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UNLOCKING HIGHER ORDER THINKING WITH REACT STRATEGY: AN EFFECTIVE SOLUTION FOR 21ST CENTURY LEARNING

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Abstract

The study conducted quantitative research using a True Experimental Design approach known as Pretest-Posttest Control Group Design, involving all grade X students of Senior High School. Cluster Random Sampling was used to select the experimental and control classes. Normality and variant homogeneity tests were conducted. Data analysis utilized a 5% significance level and paired sample t-test for hypothesis testing. Results indicated the REACT strategy effectively improved students' higher-order thinking skills. In the control class, a significant difference was found between pre-test and post-test scores, as well as in the experimental class. Observation sheet assessments showed an average score of 87.5, confirming successful application of the REACT strategy in the learning process. Therefore, the analysis demonstrates the superiority of the REACT strategy over conventional methods in enhancing the higher-order thinking skills of grade X students at Senior High School.

Keywords: *HOTS, Learning Strategy, REACT, Thinking Skill*

1. Introduction

Higher-order thinking skills (HOTS) are essential for equipping students with the necessary competencies to thrive in the 21st century, characterized by rapid technological advancements and complex global challenges. The development of HOTS is crucial in fostering critical, creative, and problem-solving abilities, which are integral to the 4Cs of 21st-century skills: communication, collaboration, critical thinking, and creativity (Yudi & Kurniawan, 2022). In Indonesia, significant efforts have been made to integrate HOTS into educational practices, as evidenced by research focusing on the development of instruments to measure and enhance these skills through innovative teaching methods (Jihannita et al., 2023; Rahayu, 2020). For instance, the creation of HOTS-based test instruments, such as those developed for the reaction rate topic, has shown high validity and reliability, indicating their effectiveness in evaluating students' higher-order thinking capabilities (Minata et al., 2022; Sulianto, 2018). Additionally, the use of problem-solving-based worksheets in chemistry has demonstrated a significant positive impact on students' HOTS, highlighting the importance of active learning strategies in promoting these skills (Faizah & Widyastuti, 2022; Tanujaya, 2017). Furthermore, the integration of HOTS in religious literacy and other disciplines underscores the broad applicability and necessity of these skills across various fields (Manurung et al., 2022). Overall, the emphasis on HOTS in educational curricula aims to prepare students not only to excel academically but also to navigate and contribute meaningfully to the increasingly complex and interconnected world of the 21st century.

The low achievement of students in higher-order thinking skills (HOTS) is a multifaceted issue that is influenced by several factors, as highlighted in the provided studies(Widana, 2017;Wiwin,2017).

Firstly, the foundational lower-order thinking skills (LOTS) are crucial, as they serve as prerequisites for developing HOTS. A study conducted in Indonesia revealed that middle school students generally performed poorly in LOTS, particularly in applying mathematical concepts, which hinders their progression to HOTS (Barut & Wijaya, 2021;Noor, 2022). Furthermore, vocational students also struggle with HOTS due to the lack of specific learning approaches and models that effectively integrate science, technology, engineering, and mathematics (STEM) education, which is essential for fostering these skills ("STEM literacy in growing vocational school student HOTS in science learning: A meta-analysis", 2022). Additionally, errors in solving HOTS-based problems are prevalent, with a significant percentage of students misunderstanding questions or making transformation errors, indicating a gap in their problem-solving abilities (Badriani et al., 2022). Differentiated learning models have been suggested as a means to improve reasoning and mathematical abilities, which are closely linked to HOTS. However, students with low reasoning abilities still meet fewer indicators of mathematical reasoning, suggesting that more tailored approaches are needed (Afifah & Fatmawati, 2024). Teachers face challenges in implementing HOTS-based assessments due to students' passive learning attitudes and diverse abilities, as well as the time-consuming nature of creating such assessments (Zana et al., 2022). Overall, improving HOTS requires a comprehensive approach that addresses foundational skills, integrates effective teaching models, and considers individual student needs and abilities

The learning process in the classroom generally aims to obtain learning outcomes in the form of changes in thinking abilities, skills and attitudes (Nuraina et al., 2022). Thinking skills are expected to change from low-level thinking skills to medium or high, from ordinary thinking skills to creative and critical thinking skills. Important changes in mathematics teaching need to be made to accommodate the ongoing demographic and female changes in math classrooms (Gradini et al., 2018). To achieve this, of course, internal and external factors are very influential. Internal factors are factors that come from within the students themselves such as student interest in learning, motivation and physical conditions owned by students, while external factors are factors that come from outside students such as the environment be it the family, school, teacher and others (Hapnita et al., 2016). Thus, teachers also play an important role in motivating students in learning and teachers need to make observations to see in more detail students' thinking skills before learning and after learning.

In the teaching and learning process as well, one that greatly affects students' thinking skills is the teacher. Teachers as facilitators in the teaching and learning process must be able to stimulate students to be able to use their thinking skills well. A cognitive skill that allows a person to understand information, apply knowledge, express complex concepts, criticize, revise according to construction results, solve problems, and make decisions is the definition of thinking ability (Susanti E, 2014). So it is necessary to optimize the potential of students in thinking skills. Optimization of student potential is always pursued through revolution and progressivity of learning implementation. Changes in the learning process have been successfully perpetuated by UNESCO as a world educational institution that to achieve the pillars of learning directed to learning to know, learning to do, learning to be, and learning to love together. Students are expected to be able to have integralistic competencies in the form of soft skills and hard skills, knowledge and skills that can answer the civilization of global progress (Latip, 2018).

Based on the 2013 curriculum based on Higher Order Thinking Skill (HOTS), one of which prioritizes students' thinking skills and aims to develop students' critical and creative thinking skills, the use of learning models, appropriate learning strategies must be realized. The main purpose of high order thinking skills is how to improve the thinking ability of students at a higher level, especially those related to the ability to think critically in receiving various types of information, think creatively in solving a problem using the knowledge they have and make decisions in complex situations (Saputra, 2016). So that the investigation of students' thinking skills becomes important and needs to be given solutions and actions to help develop them.

Bloom (Susanti E, 2014) identified two categories of thinking skills, namely low-order thinking skills and higher-order thinking skills. In mathematics learning, students are required to have higher-order thinking skills which are generally always associated with more complex and abstract thinking skills. Higher Order Thinking Skill (HOTS) is the ability to think strategically to use information to solve problems, analyze arguments, negotiate issues, or make predictions. In its application, a person can be categorized as having higher-order thinking skills if he is able to connect all the information he has comprehensively and use it to make a conclusion. Some examples of abilities classified as this

ability, namely: the ability to apply, analyze, synthesize, and evaluate (create). High ability is the ability to think that is not just remembering, re-expressing, and also referring without processing, but the ability to think to analyze information critically, creatively, creatively and able to solve problems (Anugrah Aningsih, 2018).

Kruger, K (2013) states that the definition of higher-order thinking skills involves concept formation, critical thinking, creativity/brainstorming, problem solving, mental representation, use of rules, reasoning, and logical thinking. Anderson and Kathwohl divide the levels of thinking skills into lower order thinking skills (LOST) and higher order thinking skills (HOST). LOST consists of the ability to remember, understand and while HOST consists of analyzing, evaluating and creating (Nur A, 2021). The higher-order thinking skills mentioned should be possessed by Indonesian students as one of the important factors to realize advanced learning in terms of information technology, the convergence of science and technology as an impact of technoscience, and the rise of the creative industry in the future.

In reality, many students are not able and do not have the ability to think at a higher level which includes the ability to think creatively and critically in building their own knowledge. This is in accordance with Satriawan Salim's statement in the demand of the Deputy Secretary General-Federation of Indonesian Teachers Unions that most students have thinking skills that are at a low level. This is reinforced by a number of surveys by the Programme for International Student Assessment (PISA) which in 2018 showed the results that Indonesia was ranked penultimate among Southeast Asian countries participating in the program. He explained that thinking skills require high reasoning power or Higher Order Thinking Skill (HOTS) is not limited only to exams or evaluations at the end of learning, but is shown in the learning process that forms critical, creative and evaluative thinking skills during school and can be applied in solving problems in everyday life (Puspita, R. 2018). This is in line with students at SMAN 5 Kupang, where most of the students are still at a low level of thinking. Based on observations made at SMA Negeri 5 Kupang in the process of learning mathematics, students are more interested in memorizing formulas, so they can do problems using memorized formulas. The routine and non-routine questions given are solved only by memorizing the formula, if you forget then the questions given cannot be solved. There is no effort on the part of the student to use his higher-order thinking skills well. This is also caused by the lack of stimulation from teachers in the learning process that can stimulate students' thinking patterns. In response to this, researchers then investigated further related to learning strategies carried out by teachers. Teachers use several learning models that are often mixed with conventional methods but this is still not appropriate to be able to stimulate students' ability to use their higher-order thinking skills. Overcoming the gap between reality and expectation is to use learning strategies that can stimulate students to develop their thinking skills.

One of the learning strategies that need to be applied to further improve students' higher-order thinking skills in terms of analyzing and evaluating and that provides opportunities for students to construct their own knowledge so that it is easier to understand the concepts taught and able to solve mathematical problems is the REACT (Relating, Experiencing, Applying, Cooperating, Transferring) learning strategy. Center Of Occupational Research and Development (CORD) (Putri et al., 2015;Taidi, 2019) said that in the REACT (Relating, Experiencing, Applying, Cooperating and Transferring) learning strategy students find. The meaningful relationship between abstract ideas and practical application in the context of cyberspace. Students integrate concepts through discovery, reinforcement and connectedness. The REACT strategy (Relating, Experiencing, Applying, Cooperating, and Transferring) requires teamwork and improving student performance (Yulini, 2022; Hafisani, 2020). The REACT strategy is one of the learning strategies that can help teachers to instill concepts in students, so that students do not just memorize formulas, but students can find themselves, work together, can apply in life and can transfer in new contexts, while learning to always relate to new contexts (Arni K, 2020; Musyadad, 2019). On the basis of the descriptions above, it is necessary to investigate the effectiveness of REACT strategies in learning, in this study especially to see students' higher-order thinking skills with the application of REACT learning strategies and see their effectiveness.

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2. Method

This research is quantitative research with a True Experimental Design approach type Pretest-Post test Control Group Design. This study was conducted on one group of students who were given treatment. The population in this study is grade X students of SMAN 5 Kupang for the 2022-2023 school year. The samples in this study were X-D class students as an experimental class and X-C class students as a control class.

Data collection was carried out in experimental and control classes with data collection techniques in the form of observation and test. Observation in this study was made by observing the activities of students during learning. To limit observations, these observations are made using observation sheets. This observation sheet is an instrument used to measure the practicality of learning strategies in terms of ease of use that can affect the implementation of learning activities. This observation sheet is filled out by observers as observers of learning activities in class. This observation sheet contains statements that allow the observer to put a mark (√) on answer choices that are appropriate to the ongoing learning activity. There are two alternative answer choices, namely Yes and No. The maximum score on the validation sheet is 5 if you vote yes, while the minimum score is 1 if you vote no. The criteria for practicality of the learning strategy are presented in Table 1.

Table 1 ***Practicality Criteria REACT Learning Strategy***

Value Interval	Quality
80 - 100	Practical
51 - 79	Quite Practical
20 - 50	Less Practical

3.

The implementation of this research begins with conducting tests in the form of initial tests and final tests. Pre-test (initial test) is given to students before learning takes place. This test aims to determine the initial ability of students. While the post-test (final test) is given to students after the learning process takes place. This final test aims to determine the level of improvement in students' higher-order thinking skills after being treated in the learning process using the REACT strategy.

TABLE 2 ***Scoring of Higher Order Thinking Skills of Learners***

Value Interval	Quality
86 – 100	Very Good
71 - 85	High
56 – 70	Medium
41 – 55	Low
0 – 40	Very Low

Data collection techniques consist of observation and written tests (pretest and posttest), thus the research instrument is in the form of observation sheets and test question sheets that are validated first by validators before use. Data analysis techniques consist of: 1) Analysis of observation sheets of learning activities aim to determine the implementation of learning which can be used as a benchmark for the quality of learning strategies from a practical aspect and to find out whether the learning process is in accordance with learning steps using REACT learning strategies. 2) Analysis of test results to determine students' higher-order thinking skills. Analysis of test results begins with prerequisite tests, namely normality tests and homogeneity tests. If the results are declared normal and homogeneous, then a hypothesis test analysis (t-test) consisting of an Independent Sample T-test and Paired Sample T-test is carried out to determine the effectiveness of the REACT strategy on higher-order thinking skills.

4. Results and Discussion

The data obtained from the results of this study are in the form of observations and student test results. Observation is carried out during the learning process. This observation aims to observe teacher and student activities that occur during the learning process. Is it in accordance with the steps of the REACT learning strategy. The results of observations are presented in the Table 3:

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Table 3 ***Student Learning and Activity Observation Sheet***

No	REACT Learning Steps	Student Activities	Yes	No
1	Introduction	a. Log in on time	√	
		b. Prepare study equipment	√	
		c. Do not do other work that will interfere with the learning process.	√	
2	*Relating*	Students can relate the content of the mathematics subject matter to their own knowledge when reading the illustrations provided.	√	
3	*Experiencing*	a. Students understand the activity instructions given.	√	√
		b. Students write activity steps to find a concept/formula	√ √	
		c. Students seek information from given activities through questioning.	√	
		d. Students apply formulas to problems.		
		e. Students make conclusions		
4	*Applying*	a. Students find solutions to problems and are able to apply concepts and information in solving problems	√	√
		b. Students are able to use the concepts that have been learned to facilitate problem solving.		
5	*Cooperating*	a. Students focus on group assignment	√	√
		b. Students are able to cooperate with other members in the group.	√	
		c. Able to reach group decisions for each problem.		
6	*Transferring*	a. Students learn and experience for themselves what is accomplished.	√	√
		b. From a limited context, students' skills and knowledge are expanded.	√	
		c. Students learn how to use their knowledge and skills		
7	Closing	a. Participation in closing learning activities.	√	
		b. Make conclusions in accordance with the teacher's appeal.	√ √	
		c. Correct or add to his friend's conclusions.		
		d. Record the conclusions or material provided.		

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Total score	84

The test results were initially analyzed by the prerequisite tests, namely the normality test and the homogeneity test. In this study, normality tests were carried out on all test results, namely the results of the control class pre-test, control class post-test, experimental class pre-test, experimental class post-test. This normality test uses the Kolmogorov-smirnov test to find out whether the data obtained is normal or not. The test results show all sig values. > 0.05 so that it can be concluded that the research data obtained are normally distributed as shown in the Table 4:

Table 4 ***Normality Test Results***

Variable	df	Sig.	Conclusion
Pretest Control Class	34	0,200	Normal
Post test Control Class	34	0,122	Normal
Pretest Experiment	34	0,158	Normal

Next, a homogeneity test is carried out. In this study, homogeneity tests were carried out on the data of the pre-test results of the control class and experimental class and posttest, control class and experimental class. Homogeneity test decision making based on Sig. Based on Mean. Based on the test results, sig values are obtained. Based on the mean on the pre-test results are 0.117 > 0.05 so that the data is said to be homogeneous. And sig value. Based on the mean on the post test results are 0.421 > 0.05 so that the data is also said to be homogeneous. The results of the homogeneity test are shown in the following Table 5:

Table 5 ***Homogeneity Test Results***

Variable	*Sig. Based on Mean*	Conclusion
Pre test	0,421	Homogeneous
Post test	0,117	Homogeneous

Based on the results of the normality test and homogeneity test, normal and homogeneous distributed results were obtained, thus the analysis continued with the analysis of the hypothesis test (t-test), namely: paired sample t-test. The paired sample t-test test was used to determine whether there was a difference in the average pre-test and post-test scores in each class after the implementation of the strategy, as well as to see the comparison between pre-test and post-test scores to determine the effectiveness of the REACT strategy on students' higher-order thinking skills. The paired sample t-test results in the control class obtained Sig. (2-tailed) values of 0.000 < 0.05 so that it can be concluded that there is a difference in average values between the pre-test and post-test results in the control class. Similarly, the paired sample t-test results in the experimental class obtained Sig. (2-tailed) values of 0.000 < 0.05 so that it can be concluded that there is a difference in average values between the results of the pretest and posttest in the experimental class. The analysis shows that the REACT learning strategy is effective in improving students' higher-order thinking skills.

The effectiveness that has been achieved in this learning can be caused by various factors. Both from teachers as facilitators and from students as learning subjects who are motivated to learn actively in learning. A success can also be caused by the learning strategies used whether they are memorable and interesting for students, thus impacting on students' ability to express themselves in learning so that they are more active and comfortable (Coe et al. 2021). The REACT strategy also has its own advantages, namely that it can Learning with the REACT strategy (Relating, Experiencing, Applying, Cooperating, and Transferring) is contextual learning that has advantages, which is a learning concept that helps teachers relate the material they teach to students' real-world situations, and encourages students to make connections between the knowledge they have and their application in their daily lives as members family/community (Team of Director General of Education and Culture). This learning strategy was developed with reference to constructivism because learning using the REACT strategy (Relating, Experiencing, Applying, Cooperating, and Transferring) requires students to engage in various activities continuously, think and explain their reasoning. In this case, students' higher-order thinking skills at the stage of analyzing and evaluating are trained to continue to grow. Teachers can

also play a role in instilling in students a sense of interest, confidence and a sense of need for understanding (Arny, K. 2020)

5. Conclusion

Based on the results of the analysis and discussion that has been obtained, researchers concluded that the REACT strategy is effective in improving students' higher-order thinking skills, and the application of the REACT strategy itself is very easy to use in the learning process so that classroom learning is more effective

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