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REACT Learning on the Topic of Elasticity to Enhance Students' Analytical Abilities

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Abstract

Conventional learning in class so far has not been maximized to train students' analytical abilities. One of the lessons that can improve students' analytical skills is contextual learning, one of which is REACT (Relating, Experiencing, Applying, Cooperating, Transferring) learning. Therefore, further research is needed on REACT learning to improve students' analytical abilities. This study aims to describe the effectiveness of REACT learning on elasticity to improve students' analytical abilities. This research is a pre-experimental design with one group pre-test and post-test. The subjects of the research trial were 29 students of class XI MIPA 2 SMA Negeri 10 Banjarmasin. Data collection techniques in this study used student learning outcomes tests. Furthermore, research data analysis techniques are carried out by calculating N-gain based on student learning outcomes tests. The results showed that the effectiveness of REACT learning based on N-gain calculations was 0.74 in the high category. So, it can be concluded that REACT learning is effective and feasible for improving students' analytical abilities. This proves that the use of REACT learning plays an important role in improving students' analytical abilities and assisting the development of more effective and innovative learning methods.
Keywords: Analytical Ability; Elasticity; REACT Learning

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INTRODUCTION

Physics is a field of the natural sciences that focuses on the study of natural phenomena through observation, classification, and data analysis using quantitative laws (Arini & Juliadi, 2018). Physics learning requires the mastery of concepts through meaningful and active thinking-based learning (Arini & Juliadi, 2018; Kariasa, 2020). Physics education is centered on developing competencies by exploring and comprehending nature scientifically (Yulianti et al., 2021). Physics education encourages the understanding and application of concepts by involving students in direct experiences and real-life applications (Kariasa, 2020).

In the 21st century, a skill that is highly important to master and enhance is analytical ability. Developing analytical skills can help effectively solve problems in learning, especially in physics education (Manarfah & Arafah, 2019). Proficiency in analytical skills is a crucial aspect of self-improvement, but this ability has not been proven (Harti, 2022; Nida et al., 2021). Students often struggle to analyze and connect physics concepts with mathematical concepts (Hidayatulloh, 2020). Additionally, physics education is frequently considered dense and lacking context, leading to student challenges. Cognitive tests are administered to students in the form of essays as instruments to measure learning outcomes (Muzijah et al., 2020).

In a preliminary study at SMA Negeri 10 Banjarmasin, a test was given to assess how well XI students in the MIPA 2 class could solve everyday physics problems using their analytical skills. The test results indicated that students faced difficulties in applying physics equations and that their analytical skills were notably low. This was based on the outcomes of the initial observation test of the student's analytical skills, yielding an average score of 5.35%. Additionally, interviews with physics teachers at SMA Negeri 10 Banjarmasin revealed that XI MIPA 2 students tended to be active in collaborative or group-based physics learning.

Solving the existing issues is through concept comprehension and a contextual approach to learning. One of the contextual approaches is the REACT (Relating, Experiencing, Applying, Cooperating, and Transferring) learning method (CORD, 1999). REACT learning enables students to link, seek, and understand taught concepts, apply acquired knowledge, and transfer physics concepts to daily life (Hamid, 2021; Sugita et al., 2020). REACT learning is assessed to be more effective than conventional teaching methods in achieving academic achievement, conceptual change, interest in learning, attitudes toward learning, and student motivation (Arıkan & Aladağ, 2021). Moreover, the REACT learning approach aligns with the analysis of the learning process for XI MIPA 2 students at SMA Negeri 10 Banjarmasin, where REACT stages are conducted collaboratively. With group-based learning, students can actively engage in physics education.

The relating stage involves connecting prior knowledge with new concepts. The constructivist learning theory is employed in the REACT method, where learners construct knowledge and understanding based on their experiences (Akbulut & Hill, 2020; Cahyani et al., 2021). Learners acquire firsthand learning experiences by connecting taught material to everyday activities in their living environment (Fitriah, 2019). The experiencing stage entails exploring and discovering new concepts through manipulative activities, problem-solving, and simple experiments. The applying stage involves implementing concepts in practice exercises. The cooperating stage involves collaboration and interaction among students in problem-solving (Nengsih et al., 2019). REACT learning also adopts Vygotsky's theory of cooperative learning (Feby & Abadi, 2019). In the transferring stage, learners demonstrate their understanding of concepts, which they apply in new contexts or situations (Cahyaningrum & Febriana, 2019).

Analysis involves breaking down material into smaller components, determining relationships among these components, and comprehending the overall structure (Nilah & Roza, 2020). Analytical skills are associated with three aspects: (1) differentiating, which involves sorting information by writing down the known and asked information in a problem; (2) organizing, which includes identifying the main ideas in the problem and connecting them to known theories; and (3) attributing, which

entails correctly solving problems and drawing conclusions from the results (Aprilia, 2019). The topic of elasticity is one of the physics subjects that requires analytical skills. This aligns with the fundamental competency of the topic, where learners would analyze and conduct experiments on the elasticity properties of elastic objects.

Several studies have shown that the REACT model significantly impacts students' cognitive achievement and learning outcomes (Nisa et al., 2018). Furthermore, the REACT model can also enhance the concept comprehension process in students (Jelatu et al., 2018; Karsli & Yigit, 2017; Quainoo et al., 2021). Based on previous research on REACT-based learning, there has not been a specific study demonstrating the effectiveness of the REACT approach on the topic of elasticity in enhancing students' analytical skills. Additionally, this study employs a learning outcome test instrument developed following Bloom's analytical ability indicators. Therefore, this research provides a significant contribution to the field of education by substantiating the effectiveness and relevance of the REACT approach in improving students' analytical skills.

The aim of this research is to describe the effectiveness of REACT-based learning in enhancing students' analytical skills on the topic of elasticity.

RESEARCH METHOD

The quantitative research employed a pre-experimental design with one group pre-test-post-test (Arikunto, 2010; Sugiyono, 2009).

Table 1 One group pretest-posttest design

Pre-test	Treatment	Post-test
O_1	X	O_2

Notation:
O1: Pre-test before treatment
O2: Post-test after treatment
X: REACT-based learning on the topic of elasticity

The study was conducted during the odd semester of the 2022/2023 academic year at SMA Negeri 10 Banjarmasin, involving 29 students from the XI MIPA 2 class. The data collection technique for assessing the effectiveness of REACT-based learning utilized a learning outcome test instrument. Meanwhile, the data analysis technique for the effectiveness of REACT-based learning was carried out by calculating the N-gain (Hake, 1999).

The calculation results are matched with the N-gain criteria and considered effective if they achieve a good minimum criterion. The following is the N-gain criteria table.

Table 2 N-gain criteria

No.	Score ⟨g⟩	Category
1	$\langle g \rangle \geq 0.7$	High
2	$0.7 > \langle g \rangle \geq 0.3$	Medium
3	$\langle g \rangle < 0.3$	Low

The results of students' analytical ability achievement tests are calculated and expressed in percentages.
Subsequently, the students' test assessment results would be averaged and aligned with the achievement levels in a table adapted from (Qomariya et al., 2018), as follows.

Table 3 Level of analytical skills achievement

No.	Score (%)	Achievement
1.	81-100	Very Good
2.	61-80	Good
3.	41-60	Average
4.	21-40	Poor
5.	0-20	Very Poor

RESULTS AND DISCUSSION

REACT Learning provides independent physics experiences to students, enabling them to engage in applying and solving problems actively. Students can actively develop their abilities through REACT-based learning, leading to continuous improvement over time (Ihsani et al., 2020). REACT learning is student-centered (interactive), aiding in concept comprehension, strategy development,

and implementing strategies for understanding real-world problem applications (Fauziah, 2020).

In the relating phase, students are presented with questions about the concept of elasticity. In the first session, the teacher provided questions about the elasticity of a material like rubber bands. In the second session, questions about a spring balance diagram are given. Then, in the third session, students are given questions about a spring bed. Moving on to the fourth session, students are presented with questions regarding the spring in a baby swing. In this relating phase, students actively respond to the teacher's questions because the topics relate to their surroundings. This phase boosts students' confidence to inquire about topics they haven't yet learned (Taraufu et al., 2020).

In the experiencing phase, there are two activities that students engage in, according to the Student Worksheets: guided analysis of example problems and conducting experiments. In the first session, students practiced answering example problems related to stress, strain, and elastic modulus. In the second session, they worked on examples of problems related to Hooke's law. Additionally, in the third session, students conducted an experiment on Hooke's law using a spring bed. In the fourth session, they engaged in experiments involving series and parallel arrangements of springs on baby swings.

In the applying phase, students engaged in classroom discussions to practice problem-solving and analyze experimental data. This phase was conducted in groups, where each group collaborated to solve problems provided in the student worksheets.

Furthermore, in the cooperating phase, students worked together to solve problems provided in the Student Worksheets given by the teacher. The cooperating phase also occurred in the experiencing and applying stages when students discussed together and conducted experiments within their respective groups (Lestari et al., 2021).

In the transferring phase, the teacher presented new problems and allowed students to answer these problems using their acquired knowledge. The activity of presenting the experiment results from each laboratory group in the second and fourth sessions was also included in this phase.

During the learning process, students were observed to be actively engaged in discussions and problem-solving related to the student worksheets and in conducting experiments. This can be seen in the table indicating the implementation of the REACT learning phases.

Table 4 Implementation of the REACT phases in the control class and the experimental class

Fase	**Average**			
	***K**	***E**	***K**	***E**
R	3.50 (SB)	3.50 (SB)	3.33 (SB)	3.50 (SB)
E	4.00 (SB)	4.00 (SB)	3.67 (SB)	3.91 (SB)
A	3.83 (SB)	3.33 (SB)	3.56 (SB)	4.00 (SB)
C	4.00 (SB)	4.00 (SB)	3.67 (SB)	4.00 (SB)
T	3.00 (B)	3.00 (B)	3.17 (B)	3.00 (B)
Total	3.67 (VG)	3.57 (VG)	3.48 (VG)	3.67 (VG)

Note: K : control class
E : experimental class

Table 4 shows that the control and experimental classes achieved "very good" (VG) scores on average in implementing the REACT phases. This indicates that REACT-based learning in experimental and control classes can assist students in their physics education. REACT learning is suitable for enhancing students' analytical skills, as is particularly evident in the applying phase. In the application phase, students are guided to work on problems, which helps develop their analytical skills during this phase (Nengsih et al., 2019).

Students are trained to solve realistic and relevant exercises (Ihsani et al., 2020).

Effectiveness was assessed by calculating N-gain from the students' learning outcome test. The test consisted of five essay questions covering three cognitive domains: C2, C3, and C4. This study demonstrated a significant improvement in students' learning outcomes. The following is the N-gain acquisition table.

Table 5 N-gain acquisition

Average		N-gain	Category
Pre-test	**Post-test**		
8.52	76.14	0.74	High

The calculation results of N-gain indicate that REACT-based learning effectively enhances students' analytical skills on elasticity. With a high N-gain score, contextual-based REACT learning in physics material can improve students' learning outcomes (Ibrahim & Yusuf, 2019).

Analytical Abilities

The achievement of students' analytical skills is assessed based on the average scores in each learning test. The following compares the average scores of analytical skills indicators in the pre-test and post-test.

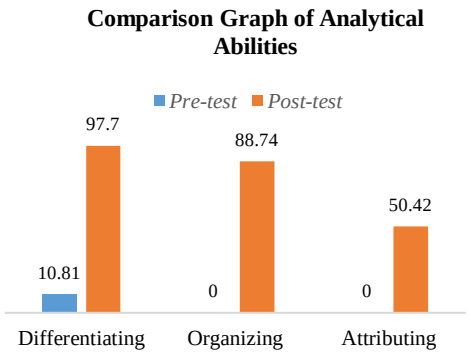

Figure 1 A comparison of the average scores of analytical skills indicators in the pre-test and post-test

Based on the comparison graph of analytical skills, it can be observed that students' analytical skills were generally low in the pre-test. However, after being exposed to the REACT-based learning intervention, there was a significant improvement in the post-test results. Nevertheless, the attributing skill indicator received a lower percentage than other analytical skill indicators. The low attributing skill is attributed to the higher difficulty level of the questions in that indicator. Analytical skills can be enhanced by correlating appropriate formulas or equations to comprehensively solve problems and draw conclusions.

Overall, the XI MIPA 2 students have demonstrated improvement in their learning outcomes, particularly in analytical skills, achieving a good level of attainment. Hence, REACT-based learning has proven effective in training and enhancing students' analytical skills. The implementation of REACT learning in physics education has been shown to positively impact students' analytical abilities (Khauriya, 2020). Improved analytical skills also correlate with better conceptual understanding (Anas & A, 2018). REACT-based learning involving experiments and problem-solving by students indicates that analytical skills influence their cognitive abilities. Students with higher analytical skills tend to achieve higher cognitive achievements than those with lower analytical skills.

CONCLUSION

REACT-based learning on elasticity effectively enhances students' analytical skills, with a high N-gain score of 0.74. REACT-based learning is deemed effective and appropriate for boosting students' analytical capabilities. This demonstrates that using REACT-based learning is crucial in elevating students' analytical skills and aids in developing more effective and innovative teaching methods.

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