

## The Effectiveness of STEM-Based Learning Models on Elementary School Students' Analytical Thinking Skills in Alternative Energy Material

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### Abstract

*This study is motivated by the problem that elementary learning tends to overemphasize cognitive aspects, while fourth-grade students have not yet developed adequate analytical thinking skills, particularly in breaking down problems. The study aims to analyze the effectiveness of STEM-based learning on alternative energy materials and to identify changes in students' analytical thinking skills after its implementation. The research employed a quantitative quasi-experimental method using a pretest–posttest control group design, involving 30 fourth-grade students from four elementary schools in Wuryantoro District selected through cluster random sampling. Data were collected through observation, tests, and documentation, and analyzed using comparative statistical techniques. The results indicate that STEM-based learning has a positive and significant effect on improving students' analytical thinking skills, with notable differences before and after treatment. It is concluded that STEM-based learning on alternative energy materials is effective in enhancing analytical thinking skills, and it is recommended as an innovative approach for elementary science learning.*

**Keywords:** Analytical thinking, Learning models, STEM

### Abstrak

Penelitian ini dimotivasi oleh masalah bahwa pembelajaran di sekolah dasar cenderung terlalu menekankan aspek kognitif, sementara siswa kelas empat belum mengembangkan keterampilan berpikir analitis yang memadai, khususnya dalam memecah masalah. Penelitian ini bertujuan untuk menganalisis efektivitas pembelajaran berbasis STEM pada bahan energi alternatif dan untuk mengidentifikasi perubahan keterampilan berpikir analitis siswa setelah implementasinya. Penelitian ini menggunakan metode kuasi-eksperimental kuantitatif dengan desain kelompok kontrol pretest-posttest, yang melibatkan 30 siswa kelas empat dari empat sekolah dasar di Kabupaten Wuryantoro yang dipilih melalui pengambilan sampel acak berkelompok. Data dikumpulkan melalui observasi, tes, dan dokumentasi, dan dianalisis menggunakan teknik statistik komparatif. Hasil menunjukkan bahwa pembelajaran berbasis STEM memiliki pengaruh positif dan signifikan terhadap peningkatan keterampilan berpikir analitis siswa, dengan perbedaan yang nyata sebelum dan sesudah perlakuan. Disimpulkan bahwa pembelajaran berbasis STEM pada bahan energi alternatif efektif dalam meningkatkan keterampilan berpikir analitis, dan direkomendasikan sebagai pendekatan inovatif untuk pembelajaran sains di sekolah dasar.

**Kata kunci:** Berpikir analitis, Model pembelajaran, STEM



## INTRODUCTION

Human activities are inseparable from the thinking process, especially when solving problems or determining the right decision-making strategies (Facione, 2015). Lorin W. Anderson These thinking skills can be developed through dynamic interaction between teachers and students during the learning process at school. Effective learning must be interactive, inspiring, enjoyable, and challenging in order to motivate students to participate actively and provide space for creativity and independence in line with their interests. In particular, analytical thinking skills—that is, the ability to think systematically and logically to break down problems into smaller components, analyze them in depth, and draw conclusions based on data—are crucial in the global era to enhance competitiveness and prepare students for daily life.

Analytical thinking skills are fundamental cognitive abilities that enable individuals to think systematically, logically, and in detail in order to solve complex problems or understand a situation comprehensively. According to the taxonomy of thinking, this ability involves a series of structured mental processes, beginning with the capacity to break down problems or situations into smaller, simpler components or constituent elements (Anderson & Karthwohl, 2001). Further development of this skill encompasses several crucial stages, namely, In-Depth Analysis; Identification of Relationships, including understanding the mechanisms of cause-and-effect relationships; and Synthesis and Solutions supported by the strength of accurate data and facts (Anderson & Karthwohl, 2001).

Primary and secondary education constitute a crucial phase that serves as a platform for students to hone their analytical thinking skills under the guidance of mentors or professional educators. From a classical philosophical perspective, as articulated by Socrates, educational institutions should ideally be understood as dynamic spaces for dialectic discourse, where the process of question-and-answer discussions serves as the primary engine driving intellectual development. In the contemporary era, the emergence of diverse alternative ideas—which sometimes appear radical or irrational—demands that students possess a strong intellectual filter; indeed, such ideas now often function as metaphysical references within modern intellectual discourse. Therefore, every concept must be critically examined through learning practices—whether conducted online or in-person—to ensure its validity and relevance. It is important to understand that the practice of analytical thinking is not an instant process; it requires sufficient time for students to process data deeply and internalize complex ideas through stages of mature contemplation (Fisher, 2011).

Analytical thinking skills are crucial in the global era for enhancing competitiveness, addressing increasingly complex real-world problems, and preparing students for the workforce (Trilling Bernie & Fadel Charles, 2009). Student engagement in learning can be realized through various activities such as listening, discussing, creating, writing reports, and solving problems. Furthermore, students who learn through the “learning by doing” method will be actively engaged in every lesson, including in science. In line with learning objectives and the nature of scientific knowledge, science must be viewed as a product, a process, and an attitude; therefore, learning in elementary school must encompass all three dimensions. Science education does not merely focus on mastering facts and natural principles but also teaches problem-solving methods, cultivates analytical thinking skills, and fosters objective and collaborative attitudes. In this regard, students need to be given the opportunity to use learning tools and media from their surroundings to apply them in daily life (Samatowa, 2016). To achieve this effectiveness, teachers must understand the role, function, and purpose of the subject they teach. In addition, improvements in students’ analytical skills are largely determined by teachers’ ability to transform conventional teaching models into more innovative learning models. Given that the core competencies of Grade 4 IPAS regarding

alternative energy projects require students to possess analytical, critical, and creative skills, this study aims to analyze the effectiveness of STEM-based learning regarding the use of alternative energy at SDN Wuryantoro and to identify changes in students' analytical thinking skills following the implementation of this model.

Based on observations conducted on September 15, 2025, in fourth-grade classes at Wuryantoro Public Elementary School 1, Mlopoharjo Public Elementary School 2, Gumiwang Lor Public Elementary School 2, and Pulutan Wetan Public Elementary School 4, there are strong indications that fourth-grade students are not yet able to think analytically to their full potential. This phenomenon is reflected in the students' inability to break down complex problems into smaller, more manageable parts. Empirical data reveal a sharp cognitive gap; while students achieve a 100% passing rate on multiple-choice questions, 60% of them fail to meet the passing standard when tackling essay-style questions. This aligns with the view of (Anderson & Karthwohl, 2001) that multiple-choice instruments tend to measure only the level of recall (C1), whereas essay questions require a deeper analytical ability (C4) to parse information.

The main problem encountered in the field is a learning approach that places too much emphasis on lower-order cognitive skills, particularly the memorization of facts, while the analytical dimension has not been fully utilized in its implementation. As a result, students feel confused and overwhelmed when faced with problems involving numbers or material whose instructions do not match the examples provided by the teacher. This low level of analytical thinking impacts the affective aspect, where students become lazy, uninterested, and lose motivation in solving science problems they perceive as difficult. (Schunk, 2012), in his theory of motivation, explains that low self-efficacy in solving complex problems can trigger passive behavior and dependence on others, as evidenced by students' tendency to copy their peers' answers without engaging in independent exploration. The root causes of the problems identified in these schools can be classified into three main points: Weaknesses in Problem Decomposition, where most students struggle to break down complex problems and fail to identify relevant information or data for initial investigation; Technical Design Constraints: Students struggle to analyze technical requirements and the limitations of solutions when designing products, resulting in outputs that are often inefficient or impractical; Evaluative Passivity: Students tend to passively accept experimental results and struggle to analyze the causes of a design's failure or success, thereby failing to determine effective improvement strategies. According to (Brookhart, 2010), without systematic guidance in dissecting information, students will continue to struggle to achieve higher-order thinking skills (HOTS). If these issues are not immediately addressed through more innovative learning models, the long-term negative impact is that students will continue to perceive science as a difficult, unpleasant, and boring subject.

One way for students to develop analytical thinking skills is by using a learning model that produces a STEM-based learning product. STEM-based learning has great potential to create more engaging and meaningful learning experiences for students. Project-based learning focuses on problem-solving activities through the development of analytical thinking skills, specifically through the STEM or STEAM approach. Science, Technology, Engineering, and Mathematics (STEM) or Science, Technology, Engineering, Arts, and Mathematics (STEAM) is a learning approach that integrates several disciplines—namely science, technology, engineering, and mathematics (math) as well as the arts (visual arts)—to foster students' ability to create (Sukmana, 2017). STEM or STEAM is an innovative learning approach that demands creative and meaningful development in students through engineering processes. STEM education is widely implemented in many developed countries, such as in the Northern Territory of Australia, where it is applied at Darwin Middle School and Darwin High School. These schools have incorporated STEM education into their curriculum through explicit

instruction, modeling, and the completion of tasks related to real-life contexts—for example, creating learning products such as three-dimensional works, robotics projects, and graphic designs as solutions to real-world problems (Setyawan, 2024).

In STEM-based learning, students are motivated to take an active role in their education. Teachers act solely as facilitators, evaluating the work students produce through the projects they complete, thereby creating tangible outcomes that encourage students to think analytically when analyzing problems encountered in science curriculum. STEM-based learning can enhance analytical thinking skills because this approach enables students to better interpret their knowledge, thereby improving their analytical thinking abilities. Objects used as contextual STEM-based learning materials that are found in the students' surroundings will contribute to the improvement of students' analytical thinking skills. Relevant research has been conducted in their study titled "The Effect of PjBL-STEM on Improving Critical Thinking Skills in Renewable Energy Content to Support Quality Education," which confirms that: The PjBL-STEM model is effective for higher-order thinking skills (HOTS). Enhancing Students' Critical Thinking Skills on Renewable Energy Content through PjBL-STEM with Design Thinking" assert that the implementation of the PjBL-STEM model (even with the integration of Design Thinking) is successful and effective in achieving the primary objective of enhancing higher-order thinking skills (HOTS), such as Critical Thinking. This indirectly supports the potential for improving analytical thinking. Thinking Skills and Learning Motivation of Elementary School Students" assert that this model has proven effective in improving Learning Motivation (Affective) as well as Critical Thinking Skills (Cognitive/HOTS). Based on the review of the relevant studies above, this study differs in its research focus. This study emphasizes the impact of STEM-based learning models on analytical thinking skills and fostering student motivation, whereas the studies reviewed above focus more on the general implementation of project-based learning. The existing research supports and addresses existing issues related to the implementation of STEM-based learning.

Given the gap between the demands of the 21st-century curriculum and the reality that students' analytical thinking skills still need to be improved, the implementation of an integrative learning model has become urgently necessary (Trilling Bernie & Fadel Charles, 2009) The STEM (Science, Technology, Engineering, and Mathematics)-based learning model offers a contextual approach that enables students not only to understand theory but also to solve real-world problems related to alternative energy through the design of technical solutions (Kelley & Knowles, 2016). By integrating these four disciplines, it is hoped that students will be able to analyze complex problems, evaluate information, and construct logical arguments systematically (Carter et al., 2018). Therefore, this study aims to empirically test the effectiveness of this model in improving students' thinking competencies.

Based on the above discussion, the research question is formulated as follows: "Is the implementation of a STEM-based learning model effective in improving students' analytical thinking skills in the field of alternative energy?" With this research question, the researcher is interested in conducting a study titled "The Effectiveness of a STEM-Based Learning Model on Students' Analytical Thinking Skills in Alternative Energy."

## METHOD

The research design used in this study was a quasi-experimental design with a non-equivalent control group. This study involved one control class and one experimental class. The control class was the class that did not receive the intervention to implement the STEM learning model, while the experimental class was the class that received the STEM model. The study was conducted in January 2026.

The population in this study consists of all fourth-grade students in elementary schools in Wuryantoro District. The sampling technique used was cluster random sampling. The reason for using the Cluster Random Sampling technique is that the sampling units in this study are groups (classes), not individuals. This was done to avoid the fragmentation of learning groups (disruption of intact groups) and to ensure that the STEM model intervention could be applied collectively in accordance with the existing class structures at the schools. The sample consisted of two classes: fourth-grade students from Wuryantoro 1 Elementary School and fourth-grade students from Gumiwang Lor 2 Elementary School as the experimental classes, and fourth-grade students from Mlopoharjo 2 Elementary School and fourth-grade students from Pulutan Wetan 4 Elementary School as the control classes.

The research procedure was conducted in three main stages: 1) Preparation Stage: This included an analysis of the alternative energy curriculum, the development of STEM-based teaching modules, and the development of an analytical thinking skills assessment instrument. 2) Implementation Stage: A pre-test was administered to both groups, followed by the intervention. The STEM model was integrated through four aspects: Science (energy concepts), Technology (use of tools/simulations), Engineering (designing prototypes of alternative energy devices), and Mathematics (calculating energy efficiency). 3) Final Stage: A final test was administered to measure the students' final analytical thinking skills.

The data collection techniques required for this study are: a) Observation. Observation is a data collection activity involving direct examination of the environmental conditions of the research subjects that support the research activities. Observations were conducted to observe the science learning process in fourth-grade classes at SDN 1 Wuryantoro, SDN 2 Gumiwang Lor, SDN 2 Mlopoharjo, and SDN 4 Pulutan Wetan. It also involves collecting baseline data on students' analytical thinking skills. b) Tests are a series of questions or exercises used to measure the level of mastery of the material that has been studied. These tests were administered to students during pretests and posttests to obtain data on their analytical thinking skills. This data was collected through written tests; the pretest was conducted before the intervention, and the posttest was conducted after the intervention using a project-based learning method. The tests in this study were used to assess students' analytical thinking skills and were subsequently administered to examine the effect of implementing a STEM-based learning model on the improvement of students' analytical thinking skills. c) Documentation: Data collection using documentation was employed to gather data from learning documents of fourth-grade students at SDN 1 Wuryantoro, SDN 2 Gumiwang Lor, SDN 2 Mlopoharjo, and SDN 4 Pulutan Wetan, as well as photographs of learning activities taken with mobile phones. The primary research instrument used was an essay test to measure analytical thinking skills. The indicators measured refer to the Revised Bloom's Taxonomy (C4), which includes: 1) Distinguishing: Selecting relevant parts of alternative energy material. 2) Organizing: Determining relationships among elements within an energy system. 3) Attributing: Determining the perspective or purpose of the information provided. Before use, the validity of the instrument was tested using the Product Moment formula and its reliability using Cronbach's Alpha.

The data analysis techniques used in this study are: a) Descriptive Statistical Analysis, used to analyze data by describing the social studies learning scores obtained from the pre-test and post-test after the learning process was implemented. Student learning scores are presented in the form of mean, median, mode, maximum value, minimum value, range, standard deviation, and variance. Student learning outcomes are grouped into five categories: excellent, good, fair, poor, and very poor. b) Inferential statistical analysis, a technique used to analyze sample data, the results of which can be applied to the population. Inferential statistical analysis was used to test the research

hypotheses using a two-way ANOVA test. To test the research hypotheses, a prerequisite analysis—specifically a normality test—was first conducted. All data were analyzed using Statistical Package for Social Sciences (SPSS) Version 25.0.

The effectiveness was assessed using the N-Gain Score to determine the extent of improvement in students' analytical thinking skills following the intervention.

The N-Gain criteria are interpreted as follows:

$g > 0.7$  (High)

$0.3 \leq g \leq 0.7$  (Moderate)

$g < 0.3$  (Low)

## RESULTS AND DISCUSSION

The STEM learning model was used to train students to apply knowledge gained in school to solve everyday problems by integrating STEM subjects into their learning. Technology was implemented during the construction of the balloon car prototype. The learning activity involved creating a project in the form of a wind-powered balloon car prototype. Mathematical literacy is the ability to analyze and express ideas, opinions, and formulas mathematically in their application. Meanwhile, mathematics in this study was used to calculate the distance and speed that the wind-powered balloon car prototype could achieve. Gregorio states that classroom organization and the flow of learning can determine a child's educational success (Erwinsyah, 2016). This study indicates that the STEM-based learning model was successful, with an average score of 100% per session, falling into the "excellent" category. This demonstrates the teacher's ability to manage the classroom and the learning process effectively, thereby positively impacting educational success.

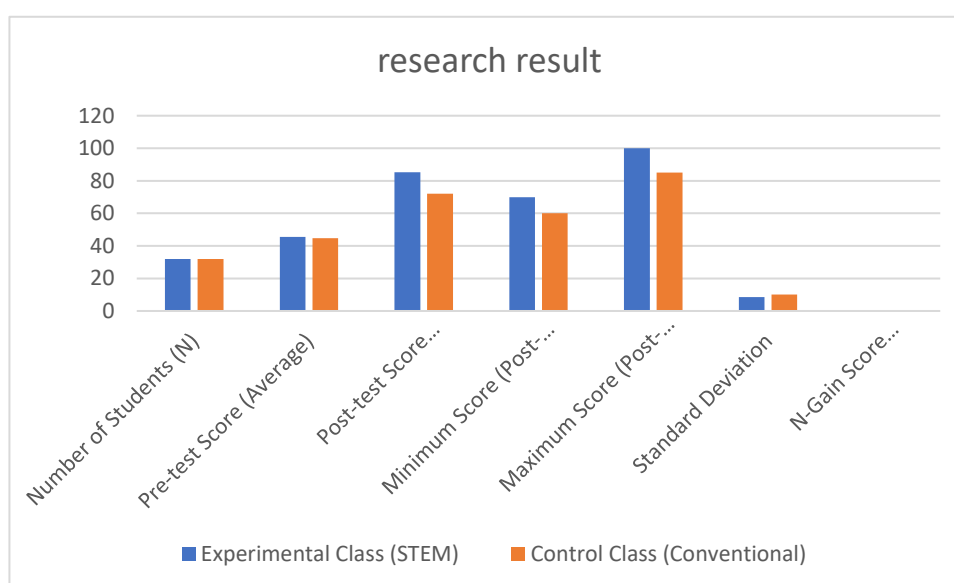
Improvements in analytical thinking skills within a STEM-based learning model were measured using pre-test and post-test results, with indicators of analytical thinking ability. The analytical thinking skills test consisted of an essay-type format, comprising five questions. Ennis argues that tests of analytical thinking skills require mental engagement, decision-making, strategy, and representation, as well as the application of new concepts in problem-solving—aspects that are better suited to essay-based tests.

The test material used in this study was designed to determine students' levels of analytical thinking skills, specifically in the subject of Natural Sciences, particularly regarding the utilization of alternative energy. The test consists of 5 questions representing 3 indicators of analytical thinking ability. The results of the students' analytical thinking ability test using the STEM-based learning model are presented in Table 1. This study was conducted to determine the effectiveness of the Science, Technology, Engineering, and Mathematics (STEM)-based learning model on students' analytical thinking ability regarding alternative energy material. Research data were obtained through a validated essay test instrument.

Based on the research findings, there is a significant difference between the pre-treatment (pretest) scores and the post-treatment (posttest) scores. A summary of the data on analytical thinking outcomes is presented in the following table:

**Table 1. Description of Students' Analytical Thinking Skills Scores**

Statistical Indicators	Experimental Class (STEM)	Control Class (Conventional)	Class
Number of Students (N)	32	32	
Pre-test Score (Average)	45,60	44,80	
Post-test Score (Average)	85,25	72,10	
Minimum Score (Post-test)	70	60	
Maximum Score (Post-test)	100	85	
Standard Deviation	8,45	10,15	
N-Gain (Improvement)	Score 0,73 ( high )	0,49 ( moderate )	

**Figure 1. Description of Students' Analytical Thinking Skills Scores**

The data show that the average pre-test score for the experimental class was 45.60 and for the control class was 44.80. This very small difference (0.80) indicates that both groups of research subjects had equivalent initial abilities before receiving the treatment. This is important in experimental research to ensure that any improvement is truly attributable to the learning model, rather than differences in students' initial intelligence.

After the intervention, the experimental class using the STEM learning model achieved an average score of 85.25, while the control class achieved only 72.10. 1) Experimental Class: Showed an increase of 39.65 points. This high score is attributed to the STEM model, which integrates four scientific disciplines, compelling students to move beyond rote memorization and analyze how alternative energy sources (such as wind or solar) function from technical and mathematical perspectives. 2) Control Class: Although there was an improvement, the results were not as optimal as those of the experimental class. This is particularly due to the limitations of the conventional model in training the "Engineering" aspect, which is the primary driving force in honing analytical logic.

The effectiveness of the STEM model is accurately demonstrated through the N-Gain scores obtained. Experimental Class ( $g = 0.73$ ): Falls into the High Category. This figure indicates that the STEM model is capable of helping students master 73% of previously unknown material. Control Class ( $g = 0.49$ ): Classified as Moderate. This improvement indicates that traditional lecture or discussion methods are only capable of providing a moderate level of understanding but are less effective in enhancing deep analytical skills.

Based on the data presented in Table 1, there is a significant difference in analytical thinking skills between the experimental and control classes. This improvement can be analyzed through the following key points: 1) The Contribution of STEM Integration to the Cognitive Level of Analysis: The increase in the experimental class's post-test average to 85.25 indicates that the STEM model is effective in stimulating students' ability to break down complex information into smaller components. In the Alternative Energy module, students not only memorized definitions but also analyzed the relationship between the availability of natural resources and energy conversion efficiency. Integrating engineering aspects into the learning process compelled students to perform systems analysis—identifying flaws in the design of alternative energy prototypes and finding corrective solutions. This aligns with the cognitive level (Analysis) in Bloom's Taxonomy, where students are required to organize and connect components.

The Effectiveness of Project-Based Learning in STEM: The N-Gain score of the experimental class, at 0.73 (High Category), demonstrates that the STEM model outperforms the conventional model (0.49). According to Lester (2014), the strength of PjBL-STEM lies in its ability to contextualize abstract concepts through hands-on practice and student-centered active thinking. This stands in contrast to the control class, where learning tends to be one-directional, leaving students less accustomed to tackling real-world problems. This strength stems from the nature of learning that involves hands-on practice and active thinking. In the control class, learning tends to be one-way, so students are less accustomed to dealing with contextual problems. Conversely, in the experimental class, the challenge of designing an alternative energy project (a wind-powered balloon car prototype) provided hands-on experience. The trial-and-error process in this engineering activity honed students' critical and analytical thinking skills as they evaluated data from testing the device.

The improvement in analytical thinking skills in the experimental class occurred because the stages of the STEM model facilitate students' active engagement in solving real-world problems. In the Engineering stage, students were asked to design a prototype of an alternative energy-generating device (a wind-powered balloon car prototype). This design process required students to analyze the variables that affect energy efficiency.

The results of the study indicate that the implementation of a STEM-based learning model has a significant positive impact on students' analytical thinking skills regarding the topic of alternative energy. Analytical thinking is defined as students' ability to break down complex problems into smaller components and understand the structural relationships among those components. This aligns with the perspective of (Anderson & Karthwohl, 2001), who define the ability to analyze as a cognitive process involving distinguishing, organizing, and connecting parts of information to understand the overall structure. In this study, the application of the STEM model facilitates this ability by shifting students' mindset from merely "knowing" to "being able to create and evaluate." Through the wind-powered balloon car prototype project, students were required to perform systems analysis to identify variables affecting energy efficiency and find corrective solutions to design failures that arose.

Analisis Kuantitatif melalui Skor Peningkatan: Peningkatan keterampilan berpikir analitis di kelas eksperimen dikategorikan sebagai signifikan secara klinis dan statistik melalui perhitungan Skor Peningkatan N. Kelas Eksperimen ( $g = 0,73$ ): Angka ini menunjukkan tingkat efektivitas yang Tinggi. Ini berarti model STEM mampu menjembatani lebih dari 70% kesenjangan antara pengetahuan awal siswa dan kompetensi maksimum yang diharapkan. Perbandingan Efektivitas: Perbedaan Skor Peningkatan N antara kelas eksperimen (0,73) dan kelas kontrol (0,49) menunjukkan bahwa STEM memberikan peningkatan 24% lebih besar dibandingkan dengan metode konvensional. Hal ini menunjukkan bahwa intervensi STEM bukan sekadar variasi aktivitas, melainkan solusi mendasar untuk meningkatkan hasil pembelajaran.

Peningkatan Berdasarkan Indikator Berpikir Analitis: Efektivitas STEM sangat terlihat pada tiga indikator utama keterampilan berpikir analitis (C\_4): a) Membedakan: Melalui aspek Sains, siswa menjadi lebih mahir dalam membedakan variabel yang memengaruhi energi alternatif, seperti perbedaan antara energi kinetik angin dan potensi energi termal matahari. b) Mengorganisasi: Aspek Teknik dan Matematika melatih siswa untuk menyusun data dari eksperimen prototipe energi alternatif ke dalam laporan sistematis. c) Mengaitkan: Siswa mampu menyimpulkan prinsip kerja teknologi berdasarkan data uji, sebagaimana dibuktikan oleh peningkatan skor pasca-uji, yang mencapai skor sempurna (100) di kelas eksperimen.

Significance Through an Interdisciplinary Approach: This improvement is significant because the STEM model shifts the learning paradigm from passive-theoretical to active-applied. 1) Interdisciplinary Connections: While in the control class, alternative energy material was studied solely as memorization in biology or physics, in the STEM class, students were required to use mathematical logic to calculate efficiency (the mathematics aspect) and design technical solutions (the engineering aspect). 2) High Cognitive Engagement: The trial-and-error process involved in designing alternative energy devices forces the brain to work at a deeper analytical level to diagnose device malfunctions, a process not observed in the control class.

Overall, STEM-based learning models have proven effective in shifting students' mindset from being merely passive recipients of information to becoming proactive analytical problem-solvers. This shift aligns with (Lester, 2013) assertion that interdisciplinary integration within STEM equips students with the ability to think critically and systematically when facing real-world challenges. The significant improvement in the effectiveness of the STEM model on analytical thinking skills in this study can be explained through statistical and pedagogical approaches. Statistically, this effectiveness is validated by an N-Gain score of 0.73, which falls into the high category, indicating that this intervention is capable of fundamentally bridging the gap in student competencies. Pedagogically, this success is supported by (Sanders, 2009), who emphasizes that integrated learning (STEM integrated) enhances cognitive engagement through exploration and design activities not found in conventional learning models

## CONCLUSION

Overall, the implementation of the STEM-based learning model has had a significant positive impact. Students become not just consumers of information, but analysts capable of connecting scientific concepts with technological realities. This proves that for applied material such as Alternative Energy, the STEM model is an effective solution for improving analytical thinking skills in the modern education era. It can be concluded that the implementation of the STEM-based learning model is significantly more effective than the conventional model. This improvement is evident not only in the higher average scores but also in the depth of students' understanding in analyzing and solving complex problems related to alternative energy.

Based on the results of the discussion in the study, it can be concluded that (1) the implementation of learning with the STEM-based learning model was carried out very well with the average score on the learning implementation sheet in the very good category, (2) the STEM-based learning model can significantly improve students' analytical thinking skills as indicated by the results of the paired t-test, (3) the calculation of each indicator of the effectiveness of the learning model is in the good category, so that the STEM-based learning model can effectively improve students' analytical thinking skills. From the results of the study, it can be seen that the STEM-based learning model can effectively and significantly improve students' analytical thinking skills even though it uses a wind-powered balloon car prototype project. Analytical thinking skills are basic abilities that are important to train in students. So it is necessary to improve the results of the analytical thinking skills test by getting students used to doing practice questions related to real-life problems, as well as maximizing the results of learning implementation by utilizing interactive learning media.

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