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REACT Strategy: An Innovative Approach to Improving Students' Chemistry Learning Outcomes

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Abstract

This research aims to determine the application of the REACT strategy as an innovative approach in improving student chemistry learning outcomes. This research was carried out at MAN 2 Padang Lawas in the Even semester of FY 2023/2024. The population in this study were all students in class X MIA with an average number of students per class of 30 people. The sample consisted of 2 classes taken with determination because the number of class X MIA was only 2 classes. The experimental class applies the REACT strategy as an innovative approach, and the control class applies conventional learning. The data collected is processed from the Posttest results. The data were analysed using the independent t-test formula to test the research hypothesis and obtained $t_{count} > t_{table}$ (4.67 > 1.67), so it can be concluded that the application of the REACT strategy as an innovative approach can improve student chemistry learning outcomes. Meanwhile, the gain test for the increase in learning outcomes for the experimental class was 72.60% in the high category, and the control class was 58.50% in the medium category. It can be concluded that the application of the REACT strategy as an innovative approach can improve students' chemistry learning outcomes.

1. Introduction

Chemistry is a branch of Natural Sciences (IPA) where the context is very close to everyday life (Islamiati, N., et al. 2020). Chemistry is a science that studies the structure, composition, properties, changes in matter, and the energy that accompanies it. The many abstract chemical concepts that students must understand in a relatively short time make chemistry one of the materials that is difficult for students to learn, resulting in low learning outcomes (Suleman, Nita., et al. 2022). In the scope of chemistry learning, it is not only the use or derivation of formulas that are learned, but there are also a collection of facts, theories, principles, and laws that are obtained and developed in a series of activities (processes) (Suleman, Nita, et al. 2022). Chemistry learning emphasizes how students master concepts and not memorizing facts from each other. Chemical concepts have a high level of generalization and abstraction which causes students to have difficulty in mastering (Farid, A and S. Nurhayati., 2014).

The achievement of quality that has been designed in the curriculum document, needs to be utilized in learning activities on the principles: (1) centered on students, (2) developing student creativity, (3) creating fun and challenging activities, (4) content based on values, ethics, aesthetics, logic, and kinesthetics, and (5) providing a variety of learning experiences through the application of various strategies and methods that are fun, contextual, effective, efficient and meaningful learning (Utami, W.S. et al., 2016).

Learning activities are the most basic activities. This shows that the success/achievement of educational goals depends largely on how the learning process is experienced by students as students (Riyanto, A.I. 2014). In the learning process, each student has the same opportunity to develop themselves optimally, but the learning outcomes obtained vary due to differences in students' abilities to adapt to the situation during learning. The most common problem faced in the world of education is low student learning outcomes and passive attitudes of students during the learning process are one of the contributing factors (Islamiati, N., et al. 2020). So that effective learning must be understood and attempted to occur in every learning activity. Effective learning can help students to improve their abilities or student learning outcomes in accordance with the competencies they want to achieve. The success of achieving educational goals in schools is influenced by many factors, including internal learning factors and external learning factors. Internal learning factors include attitudes towards learning, ability to achieve, desire to explore learning outcomes and learning habits. External learning factors include learning facilities and infrastructure, social environment, school curriculum, and assessment policies. This can be used as material to regulate and control the factors that influence the learning process in such a way that an optimal learning process can occur (Riyanto, A.I. 2014).

Based on initial observations conducted at MAN 2 Padang Lawas school, it can be seen that the teaching and learning process in chemistry lessons, especially buffer solution material, still uses classical learning, namely lecture and group discussion methods for materials related to concepts, for materials related to calculations, teachers tend to use lecture and practice methods, so that students play more and are more often bored during the learning process. The lack of student attention to chemistry material is caused by the lack of creativity from teachers during the teaching and learning process. This causes students to be less able to do the tasks given, which in the end many students' test scores are still below the KKM, which is 70.

Therefore, in order for the learning process to be more meaningful, a learning model is needed that can make it easier for students to understand the learning materials. One example of a contextual learning model is REACT. The REACT strategy is described by Crawford (2001), that there are five strategies that must be seen, namely: Relating, Experiencing, Applying, Cooperating, Transferring. Relating is learning by linking the material being studied with the context of real-life experiences or previous knowledge. Experiencing is learning that makes students learn by doing activities (learning by doing) through exploration, discovery, searching, problem-solving activities, and laboratories. Applying is learning by applying concepts that have been learned to be used, by providing realistic and relevant exercises. Cooperating is learning by conditioning students to work together, share, respond and communicate with other learners. Then Transferring (transferring) is learning that encourages students to learn to use the knowledge they have learned into new contexts or situations that have not been studied in class based on understanding (Karima, F and Kasmadi, I.M., 2015).

The REACT strategy (Relating, Experiencing, Applying, Cooperating and Transferring) is one of the most widely used implementations of the approach strategy which consists of 5 stages, namely linking, experiencing, applying, collaborating and transferring (Gunter, Tugce., 2023). The REACT strategy is one strategy to improve students' abilities and learning outcomes. The REACT strategy can be carried out by teachers, especially on material that is close to real life (Taidi, Zurisaday., 2019). The first stage of the REACT strategy is linking. Here, students learn in the context of their life experiences or previous knowledge. Students' attention is focused on everyday life experiences, and these experiences are then linked to new concepts learned or problems to be solved. After students' previous knowledge has been assessed, a supportive environment and the materials needed are given to students to explore. This occurs at the experience stage, which is the second stage of the strategy stage. The second stage of experiencing is allowing students to experience activities related to real-life events as they learn in the context of discovery, exploration and discovery. The experience stage is considered the core of contextual learning and therefore, students are obtained to be interested in learning regarding text or audiovisual-based activities or both (Quainoo, B.A., et al. 2021). The REACT approach can help transfer the role and function of content in teaching and learning to be flexible and flexible. The real benefit is that students learn more easily and are motivated to learn better (Algiranto, et al. 2023).

In previous research Taidi, Z., et al. (2019) stated that the Contextual Teaching and Learning (CTL) learning method with the REACT strategy was proven effective in improving student learning outcomes in buffer solution material in class XI IPA SMA Negeri 2 Langowan. Based on the research results of Suleman, Nita., et al. (2022) from hypothesis testing using the t-test, it was obtained that at a significance level of 0.05 with dk = 53, the calculated t was 5.695, which was greater than the t table, which was 1.674, so it can be concluded that H0 is rejected and H1 is accepted, meaning that there is an effect of using REACT strategy learning on students' cognitive learning outcomes on buffer solution material. Furthermore, it is supported by the research results of Karima, F and Kasmadi, IM, (2015) which state that the application of MEA and REACT learning can improve learning outcomes. The learning outcomes of chemistry in the cognitive aspect that were given REACT learning were better than those given MEA learning, this can be seen from the increase in pretest and posttest scores in both experimental classes with an average pretest value of experimental class 1 (MEA) 34 increasing to 74 on the posttest and experimental class 2 (REACT) 39 increasing to 84.97. Nurhayati, S. (2014) stated that chemistry learning with the REACT strategy has a positive effect on students' chemistry learning outcomes. According to Ihsani, A.Z., et al. (2020), REACT learning has a positive effect on students' KBK on the concept of solubility and solubility product.

Based on the description of the problems that have been explained above, the researcher conducted a study with the aim of the study, namely the application of the REACT strategy as an innovative approach in improving students' chemistry learning outcomes. This study has a main discussion, namely the application of learning using the REACT strategy with conventional learning, namely lectures, questions and answers and assignments.

2. Materials and Methods

This research was conducted at MAN 2 Padang Lawas in the Even Semester of Academic Year 2023/2024. The population in this study were all students of class X MIA with an average number of students per class of 30 people. The sample consisted of 2 classes, which were taken by determination because the number of class X MIA was only 2 classes. The first class, as an experimental class, consisted of 30 students, and the second class, as a control class, consisted of 30 students. The research design is presented in Table 1 below:

Table 1. Research Design

Group	Pre-Test	Treatment	Post Test
Experiment	T_1	X	T_2
Control	T_1	-	T_2

The instrument used in this study was a multiple-choice test used for a pretest and a posttest. Data analysis was carried out using normality, homogeneity, and hypothesis tests. To see the increase in student scores, a gain test was carried out.

$$\text{Normalised gain} = \frac{\overline{postest} - \overline{pretest}}{maximum\ score - \overline{pretest}} \times 100$$

With the following gain criteria:
$g < 0.3$ = low gain
$0.3 \le g \le 0.7$ = medium gain
$g > 0.7$ = high gain

3. Results and Discussions

This research was conducted at MAN 2 Padang Lawas in the even semester of the 2023/2024 academic year. The sample consisted of 2 classes, namely the experimental class with 30 students treated with the REACT strategy in the chemistry learning process, while the control class with 30 students was treated with conventional learning (lectures, questions and answers, and assignments). The instrument used was multiple-choice questions consisting of 20 questions for the pre-test and post-test. The pre-test was given to students before they were given the learning. This pre-test aims to determine the students' initial abilities. While the post-test was given to the experimental class after being taught using the REACT strategy and the control class after being taught conventionally (lectures, questions and answers, and assignments) in the form of 20 multiple-choice questions with a randomised order from the pre-test questions. In summary, the results of the students' pre-test and post-test can be seen in the following Table 2 below:

Table 2. Research Results Summary

Data	Pre-test		Post-test	
	Experimental Class	Control Class	Experimental Class	Control Class
Minimum Value	20	20	70	60
Maximum Value	60	60	95	85
Mean Value	32,5	33,17	81	71,83
Standard Deviation (SD)	11,64	11,41	6,88	8,25

The table above shows that the experimental class and the control class experienced an increase in scores after being given the application of learning. There is a difference in the increase in the average score in the control class and the experimental class due to different treatments. The average score in the control class increased with a difference between the pre-test and post-test of 38.66. While the average score in the experimental class increased with a difference between the pre-test and post-test of 48.5.

The learning outcomes of each group were then tested for data analysis prerequisites first, including normality tests and homogeneity tests. The normality test is a test carried out to determine whether the data in each group is normally distributed or not. The normality test is carried out using the Liliefors test. The Liliefors normality test is a non-parametric test used to determine whether the data is normally distributed or not. Data is said to be normally distributed if $Lo < L\alpha_{(table)}$ with a significance level of $\alpha = 0.05$.

Table 3. Normality Test Results

Statistics	Pre-test		Post-test	
	Experimental Class	Control Class	Experimental Class	Control Class
Lo	0,158	0,157	0,148	0,129
$L\alpha_{(table)}$	0,161			
Information	$Lo < L\alpha_{(tabel)}$	$Lo < L\alpha_{(tabel)}$	$Lo < L\alpha_{(tabel)}$	$Lo < L\alpha_{(tabel)}$

Description	Normally Distributed	Normally Distributed	Normally Distributed	Normally Distributed

To prove whether the data is normally distributed or not, after conducting a normality test is conducted by comparing the significance value of the results of the Lilliefors normality test (Lilliefors Observation) with a significance level of 5% at n = 30 of 0.161. If the significance value of the test results is less than 0.161, the data can be said to be normally distributed, while if the test results are more than 0.161, the data can be said to be not normally distributed. Based on the results of the normality test that has been carried out, the significance value obtained is less than 0.161, then the test results can be concluded that the data is normally distributed.

Furthermore, a homogeneity test is carried out to determine whether a set of data to be analysed comes from a population that is not much different in diversity or not in the study. In this study, the diversity in question is the level of student ability. The data homogeneity test is carried out using the F test at a significance level of $\alpha = 0.05$. Data can be said to be homogeneous if $F_{count} < F_{table}$.

Table 4. Homogeneity Test Results

Statistics	Pre-test		Post-test	
	Experimental Class	Control Class	Experimental Class	Control Class
F_{count}	1,034		1,436	
$F_{(table)}$	1,86		1,86	
Information	$F_{count} < F_{table}$		$F_{count} < F_{table}$	
Description	Homogeneous Data		Homogeneous Data	

For the variant, is homogeneous or not after the homogeneity test is carried out by comparing the significance value of the homogeneity test results with a significance level of 5% at n = 30 of 1.86. If the significance value of the test results is less than 1.86, then it can be said that the variant is homogeneous, while if the significance value of the results is more than 1.86, then it can be said that the variant is not homogeneous. Based on the results of the homogeneity test that has been carried out, the significance value obtained is less than 1.86, then it can be concluded that the variants are homogeneous.

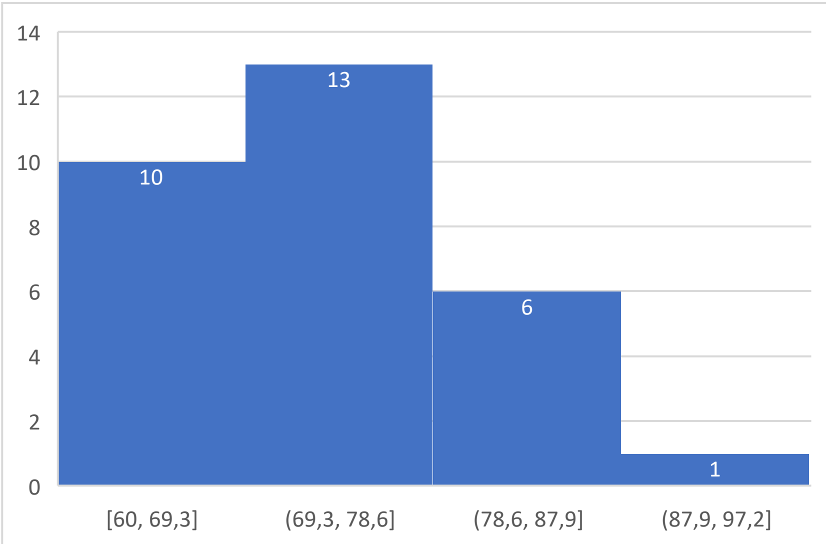
After all the analysis prerequisites for testing are met, the next step is to conduct a hypothesis test. Hypothesis testing is carried out to determine whether the alternative hypothesis (Ha) is accepted or rejected. The hypothesis test carried out is the t-test at a significance level of $\alpha = 0.05$, with the test criteria accepting Ha if $t_{count} > t_{table}$.

Table 5. Hypothesis Test Results

Statistics	Data	
	Experimental Class	Control Class
Mean	81	71,83
Variance	47,38	68,07
$t_{(count)}$	4,67	
$t_{(table)}$	1,67	
Information	$t_{count} > t_{table}$	
Description	Ha accepted, Ho rejected	

To find out whether there is an influence or not, after conducting a t-test by comparing the 5% significance value of 1.67. If the significance value of the test results is greater than 1.67, then it can be said that there is an influence, while if the significance value of the results is less than 1.67, then it can be said that there is no influence. From the results of the hypothesis test calculation, t count is 4.67 and t table is 1.67, then $t_{count} > t_{table,}$ then accept Ha, reject Ho. So it can be concluded that the application of the REACT strategy as an innovative approach can improve students' chemistry learning outcomes.

The following is a graph of the post-test results from the experimental class and the control class.



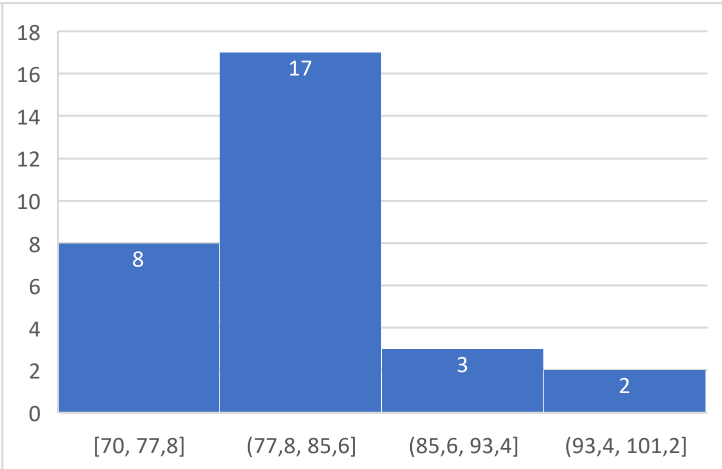


Figure 2. Posttest Results for Control Class

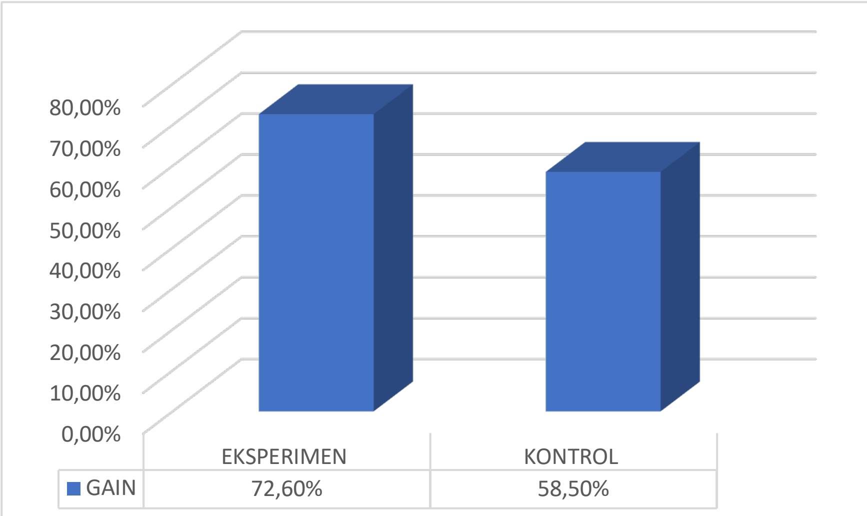
Furthermore, the results of the pre-test and post-test scores were used to calculate the gain value of the increase in student learning outcomes. From the results of the gain calculation, an increase in student learning outcomes from both classes was obtained, namely:

Table 6. Improvement of Learning Outcomes

	Normalized Gain	Description

Experimental Class	0,726	High Learning Outcome
Control Class	0,585	Medium Learning Outcome

The following graph shows the increase in student learning outcomes from both classes.



From the picture above, it can be concluded that students who are taught using the REACT strategy experience higher learning outcomes than students who are taught conventionally (lectures, Q&A, and assignments). In other words, the level of understanding of students who are taught using the REACT strategy is better than students who are taught conventionally (lectures, Q&A, and assignments). In the experimental class, the REACT strategy was applied to the buffer solution material. In implementing this strategy, many activities and experiences are gained with students who are different from the control class. The REACT strategy consists of five strategies that must be visible in learning, namely relating, experiencing, applying, cooperating, and transferring. The REACT strategy begins with relating, namely by providing apperception, namely the teacher directs students to make connections between new concepts and something that is familiar to students by asking questions about interesting phenomena.

Then, the related strategy is continued by providing brief material. Furthermore, the experiencing strategy is learning that makes students learn by doing activities, so simple, practical activities are chosen to compare the addition of acids, bases, or dilutions to buffer and non-buffer solutions. Students carry out a simple practicum to prove the truth of the theory that buffer solutions can maintain their pH, and this practicum makes learning interesting for students. The application strategy is carried out by giving practice questions regarding the buffer solution material that has been studied; here, students apply the concepts that have been studied. In the cooperative strategy, students are conditioned to work together in learning; this strategy is carried out simultaneously with the experiential strategy. Next, students transfer their knowledge into new situations that have not been studied in class, in the transferring strategy. This causes experimental class students to have better learning outcomes, because the understanding they gain is multi-fold, from connecting new material with previous knowledge in relating strategies, doing practicums to prove theories in experiencing strategies, applying concepts in applying strategies, working together in learning and sharing discusses material on cooperative strategies to transfer knowledge in new situations on transferring strategies.

The results of this study are supported by research by Pohan, H.M., et al. (2024) stating that the REACT learning model can improve learning outcomes, this can be seen from the results of the experimental class research, the average value after implementing the REACT learning model was 73.33 and 60.33 in the control class and the independent t test using SPSS obtained a sig value of 0.025 <0.05. Widiadnyana, Putu, et al. (2021) stated that the application of the REACT strategy assisted by the augmented reality application of spatial figures in mathematics learning can improve student learning outcomes. According to Sigiro, Mula, et al. (2024), who stated that the results of learning physics taught through the REACT learning model on the results of learning physics on dynamic electricity material for class X and kinetic theory of gases for class XI IPA SMA Swasta Santu Fransiskus Aek Tolang increased. According to Quainoo, B.A., et al. (2021) stated in his research that the REACT strategy is more effective for teaching molecular genetics compared to conventional approaches. Although REACT cannot bridge the gap between low and high achievement groups, in terms of performance, the low and high achievement groups are equivalent. Students are allowed to search for and share information and connect new concepts with previous concepts, REACT strategy learning to facilitate students' understanding of the concept of molecular genetics. Taraufu, A.F., et al. (2020) stated that there is an influence of the application of the REACT learning strategy on student learning outcomes in the material on the concept of acids and bases. This can be seen from the results of the product moment correlation analysis obtained an rxy value of 0.6466, which indicates a strong level of relationship. The results of the determining coefficient to determine the effect of REACT learning on learning outcomes were obtained at 41.82%.

This REACT strategy explains that students must be involved in continuous activities, think and explain their reasoning, know the various relationships between themes and concepts, not just memorise and read facts repeatedly and listen to lectures from educators. There are 5 stages in the REACT strategy, namely:

1. *Relating (associating)*
   Relating is learning in the context of linking new knowledge with life experiences. In using this strategy, teachers must link the material being studied with something that is already familiar to students.
2. *Experiencing*
   Experiencing is learning in the context of exploration, discovery, and invention activities. Learning will be effective when students can use tools and materials in discovery activities.
3. *Applying*
   Applying is learning that emphasises the activity of demonstrating knowledge in context and its use. Students are said to be able to apply concepts if they can use their knowledge in problem-solving.
4. *Cooperating*
   Cooperating is learning in the context of sharing, responding, and communicating among students. This stage is an important stage in contextual learning strategies. Students who learn individually sometimes cannot show significant progress in problem solving compared to students who learn in groups
5. *Transferring (Moving)*
   Transferring is a learning activity where teachers assist students to use what they have learned and apply it in new situations or contexts (Islamiati, N., et al. 2020).

Learning with the REACT strategy begins by providing motivation to students. Teachers motivate students by linking learning materials with the knowledge they have acquired (either from school or from the surrounding environment) so that students can understand the concept easily. Students are allowed to have experience in the process of discovering the concept of the material being studied by solving problems or doing any activities provided in the student worksheet. The concepts obtained are then used to solve the problem (Supandi et al., 2016). Then, students discuss with their groups about the problem-solving that has been done. After that, they present the results of the discussion regarding the problems that have been solved, and finally, students try to solve new problems using the concepts they have understood. The implementation of REACT learning involves students directly so that it can motivate students to be more enthusiastic and active (Ihsani, A.Z., et al. 2020).

5. Conclusions

Based on the analysis of student learning outcomes data from the experimental class and control classes at MAN 2 Padang Lawas in the even semester of the 2023/2024 academic year on the material of buffer solutions, it can be concluded that: The application of the REACT strategy as an innovative approach can improve students' chemistry learning outcomes obtained from the hypothesis test, t count 4.67> t table 1.67. The increase in learning outcomes for the experimental class was 72.60% in the high category and the control class 58.50% in the medium category. It can be concluded that the application of the REACT strategy as an innovative approach can improve students' chemistry learning outcomes

References

Algiranto, et al. 2023. *PBM Assistance with the REACT Approach Based on Environmental Awareness in the Post-New Normal Era.* CEMERLANG JOURNAL: Community Service. Vol. 5. No. 2. Pages: 203 – 211.

Farid, A. and S. Nurhayati. 2014. *The Effect of Applying the REACT Strategy on Chemistry Learning Outcomes of Grade XI Students.* Chemistry in Education. Vol 3. No.1. Pages: 36-42.

Gunter, Tugce, 2023. *Using CBA REACT Strategy Supported by Crossword Puzzle Game on the Topic of Acid-Base Titrations.* J. Sci. Learn. Vol. 6 No. 1. Pages: 87-99.

Ihsani, A.Z., et al. 2020. *Application of the REACT Learning Model to Students' Critical Thinking Skills on the Concept of Solubility and Solubility Product*. Journal of Chemical Education Innovation. Vol. 14. No. 1. Pages: 2498 – 2511.

Islamiati, N., et al. 2020. *The Effect of Problem-Based Learning Model on Chemistry Learning Outcomes of Class X MS Students of SMAN 1 Kediri on Reduction and Oxidation Reactions Material.* Chemistry Education Practice. Vol. 3. No. 2. Page: 112-115.

Karima, F and Kasmadi, I.M., 2015. *Application of MEA and REACT Learning Models on Redox Reactions Material.* Journal of Chemical Education Innovation, Vol 9, No. 1. Page: 1431-1439.

Pohan, H.M., et al. 2024. *Exploring the World of Redox with REACT: An Innovative Learning Approach to High School Students' Learning Outcomes.* EKSAKTA: Journal of Mathematics and Natural Sciences Research and Learning. Vol. 9 No. 2. Page: 299-306.

Quainoo, B.A., et al. 2021. *Effect of the REACT Strategy on Senior High School Students' Achievement in Molecular Genetics.* LUMAT: International Journal on Mathematics, Science and Technology Education. Vol 9. No. 1. Pages: 696–716.

Riyanto, A.I.2014. *Implementation of REACT Learning Strategy to Improve Student Learning Outcomes. Journal of Electrical Engineering Education*. Vol. 03 No. 02. Pages: 37- 46.

Sigiro, Mula, et al. 2024. *The Effect of REACT (Relating, Experience, Applying, Cooperating and Transferring) Learning Model on Physics Learning Outcomes in Dynamic Electricity Material for Class X and Kinetic Theory of Gases for Class XI IPA Semester II of SMA Swasta Santu Fransiskus Aek Tolang.* Journal of Natural and Applied Sciences Education (JPIPA&T).

Suleman, Nita, et al. 2022. *The Effect of REACT Strategy on Students' Cognitive Learning Outcomes in Buffer Solution Material.* Jambura Journal of Educational Chemistry. Vol. 4. No. 1. Pages: 44-50.

Supandi, et al., 2016. *Analysis of Mathematical Representation by React Strategy on Realistic Mathematics Education*. Anatolian Journal of Education. Pages: 1-12.

Taidi, Zurisaday., 2019. *The Effectiveness of REACT Strategy (Relating, Experiencing, Applying, Cooperating, Transferring) on Student Learning Outcomes in Buffer Solution Material in Grade XI of SMA Negeri 2 Langowan. Oxygenius*. Vol. 1, No. 2. Pages: 35-39.

Taraufu, A.F., et al. 2020. *The Effect of Applying REACT Learning Strategy (Relating, Experiencing, Applying, Cooperating, and Transferring) on Student Learning Outcomes in Acid Base Concept Material.* Oxygenius Journal of Chemistry Education. Vol. 2, No. 2. Pages: 52-57.

Utami, W.S. et al., 2016. *React (Relating, Experiencing, Applying, Cooperative, Transferring) Strategy to Develop Geography Skills.* Journal of Education and Practice. Vol. 7. No.17. Pages: 100-104.

Widiadnyana, Putu, et al. 2021. *Application of REACT Strategy Assisted by Augmented Reality of Spatial Buildings on Mathematics Learning Outcomes.* Syntax Literate: Indonesian Scientific Journal. Vol. 6. No. 12. Pages: