1 = poor; 2 = enough; 3 = good, and 0 for invisible descriptors. Then, the total score for each syntax is calculated using the formula:

$$\% = \frac{the\ total\ score\ obtained}{maximum\ total\ score}\ x\ 100\%$$

2. Test Data Analysis
   In this study, the data analysis technique used was the technique of analyzing test results in the form of pre-test and post-test using the help of the Statistical Program for Social Science (SPSS) version 23.0 application. To carry out the test data analysis techniques, normality tests, homogeneity tests and hypothesis tests were carried out.

2.3. Data Normality Test

The normality test in this study used the Shapiro-Wilk method with the help of the SPSS version 23.0 application based on the probability or significance value. Data is said to meet the assumption of normality or normally distributed if the Shapiro-Wilk value is sig > 0.05 whereas those that are not normally distributed have a sig value <0.05.

2.4. Data Homogeneity Test

In this study the Levene test was used using the SPSS version 23.0 application with the criteria that if the significant value was > 0.05, the data was declared homogeneous and if the significant value was <0.05, the data was declared not homogeneous.

2.5. Hypothesis testing

The calculation of the t-test was carried out with the help of SPSS 23.0 Software by using the Independent Sample t-Test with the criteria if the value t (count) > t (table), then H_0 is rejected and H_a is accepted. conversely if t (count) < t (table), then H0 is accepted and Ha is rejected.

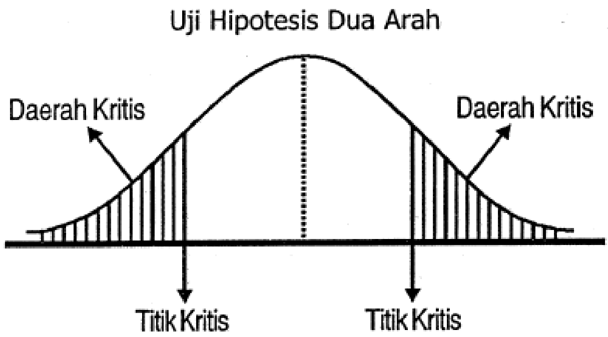

Figure 1. Two-tailed Test

The test criteria that apply are accept H0 if $t < t_{(1-\alpha)}$ and reject H0 if $t > t_{(1-\alpha)}$. The degrees of freedom for the t distribution list are (n1+n2-2) with probability (1- α). By using the formula:

$$t = \frac{\underline{X_1} - \underline{X_2}}{\sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)\, s_2^2}{n_1 + n_2 - 2} \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

With:
X1 = Average score of experimental class students
X2 = Average value of control class students
n1 = Number of students in the experimental class
n2 = Number of students in the control class
s12 = variance of experimental class students
s22 = variance of control class students

The hypothesis testing was carried out in this study using the t-test, by calculating data from students' post-test scores in the experimental class and the control class. The criteria for testing H0 are rejected if t (count) > t (table) with a significance level of 5% (α = 0.05). The calculation of the t-test was carried out with the help of SPSS 23.0 software using the Independent Sample t-Test with the criteria if the value of t (count) > t (table) then H_0 is rejected and H_a is accepted, conversely if t (count) < t (table) then H_0 is accepted and Ha is rejected.

3. Results and Discussion

In this study, the experimental class used the problem based learning model while the control class used the direct instruction learning model. Problem Based Learning is defined as Problem Based Learning, which is a type of learning model that involves students in an activity (project) to produce a product. Student involvement starts from planning, designing, implementing, and reporting the results of activities in the form of products and implementation reports. This learning model places more emphasis on long-term learning processes, students are directly involved with various issues and problems of everyday life, learn how to understand and solve real problems, are interdisciplinary, and involve students as the main actors in designing, implementing and reporting the results of activities (student centered).

This learning model aims to encourage students to learn through various real problems in everyday life associated with the knowledge they have learned or will learn. The problems raised in the Problem Based Learning model are not "ordinary" problems or not just "practice". Problems in PBL demand an explanation of a phenomenon. The focus is on how students identify learning issues and then look for alternative solutions.

In this research, problem-based learning model learning is problem-oriented learning by grouping students into several groups with 5-6 members. For the experimental class with a total of 33 people, divided into 6 groups with 3 groups consisting of 6 people and the next 3 groups consisting of 5 people. Through this learning model students can work together to understand a concept and solve problems related to everyday life. Activities like this make students understand chemistry concepts better so that it is hoped that the learning outcomes obtained will increase.

This research was conducted in four meetings in the experimental class as well as in the control class. To measure student learning outcomes, a pre-test and post-test were carried out in the form of 10 multiple choice questions taken from the National Examination (UN) questions so that there was no need to test the validity and reliability of the questions. The pre-test and post-test questions are the same but the order of the questions is different. This research begins with a pre-test before the treatment is carried out, to determine the ability of students in both the experimental and control classes before being given learning. Then at the last meeting a post-test was given to see the extent to which students' abilities had been given learning. The results of the pre-test and post-test given in both classes can be seen through the bar chart in Figure 2 below:

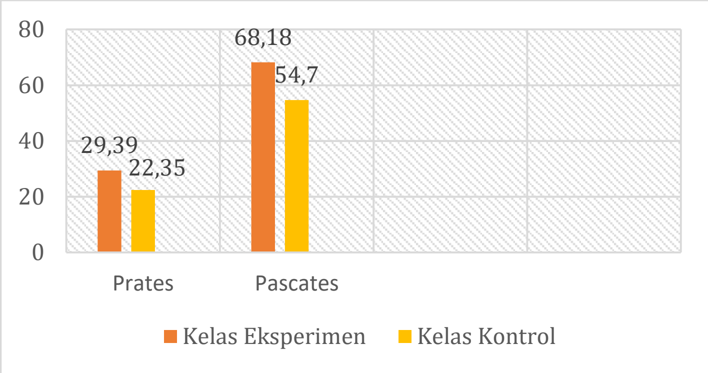

Figure 2. Chart of Mean Pretest and Posttest Scores of Experimental Class and Control Class

3.1. Data Testing Results

Table 1. Normality Test with Transformation result Pretest data

Class	N	Significant Value
Experiment	33	0,095
Control	34	

In Table 1, the significance value of the experimental class and the control class is 0.095, which means it is significant > 0.05. This means that the pre-test value data (tested data) in the experimental class and control class is normally distributed. So that a parametric different test can be carried out with the Independent Sample t-Test.

Table 2. Normality Test with Transformation result Pretest data

Class	N	Significant Value
Experiment Class and Control Class	67	0,908

From table 2. it can be obtained that the value of sig. 0.908 > 0.05. This proves that the data on the results of the experimental and control class students are homogeneous.

Table 3. Hypothesis Test

Pascates	t_{count}	t_{table}
Experiment Class and Control Class	2,988	1,997

The t-test was carried out to find out whether there were differences in learning by applying the problem-based learning model and the direct instruction model to students' chemistry learning outcomes at SMA Negeri 1 Tanjung Batu. In table 4.10 it can be seen that the value of tcount > ttable with a value of t (count) = 2.988 and a value of t (table) = 1.997 (dk) = 65 at a significance level of 5% so that it can be compared to t (count) > t (table) which is 2.988 > 1.997 so that H_0 is rejected and H_a is accepted. This means that there is a significant difference in student learning outcomes between problem-based learning and direct instruction at SMA Negeri 1 Tanjung Batu.

3.2. Description of Observational Data

Based on data from observations of teacher activity, in the experimental class with problem-based learning, the activity was higher than the control class with the direct instruction learning model. The following is a diagram showing the average syntax of the experimental class teacher and the control class can be seen in Figure 3 below:

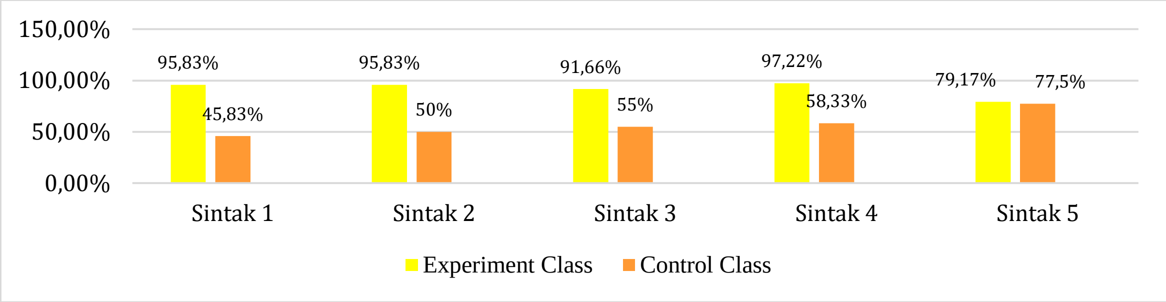

Figure 3. Teacher Observation Mean Percentage Bar Chart

Note:

1 : Student Orientation on Problems
2 : Organizing students to learn
3 : Guiding and investigating individuals or groups
4 : Develop and Present the Work
5 : Analyze and Evaluate the Problem Solving Process

In addition to the results of observations on teacher activity, student activity was also observed by observers through observation sheets of student activity in both the experimental class and the control class. This can be seen through the diagram below:

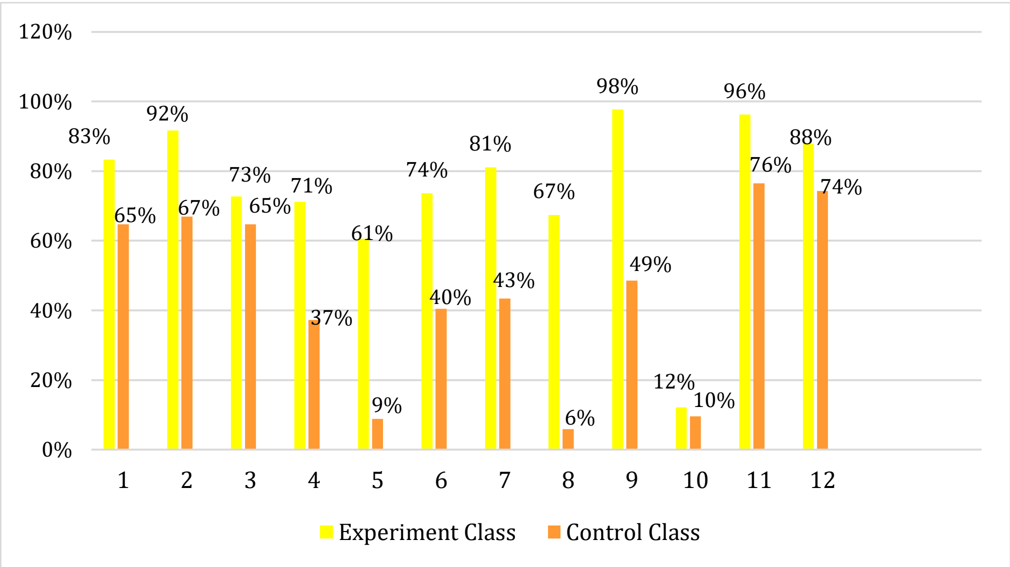

Figure 4. Chart of the Average Percentage of Student Syntax Observations

Note:

1 : Students listen to the learning objectives conveyed by the teacher.
2 : Students observe the phenomena presented by the teacher carefully.
3 : Students listen to the formulation of the problem presented by the teacher.
4 : Students collect information related to the problems contained in the module.
5 : Students contribute ideas to improve the formulation of the problem.

6 : Students are actively involved in conducting experiments/observations and collecting data.
7 : Students analyze the data obtained from the experiments/observations that have been made.
8 : Students contribute ideas to make conclusions from the investigations that have been carried out.
9 : Students listen to the presentation of the report submitted by the group representative.
10 : Students in other groups respond to the results of the presenter's group.
11 : Students pay attention to the evaluation of the investigation process that has been carried out.
12 : Students listen to the teacher's explanation regarding feedback on the problem solving process.

From the results of the observations above, it can be concluded that the activity in the experimental class was higher than the control class, causing the learning outcomes of the experimental class to be higher than the control class. The use of modules in the experimental class was not a factor causing the learning outcomes of experimental class students to be higher than the control class, but the application of the PBL model to learning activities made student activity higher so that the experimental class student learning outcomes were better. By learning the problem based learning model, the students in the experimental class were more active in learning activities which led to a better understanding of the salt hydrolysis students in the experimental class compared to the control class students, whose learning used the direct instruction model. Students were seen to be less actively involved in the learning process. What distinguishes this research from other studies is the place of research, the material and the domain studied.

4. Conclusions

The application of the Problem Based Learning (PBL) learning model has an effect on the chemistry learning outcomes of class XI students of SMA Negeri 1 Tanjung Batu. This can be seen from the average post-test results of students in the experimental class better than the average post-test results in control class students. The results of statistical analysis using the t-test showed that tcount was 2.988 and ttable was 1.997 with a significance level of $\alpha = 5\%$. The results obtained are that tcount > ttable, then the null hypothesis (H0) is rejected, which means that there is an effect of applying the problem-based learning model on students' chemistry learning outcomes in Salt Hydrolysis material at SMA Negeri 1 Tanjung Batu.

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Author Contribution:
Izzati take part in this manuscript as data collector, writing the manuscript, and data interpretation. Made Sukaryawan as suvervisor and review. Bety Lesmini provides our revised article and proofread the manuscript.

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Ethical Review Board Statement:
The study was conducted in accordance with SMAN 1 Tanjung Batu approval. All of the experiment in this research is did under the approval of SMAN 1 Tanjung Batu.

Informed Consent Statement:
Not applicable

Data Availability Statement:
We encourage all authors of articles published in AJCSEE to share their research data. This section provides details regarding where data supporting reported results can be found, including links to publicly archived datasets analyzed or generated during the study. A statement is still required when no new data are created or unavailable due to privacy or ethical restrictions.

Conflicts of Interest:
The authors declare no conflict of interest. The school (SMAN 1 Tanjung Batu) had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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