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The Influence of the TAPPS (Thinking Aloud Pair Problem Solving) Learning Model on the Cognitive Abilities of Reaction Rate Material

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Abstract

This research aims to determine the effect of the TAPPS (Thinking Aloud Pair Problem Solving) learning model on the cognitive abilities of class XI students in reaction rate material at SMA Negeri 1 Ampibabo. The population in this study were all students of SMA Negeri 1 Ampibabo, totaling 150 people consisting of 5 classes. This type of research is a type of quasi-experimental research with a research design using pretest and posttest experimental groups and control groups. Sampling was carried out based on purposive sampling with a research sample of XI IPA E totaling 35 students as the experimental class using the TAPPS learning model, XI IPA A totaling 35 students as the control class using the learning model conventional. Data collection techniques use test techniques. Based on the research results, it can be concluded that there is an influence of the TAPPS learning model on reaction rate material on students' cognitive abilities at SMA Negeri 1 Ampibabo. This is based on the results of calculations using the SPSS Version 25 application where the Sig value (2-tailed) = 0.029 < 0.05, then Ha is accepted and Ho is rejected, meaning that there is a significant influence between the use of the TAPPS learning model on reaction rate material on the cognitive abilities of class XI students in the Reaction Rate material at SMA Negeri 1 Ampibabo.

Keywords: reaction rate; student cognitive; thinking aloud pair problem solving

Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran TAPPS (*Thinking Aloud Pair Problem Solving*) terhadap kemampuan kognitif siswa kelas XI pada materi laju reaksi di SMA Negeri 1 Ampibabo. Populasi dalam penelitian ini adalah seluruh siswa SMA Negeri 1 Ampibabo yang berjumlah 150 orang, yang terbagi ke dalam 5 kelas. Jenis penelitian ini adalah penelitian kuasi-eksperimen dengan desain penelitian yang menggunakan *pretest* dan *posttest* pada kelompok eksperimen dan kelompok kontrol. Pengambilan sampel dilakukan berdasarkan *purposive sampling*, dengan sampel penelitian berupa kelas XI IPA E (35 siswa) sebagai kelas eksperimen yang menggunakan model pembelajaran TAPPS, dan kelas XI IPA A (35 siswa) sebagai kelas kontrol yang menggunakan model pembelajaran konvensional. Teknik pengumpulan data dilakukan melalui tes. Berdasarkan hasil penelitian, dapat disimpulkan bahwa terdapat pengaruh model pembelajaran TAPPS terhadap kemampuan kognitif siswa pada materi laju reaksi di SMA Negeri 1 Ampibabo. Hal ini didasarkan pada hasil perhitungan menggunakan aplikasi SPSS Versi 25, di mana nilai Sig (2-*tailed*) = 0,029 < 0,05; dengan demikian Ha diterima dan Ho ditolak, yang berarti terdapat pengaruh signifikan dari penggunaan model pembelajaran TAPPS pada materi laju reaksi terhadap kemampuan kognitif siswa kelas XI di SMA Negeri 1 Ampibabo.

Keywords: kognitif siswa; reaksi kimia; thinking aloud pair problem solving

Introduction

Education is an effort made to help children be able to compete in today's

human civilization. Education has the meaning of a continuous process, which means it has no end so that it produces quality products. Education has a function as a tool to eliminate ignorance and develop abilities and shape the character of a useful national civilization. The world of education today requires learning activities that can adapt to the needs of the 21st century (Olugbenga, 2022). The role of education is very important, so a quality learning process is needed to advance human life (Slamento, 2010). The higher the quality of the learning process carried out, the higher the quality of education will be possible. The learning process is essentially useful for developing students' skills, activities and creativity through various interactions and learning experiences.

Learning chemistry is a part of science that studies everything that includes composition, structure and properties, changes, dynamics and energetics of substances, which involves skills and reasoning (Wiji et al., 2022). There are two things related to chemistry that are inseparable, namely chemistry as a product (chemical knowledge in the form of facts, concepts, principles, laws, theories and scientific findings) and chemistry as a scientific work process. In general, understanding chemical concepts involves studying macroscopic, microscopic and symbolic aspects (Mulyanti, 2017). Presenting concrete chemical properties is quite easy to do, but explaining the process of chemical changes which are related to changes in material particles (microscopic aspects) and the use of symbols is quite difficult to understand (Sholeh et al., 2025). One indicator of the success of the chemistry learning process is that students have the ability to solve the problems they face, both in the form of questions and problems originating from everyday life (Junita, 2015).

Cognitive is the formation of character or attitudes in work activities (affective) based on thought patterns and movements (psychomotor). Cognitive education by teachers involves the structuralization of students in the 10th (top ten) category, and is adjusted to ownership standards that seek to involve the child's psychomotor conditions, and applies to the consequences of obtaining good skills, in character (Talanquer, 2023).

Based on the results of interviews conducted by researchers at SMA Negeri 1 Ampibabo with teachers in the chemistry subject area, that most students at SMA N 1 Ampibabo do not like chemistry subjects because chemistry subjects are considered difficult by them, and students at that school also do not understand the subject. chemistry, especially in reaction rate material, is because there are many abstract concepts, calculations and formulas that students must memorize. Students at SMA N 1 Ampibabo still use old learning methods and models because teachers do not have the creative spirit to provide learning to students. The chemistry teacher at SMA Negeri 1 Ampibabo also provided information that students' grades in chemistry subjects were still poor, this was seen from the lack of students' ability to explain the factors that influence reaction rates and determining reaction orders, which had an impact on students' grades. When the teacher gave questions that is slightly different from the example questions that have been explained, then students will be confused or have difficulty and will not be able to answer the questions given. So that chemistry subjects, especially at SMA Negeri 1 Ampibabo, only got an average score of 70. Around 50% of students were below the minimum completeness criteria (KKM) standard.

The reason for taking reaction rate material is that it is one of the learning materials at SMA Negeri 1 Ampibabo, namely reaction rate material which contains many concepts that are quite difficult for students to understand, because it involves chemical reactions and calculations and involves concepts that is abstract and is considered by students to be relatively new material. One of the subjects of chemistry that is abstract and contains a lot of calculations is the topic of reaction rates. As stated by Humairoh and Yonata (2022), reaction rate is a concept that explains something that is

abstract and involves mathematical calculations to solve a problem.

Method

This type of research is quasi-experiment research, where this research attempts to try and find causal relationships from the treatment of a subject being investigated by involving a control class and an experimental class. So this research used two classes, namely the experimental class which was treated with the Thinking Aloud Pair Problem Solving (TAPPS) learning model and the control class with the conventional learning model, namely learning using the lecture method (Sugiyono, 2013). The research design used in this study was a nonequivalent pretest-posttest control design. This research design can be seen in Table 1.

Table 1.
Pretets-Postets Control Nonequivalent Design Research Design

Group	Pre-test	Treatment	Post-test
Experiment	O1	X	O2
Control	O1	Y	O2

(Sugiyono, 2013)

This research will be carried out at SMA Negeri 1 Ampibabo. This school is located at Jalan Djide No. 353, East Ampibabo Village, Ampibabo District, Parigi Moutong Regency, Central Sulawesi Province. This research was conducted from April–May 2025. The population in this study were all students in class. The sample in this study was 70 students of class XI Science at SMA Negeri 1 Ampibabo, taken from two classes, namely class XI Science A and class XI Science E, each class consisting of 35 people. The sample was determined using a purposive sampling technique according to its achievements.

The data collection technique in this research was carried out through a multiple choice test. A test is a set of stimuli given by teachers to students to see their achievements. The test in this study was used to see the increase in students' knowledge during the initial test and final test.

Research Instrument
The instruments in this research include:

1. RPP (Learning Implementation Plan)

RPP is a plan that provides an overview of procedures and how to organize learning, the aim is to achieve a basic competency and has been specified in the content standards. The function of the RPP is as a reference for teachers to carry out learning and teaching activities (learning activities) with students, so that they are more focused, run effectively and efficiently (Kunandar, 2011).

RPP validity criteria are calculated using the formula:

$$Va = \frac{\text{Tsh}}{\text{Tsc}}\ x\ 100\ \%$$

Information :
Va = Validation from experts
Tsh = Total expected maximum score
Tsc = Total empirical score (validation results from validators)

2. Test

According to Sugiharti, (2018) A test is a tool or procedure used to find out something using predetermined methods or rules. This test aims to obtain data on student learning outcomes after the teaching and learning process has been carried out. The type of questions in this study is multiple choice with options A, B, C, D, and E. The scoring of each item will be based on whether the answer is correct or incorrect. Before this instrument is used or given to students, a validation test is first carried out by a validator. As for the test validity criteria

Test validity criteria are calculated using the formula:

$$Va = \frac{\text{Tse}}{\text{Tsc}}\ x\ 100\ \%$$

Information :

Va = Validation from experts
Tsh = Total expected maximum score
Tsc = Total empirical score (validation results from validators)

3. LKPD (Student Worksheet)

LKPD are sheets containing tasks that must be done by students. LKPD in research is made based on learning objectives that must be achieved at each meeting given to students during learning. The components in the LKPD include class, group, instructions, learning objectives and questions.

The validity criteria for the LKPD are calculated using the formula:

$$\frac{\text{Tse}}{\text{Tsc}} \; x \; 100\,\%$$

Information :
Va = Validation from experts
Tsh = Total expected maximum score
Tsc = Total empirical score (validation results from validators)

Results and Discussion

The results obtained in this research are in the form of a teaching and learning process using the TAPPS learning model in the experimental class (XI IPA E) and conventional learning models in the control class (XI IPA A) and student learning outcomes in class reaction rate material XI Science SMA Negeri 1 Ampibabo.

Instrument Analysis

Before conducting research, first validate the research instrument. This validation is used to obtain a research instrument that has valid criteria. Validated research instrument instruments include: and cognitive tests (affective and psychomotor) of students in the form of multiple choice questions, Learning Implementation Plans (RPP), and Student Worksheets (LKPD).

1. Validation Results of Cognitive Value Test

The cognitive value test used in the student learning process was in the form of 25 multiple choice questions prepared by the researcher. And has been validated by a lecturer as an expert validator. The results from the expert validator show that the student learning process test is valid to be tested as a research instrument on the research sample.

2. Learning Implementation Plan (RPP) Validation Results

The validation results of the RPP with an average validity criterion of 93.75%, where this value is included in the very valid criteria or can be used without revision, namely at 85.01% -100.00% (Akbar, 2013).

3. Student Worksheet Validation Results (LKPD)

LKPD validation results with an average validity criterion of 70.90%, where this value is included in the criteria of being quite valid or usable but needs minor revision, namely at 70.01%-85.00% (Akbar, 2013).

Data Analysis Results

1. Normality Testing

This normality test is carried out with the aim of finding out whether the data obtained is normally distributed or not as a requirement for hypothesis testing. This normality test and data uses the One Sample Kolmogorov Smirnov Test method using SPSS (Statistical Product and Service Solution) software version 25. The interpretation is by looking at the output results in the Asymp section. Sig (2-tailed). If the significance value is ≥ 0.05 then the data is normally distributed and if the significance value is ≤ 0.05 then the data is not normally distributed. The normality test results obtained are as follows in Table 2.

Table 2.

Normality Test Results

Class	Data	N	Significance	Information
XI IPA E (Experiment)	Pretest	35	0.057	Normally distributed
	Posttest		0.085	Normally distributed
XI IPA A (Control)	Pretest	35	0.200	Normally distributed
	Posttest		0.056	Normally distributed

2. Homogeneity Testing

Homogeneity testing has one condition which states that the differences between the two classes taken as samples must be homogeneous. This homogeneity test will use the Levene test. The basis for decision making in the Levene homogeneity test, if the significance value is > 0.05 then the data is homogeneous and if the significance value is < 0.05 then the data is not homogeneous. The homogeneity test results can be seen from the following Table 3.

Table 3.
Pretest Homogeneity Test Results

	Levene Statistics	df1	df2	Significance	Information
Pretest	0.752	1	35	0.389	Homogeneous

Table 4.
Posttest Homogeneity Test Results

	Levene Statistics	df1	df2	Significance	Information
Posttest	0.642	1	35	0.426	Homogeneous

3. Testing Hypothesis

Hypothesis testing is used to prove the truth of the proposed hypothesis, namely to determine the effect of the TAPPS (Thinking Aloud Pair Problem Solving) learning model on student learning outcomes. If the significant value (Sig.) is smaller than 0.05 then a variable is said to have a significant effect on other variables. The criteria for acceptance and rejection of the hypothesis are:

- If the Sig value. (2-tailed) > 0.05 then HO is accepted and Ha is rejected
- If the Sig value. (2-tailed) < 0.05 then HO is rejected and Ha is accepted

Once it is known that the learning outcomes data for the two samples have a normal and homogeneous distribution, then hypothesis testing is carried out using the t test. The results of data testing for both samples can be seen in Table 5.

Table 5.
Posttest t test Results

Class	Data	N	Average	Q	Significance
XI IPA E	Posttest	35	80.23	2.225	0.029
XI IPA A		35	75.43		

The aim of this research is to find out how the TAPPS learning model influences student learning outcomes in the material on reaction rate XI SMA Negeri 1 Ampibabo. The sample used in this research was 70 students from 2 classes, namely the experimental class with 35 students from class XI IPA E and the control class with 35 students from class XI IPA A.

The initial stage of carrying out this research is to prepare the research instruments that will be used in the research. The research instruments are RPP, LKPD, and Student Learning Outcome Tests. Then

this research instrument is validated by valid expert validators to produce research data that is good and can be trusted.

The research implementation in the experimental and control groups used a time allocation of 3 x 45 minutes for each meeting, with the same material presented, namely Reaction Rate material and the order in which the material was delivered was also the same, but different treatments were carried out in the learning model used, where the experimental group used the learning model TAPPS while the control group used a conventional learning model.

The instrument used in this research was 25 multiple choice questions which had been validated in terms of content and instrument validation submitted to students in class XI IPA A and XI IPA E at SMA Negeri 1 Ampibabo. Before (pretest) and after (posttest) learning, to measure student learning outcomes. Data analysis was carried out on this instrument using the SPSS version 25 application which consists of normality, homogeneity and t tests on the pretest and posttest on the learning outcomes of students in class XI IPA A and XI IPA E.

Based on the results of the pretest data normality test in the experimental class, a significant value of 0.146 > 0.05 was obtained and in the control class the significant value was 0.119 > 0.05. The results of the posttest data normality test in the experimental class had a significance value of 0.139 > 0.05 and the control class was 0.146 > 0.05, this shows that the data distribution in both classes was normally distributed.

The results of the homogeneity test on the pretest data obtained a significance value of 0.902 > 0.05. The test results on the posttest data have a significance value of 0.264 > 0.05, thus the data in this study is homogeneous, which means that the simple groups used come from the same varied population.

The results of the hypothesis test or t test on pretest data for the experimental and control classes before being given different treatment showed that the average student learning outcomes in the experimental class were 43.43 and the control class was 40.80 with a significance value of 0.389 > 0.05 So it can be concluded that there is no difference in the average student learning outcomes in the experimental class or control class. This is in accordance with the basis for decision making if the significance value is > 0.05 then Ho is accepted and Ha is rejected. Furthermore, in the posttest data for the experimental class and the control class after being given different treatments, there was a change in the average learning outcomes of the experimental class and control class students due to the treatment, this was proven by the average value of the learning outcomes for the experimental class students being 80.23 while control class the average value of student learning outcomes is 75.43 and the significance value is 0.029 <0.05 so based on decision making if the significance value is <0.05 then Ho is rejected and Ha is accepted meaning there is an influence of the TAPPS on the learning outcomes of students at SMA Negeri 1 Ampibabo

Based on the data obtained, learning uses the TAPPS model. The results of the research and discussion in this research show that in student learning outcomes there are significant differences between the experimental class and the control class, where the average score for the experimental class is 80.23, which is higher than the control class, namely 75.43, thus it can be concluded that The TAPPS learning model can provide better grades than conventional learning models. As well as the results of hypothesis testing which show that there is an influence of the TAPPS learning model on student learning outcomes, so it can be said that learning using the TAPPS model has a positive influence on the learning outcomes of class XI IPA E students. Ampibabo 1 Public High School.

Based on data obtained from inferential statistical tests on the TAPPS Thinking Aloud Pair Problem Solving learning model, it has an influence with higher results on student learning outcomes as a result of the advantages that are characteristic of the TAPPS learning model, namely students are ready to learn everything. , working on problems in groups

well, having serious discussions, students' understanding increases and students have new skills (Maslaha, 2022). The use of this model can make students involved in thinking activities so that they can be directly involved in the learning process. Student involvement in the learning process can increase their understanding and knowledge (Habiddin & Page, 2023).

The lack of success in implementing the TAPPS model can be caused by several factors, for example the implementation of the TAPPS model is less effective, such as discussions that do not run optimally or the abilities between students are classified as having a wide range of differences, so that when the TAPPS model is applied where students alternate between being Listeners and problem solvers, they still relying or relying on students who are considered smarter (Noh et al., 2025). So that cooperation between students cannot run in a balanced two-way manner. In addition, students who are not used to implementing discussions can result in ineffective time.

The results of this research are also in accordance with Whimbey and Lochhead's (1999) statement regarding the strengths and weaknesses of the TAPPS learning model, namely:

- Students' comfort in learning can increase
- The learning that took place was enjoyable
- All students can actively participate
- Students' ability to solve problems can increase

However, there are also disadvantages, namely:

- It is possible that there may be misunderstandings when the problem solver conveys the solution to the listener
- Each meeting may take longer

The influence of the TAPPS (Thinking Aloud Pair Problem Solving) learning model can improve student learning outcomes because in this learning model students are stimulated to be more active and independent and can be more actively involved in solving problems in discussions because students look more enthusiastic. This happens because the groups are divided into 5-6 students. Grouping students can encourage their involvement in the teaching and learning process

The TAPPS model places emphasis on solving problems rather than looking at the final assessment. Students can also organize strategies and approaches to success and failure that might be used to solve problems. So that there can be an increase in students' abilities in creating concepts, identifying errors and organizing ideas (Bakley et al, 2012)

The results of hypothesis testing show that there is an influence of the TAPPS learning model on student learning outcomes and based on student pretest and posttest results, it can be said that the TAPPS learning model can have a positive influence on learning outcomes of class XI Science students at SMA Negeri 1 Ampibabo.

The results of this research also reveal the advantages and disadvantages of the TAPPS model applied. Based on the results of learning in the experimental class, it can be said that this model is in accordance with statements (Hu, 2024), including that it can develop students' ability to solve problems, reduce impulsive thinking (without planning), can improve active listening skills, improve communication skills, build self-confidence in solving problems, and students' thinking patterns are more structured (Lestari & Yenti, 2024). Meanwhile, the shortcomings of the TAPPS model that are known based on learning results during research are in accordance with the statement (Purwaningrum, 2016), including that the TAPPS model requires a lot of time, students find it difficult to express the ideas they have in mind, allowing for misunderstandings regarding problem solving from the information conveyed by the problem solver and that is understood by the listener, and listeners sometimes experience difficulties when guiding or giving instructions as well as correcting the problem solver when solving a problem (den Otter et al., 2022).

The influence of the TAPPS learning model in this research had several obstacles during its implementation. The obstacle that is usually found is that students do not really understand and are used to learning using

the TAPPS learning model which researchers apply during the learning process, so it is quite difficult for students to adapt and the duration of time used during the learning process takes a long time. which is quite long so teachers must have good time management to implement this learning model.

Conclusion

Based on the results of research data analysis, it can be concluded that there is an influence of the TAPPS learning model on student learning outcomes in reaction rate material at SMA Negeri 1 Ampibabo. This is proven by the results of the t test in the experimental class which obtained an average value of 80.23 while in the control class it was 75.45 with a significance value of 0.029 <0.05. This means that the significance value is smaller than the alpha value, which can be concluded that the researcher's hypothesis which states "there is an influence of the TAPPS learning model on student learning outcomes based on the level of problem solving ability in class) can also be seen that students can learn using this learning model so that students' grades have reached the KKM score.

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