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Analysis of the Role of STEAM Education in Improving Critical Thinking Skills for Sustainable Development

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ABSTRACT

Objective: *The era of Society 5.0 requires individuals to have strong critical thinking skills. STEAM learning improves critical thinking skills by integrating science, technology, engineering, art, and math. This study aims to systematically review the existing literature on the effectiveness of STEAM learning in improving students' critical thinking skills, especially in achieving SDG point 4, namely quality education.* ***Method:*** *This research uses the literature review method. A total of 20 relevant articles that met the inclusion criteria were selected and analyzed in depth to identify key findings related to the impact of STEAM learning on the development of critical thinking skills.* ***Results:*** *The analysis shows that STEAM learning has significant potential in improving students' critical thinking skills. Some key findings include the following: STEAM learning stimulates students to think critically, creatively, and analytically in solving problems; STEAM facilitates the development of collaboration, communication, and problem-solving skills that are relevant to the demands of the future world of work, and STEAM learning contributes to the achievement of SDGs point 4 by providing quality and appropriate education for students.* ***Novelty:*** *This research contributes to the field of education by presenting a comprehensive review of the effectiveness of STEAM learning in improving critical thinking skills in the context of achieving SDGs point 4. The results of this research can be a reference for educators, curriculum developers, and policymakers in designing effective learning programs to prepare young people for future challenges.*

INTRODUCTION

Society 5.0 represents a transitional phase following Industry 4.0, focusing on the integration of technology with human aspects in daily life (Ardinata et al., 2022). This integration is particularly crucial in the field of education, where sustainable development goals (SDGs) underscore the need for inclusive and accessible quality education for all. To effectively achieve these SDGs, it is important to continuously assess educational policies to enhance their effectiveness (Akanbi & Adesina, 2024). In this context, education must not only impart academic knowledge but also foster lifelong learning skills that prepare individuals to tackle complex global challenges. People today must possess the ability to drive effective change, characterized by keen reasoning, informed decision-making, and careful observation of diverse situations. The capacity to analyze various perspectives is essential. One critical skill that individuals need to develop is critical thinking. This encompasses the ability to evaluate issues, substantiate claims with relevant evidence, and analyze problems thoughtfully (Setiawan et al., 2022). As society evolves, cultivating critical thinking skills becomes increasingly vital for personal and professional success.

Critical thinking skills have five aspects, indicators of individuals who have thought critically. The five indicators can be described as follows: Presenting essential explanations (Elementary Clarification); Forming basic skills (Basic Support);

Concluding (Interference); Explaining further explanations (Advanced Clarification); and Organizing strategies and tactics (Strategy and Tactics) (Wijayanti & Siswanto, 2020). The development of critical thinking skills aligns with educational objectives aimed at realizing the Sustainable Development Goals (SDGs) within the academic field. Fostering these skills is crucial for empowering individuals to engage thoughtfully with complex issues and contribute positively to society.

Having strong critical thinking abilities is crucial, particularly in relation to the Sustainable Development Goals (SDGs) focused on education, where the quality of learning is often assessed through student outcomes in literacy and numeracy. These foundational skills are essential for developing critical thinking capabilities. However, recent data indicates a concerning decline in reading proficiency among students starting from grade 11 Senior High School/Islamic Senior High School/Equivalent. Specifically, in 2021, the reading proficiency rate was reported at 52.10%, which fell to 49.25% in 2022. This decrease not only highlights challenges in literacy but also poses potential risks to students' overall critical thinking skills (Bappenas, 2023). Observations suggest that one of the primary issues affecting learning is the lack of active student engagement in educational activities. This disengagement can limit opportunities for developing essential skills such as critical thinking, making it imperative to address these challenges within the learning environment.

Research conducted by the Trends in International Mathematics and Science Study (TIMSS) indicates that students struggle to answer high-level cognitive questions, highlighting a relatively low level of critical thinking skills among them. This deficiency in critical thinking is a pressing concern that calls for attention not only to student development but also to teacher competencies. Elementary school teachers have shown enthusiasm towards adopting new learning models; however, they require training and adjustments to the tools and supporting facilities necessary for fostering 21st-century skills (El-Deghaidy & Mansour, 2015). The implementation of these learning models faces several obstacles, including rigid curricula, constrained learning structures, worries about students' competitive abilities, doubts regarding the effectiveness of assessment systems, and insufficient collaboration among teachers (Margot & Kettler, 2019). These challenges present significant barriers for both teachers and students in the teaching and learning process. Therefore, enhancing the quality of learning that aligns with the curriculum is crucial for developing diverse learning strategies. A well-structured learning model can effectively promote and stimulate students' critical thinking abilities and skills (Kemendikbudristek, 2021). Addressing these issues is vital for preparing students to thrive in an increasingly complex world.

One of the most popular learning models today emphasizes collaboration across various disciplines to create a more engaging and interactive educational experience. STEM (Science, Technology, Engineering, and Math) is a well-known integrated approach that effectively enhances teaching and learning activities. Recently, STEM has evolved into STEAM, which includes art as an integral component. This addition aims to foster creativity, risk-taking, collaboration, experiential learning, and problem-solving skills, all of which are essential for achieving a better future (Malecha, 2020). Incorporating STEAM learning into the curriculum seeks to develop students' understanding of science through an interdisciplinary approach (Hom, 2014). Research indicates that STEAM-based learning models can significantly enhance students' critical thinking skills (Marwiyah, 2022). The STEAM learning system fosters collaboration

across disciplines, stimulating learners to apply both practical understanding and theoretical knowledge, thereby enhancing their critical thinking abilities (Ichsan et al., 2024).

Moreover, the collaborative nature of the STEAM learning system encourages students to engage with problems that require analytical thinking and critical reasoning skills (Ellianawati et al., 2025). By equipping learners with creativity and innovation, they are better prepared to tackle future challenges and seize opportunities (Clarke, 2019). Recognizing the importance of equality in education is essential as we further develop the STEAM learning model. This focus is key to realizing the Sustainable Development Goals (SDGs) in education, ensuring that all individuals have access to quality learning opportunities.

RESEARCH METHOD

This research employs a qualitative-descriptive approach, utilizing a literature review method to gather relevant information. To collect data, we consulted national and international journals, as well as books that align with the research topic. The analysis of this data was conducted through content analysis techniques. For the article search strategy, we utilized various databases, including Google Scholar, Scopus, DOAJ, Web of Science, and SINTA. The keywords used in our search focused on "STEAM learning methods" and "critical thinking skills." We established several criteria for data selection: 1) Original articles from the primary source; 2) Research articles published from 2020 to 2024; 3) content articles in English and Indonesian; and 4) Respondents in the article are students. Figure 1 presents a flowchart outlining the research process and methodology. This systematic approach ensures a comprehensive review of the literature and accurate assessment of the effectiveness of STEAM learning in enhancing critical thinking skills.

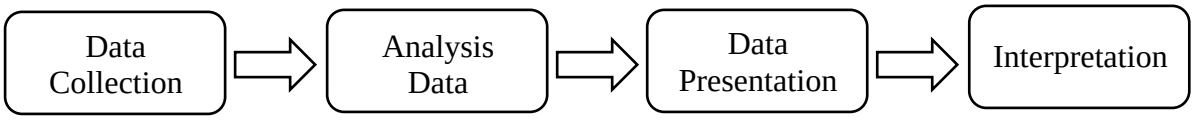

Figure 1. Literature review flow

The qualitative data analysis in this research follows four key stages:

a. Data Collection: The initial stage involved gathering relevant journals and publications through various academic databases, including Google Scholar, Scopus, DOAJ, Web of Science, and SINTA.
b. Data Processing and Analysis: After collecting the data, the next step was to process and analyze the information pertinent to the research topic. This involved scrutinizing the content of the selected articles to identify key themes and findings.
c. Data Presentation: The data was then presented in a narrative form, which included a concise explanation of the main points along with a table summarizing the review results. This format facilitates a clearer understanding of the insights derived from the literature.
d. Interpretation of Results: Finally, the last stage involved interpreting the review results obtained from the analysis. This interpretation provides context and meaning to the findings, helping to draw conclusions about the effectiveness of STEAM learning in enhancing critical thinking skills.

These systematic stages ensure a thorough literature examination and contribute to a well-rounded understanding of the research topic.

RESULTS AND DISCUSSION

Results

This literature study reviewed eligible articles to summarize and analyze the findings. Sources were evaluated for eligibility and relevance based on specific categories: learning with STEAM models and critical thinking skills. Based on the predetermined categories, 20 articles were selected for the review process and used as references for this literature study This literature study involved a comprehensive review of eligible articles to summarize and analyze the findings related to STEAM learning models and critical thinking skills. The sources were evaluated for both eligibility and relevance based on specific criteria corresponding to these categories. From the predetermined categories, a total of 20 articles were selected for the review process, serving as foundational references for this literature study. These articles encompass a range of research that highlights the effectiveness of STEAM learning in fostering critical thinking skills among students. The selected articles included in Table 1.

Table 1. Review result

Author (Years)	Findings
Fitria et al. (2023)	By developing learning media, the PjBL-STEAM model can Improve students' creative thinking skills, and teachers play an important role in implementing learning media developments
Priantari et al. (2020)	STEAM and PBL learning models have a positive impact on student's critical thinking skills
Angga (2022)	Students can find the meaning of learning that has been done by applying the PBL-STEAM model.
Bedewy & Lavicza (2023)	The application of STEAM can foster creativity and critical thinking skills by dealing with transdisciplinary learning
Diana & Saputri (2021)	There is an increase in critical thinking skills, emotional intelligence, and being able to improve 4C with the PjBL-STEAM learning model.
Fitriyah & Ramadani (2021)	PBL-STEAM learning can be used as a learning alternative to improving 21st-century skills
Sukmawati & Rakhmawati (2023)	To improve high-level skills in early childhood can be done by doing STEAM-based learning
Salamah et al. (2024)	STEAM learning can improve critical thinking skills in the religious, moral, physical motor, and social-emotional aspects of children aged 5-6 years
Mardlotillah et al. (2020)	The use of STEAM learning can provide significant differences in critical thinking skills.
Rahmadana & Agnesa (2022)	STEAM can be applied in learning models, group projects, PBL, and enhancing 21st-century skills. Not only this but it can also be applied to multidisciplinary topics
Rahmawati (2021)	STEAM learning on wind power car projects can make an excellent learner response
Sulastri & Cahyani (2021)	Applying the STEAM approach increases students' critical thinking skills regarding the financial statements of service companies.

Author (Years)	Findings
Azzahra (2024)	The application of STEAM can encourage students to achieve 21st-century competencies.
Khadijah et al. (2024)	STEAM can improve children's counting skills
Rahayu et al. (2023)	STEAM learning can develop children's critical thinking skills
Suryaningsih & Nisa (2021)	Implementing STEAM learning provides positive benefits, namely, supporting science process skills, critical thinking skills, science and digital literacy, and students' motor skills.
Hafizhah et al. (2024)	STEAM-based learning can improve students' critical thinking skills as indicated by students' answers that meet the indicators of critical thinking skills
Suryaningsih et al. (2023)	The STEAM-PBL approach can encourage students' creative thinking skills on salt hydrolysis material, including technology use.
Allanta & Puspita (2021)	The JBL-STEM learning model can influence critical thinking skills and students' self-efficacy.
Agusta (2024)	Student learning outcomes with high presentations are characterized by the improvement of teacher quality and students' critical thinking skills.

Discussion

Integrating STEAM and interventions into the physics teaching and learning process, particularly through the Problem-Based Learning (PBL) learning prototype, has been shown to have a positive and significant impact on enhancing 21st-century skills, specifically the 4C competencies: Critical Thinking, Creativity, Collaboration, and Communication. This integration not only improves students' critical thinking skills but also enhances their conceptual literacy and emotional regulation, while promoting their creative thinking abilities (Diana & Saputri, 2021). Furthermore, employing learning materials aligned with the PjBL-STEAM paradigm can foster greater creativity in students when learning physics concepts, especially those related to light and optics (Fitria et al., 2023). This emphasizes the effectiveness of the STEAM approach in making complex subjects more accessible and engaging, ultimately preparing students better for future challenges.

The Problem-Based Learning (PjBL) model, combined with STEAM-based learning, enables students to broaden their horizons across various disciplines, which is essential in today's rapidly evolving and complex world. Both the humanities and sciences play a vital role in equipping students with the necessary skills to adapt and thrive. Key abilities developed through this approach include effective communication, sharp critical thinking, inspiring leadership, strong teamwork, innovative thinking, and resilience in the face of challenges. Data analysis revealed a significant result with a value of 0.046, which is below the 0.05 threshold, indicating a notable impact from employing the PjBL model and STEAM approach in the control class. This suggests that the critical thinking skills of students in the experimental and control classes differ significantly (Zubaidah, 2019). Additionally, the implementation of STEAM and PjBL strategies in the experimental class effectively enhanced students' critical thinking abilities, demonstrating the efficacy of these approaches in fostering critical thinking skills (Priantari et al., 2020).

The implementation of Problem-Based Learning (PBL) has shown a remarkable success rate of 100%, placing it in the very high category for effectiveness. This outcome reflects the teacher's consistent application of the PBL steps throughout the learning process. According to post-test results, the majority of group members scored above 80, with 90% of students exceeding the minimum learning criteria. This achievement indicates that the tasks related to transforming the shape of objects met the established assessment standards. Moreover, students demonstrated strong collaboration within their groups, effectively creating descriptions of their designs that focused on the concept of changing the form of objects. Throughout this process, students exhibited good communication skills, enhancing their teamwork experience. Additionally, the students showed noticeable improvements in creativity and critical thinking skills as they created artworks that incorporated ideas about transformations in object shapes (Angga, 2022). This highlights the success of the PBL approach in fostering not just academic achievement but also essential soft skills among students.

The STEAM learning approach is recognized as a transdisciplinary method that promotes the integration of various disciplines. By employing STEAM strategies, students can engage in a holistic learning experience that allows them to explore the interconnections between different subjects through creative processes. This approach not only enhances their understanding of how these disciplines relate but also fosters critical thinking and problem-solving skills. Moreover, the creative processes inherent in STEAM learning can be further explored through a transdisciplinary educational framework, which seeks to identify specific thinking skills that act as instruments for problem-solving. This enables students to tackle complex challenges they may encounter in the real world (Diana & Saputri, 2021). Ultimately, the STEAM approach equips learners with the skills and knowledge necessary to navigate and address contemporary issues effectively.

The PjBL-STEAM paradigm is effective in maximizing learning objectives while enhancing students' emotional intelligence and higher-order cognitive abilities. Research shows that students with strong foundational mathematical skills who engaged with the PjBL-STEAM model exhibited significant improvements in numeracy-based higher-order thinking skills when compared to their peers using a direct learning approach. The PjBL-STEAM approach has proven to be more impactful in fostering emotional intelligence and equipping students with essential skills such as teamwork, initiative, communication, problem-solving, and self-management, surpassing the benefits offered by traditional direct learning methods. These skills are crucial for developing critical thinking abilities, particularly in addressing real-world challenges and navigating numeracy-related difficulties. Moreover, students utilizing the PjBL-STEAM model demonstrated superior learning performance compared to those who participated in the direct learning model (Fitriyah & Ramadani, 2021). This highlights the effectiveness of the PjBL-STEAM approach in promoting both academic success and essential life skills among students.

With a success rate of 53.1%, students in the experimental class who met the criteria of being able to come up with very creative ideas showed good performance. Meanwhile, 3.1% of students were categorized as able to create original work through scientific inquiry. Furthermore, courses using PjBL-based STEAM learning had an average score of 77.9 for creative thinking skills, which was higher than the average score of 62.02 for schools using scientific learning. This suggests that, compared to

scientific learning methods, the PjBL-based STEAM learning paradigm is more successful in fostering student creativity (Fitriyah & Ramadani, 2021).

The implementation of STEAM learning models and techniques fosters advanced thinking skills, including critical assessment of information, situational analysis, and effective problem-solving. By integrating STEAM into the classroom, student motivation and engagement have significantly increased, providing learners with the optimal opportunity to realize their full intellectual potential. However, one of the primary challenges in implementing STEAM-based learning is the knowledge gap between existing human resources and the demands of STEAM education. Despite this obstacle, the STEAM approach presents an innovative solution for the education sector to adapt to the evolving and advancing landscape, particularly as we move towards the Industrial Revolution 4.0 (Sukmawati & Rakhmawati, 2023). This adaptability underscores the importance of equipping both educators and students with the skills necessary to thrive in a rapidly changing world.

Children between the ages of five and six benefited from the STEAM learning approach regarding their Higher-Order Thinking Skills (HOTS). The implications include (1) children's ability to recognize the media prepared by the teacher; (2) their ability to explain and describe experimental results; (3) their ability to recognize changes, understand the experimental process, and compare experimental results; (4) their ability to solve fundamental problems; and (5) their ability to express opinions regarding the experiments conducted (Salamah et al., 2024).

The t-test findings showed that, compared to conventional teaching techniques, the STEAM approach combined with the PjBL model was more successful in improving higher-order thinking skills. Fifth-grade teachers can use this learning paradigm, which combines project-based learning with the STEAM approach (Mardlotillah et al., 2020).

The STEAM approach, which seeks to enhance student creativity, evolved from STEM learning techniques with an arts component. It allows individuals to develop fresh and original ideas, solve problems, and think creatively (Perignat & Katz-Buonincontro, 2019). Biology learning is enhanced by the STEAM approach, especially when combined with interdisciplinary subjects such as ecology, biotechnology, and environmental change. Students gain valuable 21st-century skills, such as critical and creative thinking. Science, technology, engineering, arts, and math (STEAM) is a learning approach that integrates five disciplines, with biology being studied and the other four. However, in practice, the artistic component of STEAM is often still only applied to the visual, artistic, and creative aspects (Fitriyah & Ramadan, 2021).

The high scores (80%, 100%, 96%, 100%, 100%, 80%, 100%, 80%, and 80%) show the successful integration of STEAM learning by following the prepared stages. The fact that students achieved an average observation score of 90.5 indicates that the wind-powered car project has successfully met all the requirements for STEAM education. Statistical analysis of the independent t-test revealed a statistically significant difference ($p = 0.000$) between the two groups, with the p-value significantly less than 0.05. The normalized N-Gain test assessed how STEAM education through the wind-powered car project affected primary school students critical thinking skills. The experimental class results showed considerable improvement (N-Gain value 0.6348), but the control class only showed low improvement (N-Gain value 0.02557). The critical thinking skills of elementary school students improved significantly due to STEAM learning through the wind-powered car project. A positive response rate of 97.3% from children indicates

that using wind-powered car projects for STEAM education is a fun and successful approach for elementary school students (Rahmadana & Agnesa, 2022). After participating in STEAM-based project-based learning online, students' higher-order thinking skills improved significantly based on pretest and posttest results (Sulastri & Cahyani, 2021).

Integrating STEAM concepts and ideas within the STEAM learning model for mathematics emphasizes the importance of aligning basic numeracy concepts with integrated thinking across the STEAM disciplines—science, technology, engineering, art, and mathematics. One effective alternative to make the numeracy learning process more engaging and creative, thereby preventing student boredom, is the implementation of the STEAM method. Utilizing the STEAM approach in numeracy education not only enhances students' learning experiences but also helps them develop competencies that are vital for success in the 21st century (Azzahra, 2024). This alignment fosters a more comprehensive understanding of how mathematics connects with various fields, equipping students with the skills necessary to thrive in an increasingly complex and interdisciplinary world.

Observations conducted during meetings and learning cycles indicate that the STEAM learning approach has effectively aided students in enhancing their counting skills. The assessment results reveal that students' counting abilities are close to mastery, achieving an average score of 64.4. Initially, in the first cycle of observations, children demonstrated development "as expected" (BSH) with an average score of 3.73. In the second cycle, test results indicated further improvement in counting skills, with an average score rising to 74.41. However, the observation results still categorized the children as "developing as expected" (BSH), with an average score of 4.2. These findings suggest that students who previously struggled with recognizing number symbols, sorting numbers, writing numbers as instructed by the teacher, and performing basic addition have begun to overcome these challenges through the application of STEAM learning methodologies. This progress highlights the effectiveness of the STEAM approach in fostering essential mathematical skills (Khadijah, 2024).

The STEAM learning model is designed to promote higher-order thinking skills, serving as a crucial target for student development. Tailored to meet the needs and objectives of early childhood education, this model should be simple and accessible for young learners. To effectively implement this approach, schools must ensure that it aligns structurally with the curriculum and the overall learning process, adequately preparing children for future demands. STEAM education, which encompasses Science, Technology, Engineering, Arts, and Math, plays a pivotal role in fostering students' character development and other essential qualities. By integrating these disciplines, STEAM helps equip children with the skills and attitudes necessary for future success (Rahayu et al., 2023). This holistic approach not only enhances academic achievement but also supports the development of well-rounded individuals ready to navigate a complex world.

The assessment results revealed a positive upward trend in students' science process skills, which achieved an average score of 4.164 and a percentage of 83%. This positions their skills within the high category, reflecting a strong grasp of the necessary competencies in the science learning phase. Similarly, students' inventive thinking abilities also demonstrated impressive performance, with a score of 4.134 and a percentage of 82.7%, placing them in the high group as well. These outcomes suggest

that students responded positively to the learning innovations integrated into STEAM projects. The high percentage of students exhibiting creative thinking and strong science process skills further underscores the effectiveness of the STEAM approach in enhancing students' learning experiences and abilities (Suryaningsih & Nisa, 2021). This reinforces the value of incorporating innovative educational practices that engage students and promote critical and creative thinking.

Science education that incorporates STEAM comprises four main components: science, technology, art, and numeracy. The science aspect is represented by the learning materials, while technology is embodied in the use of media such as projectors and smart boards. Art is illustrated through the use of metaphors, and numeracy is represented by questions or activities that involve calculations. Teachers play a crucial role in adapting educational resources and activities to align with the objectives and skill levels of their students. In the engineering component, students prepare for future classes by engaging in project-based work. In a recent assessment of 53 fifth-grade students at Islamic Elementary School Al-Zaytun, it was found that a total of 43 students achieved "perfect" scores, reflecting a strong mastery of critical thinking skills within science classes (Hafizhah et al., 2024). This indicates the effectiveness of the STEAM approach in enhancing students' understanding and application of science concepts through integrated learning experiences.

Students' creative skills in the context of salt hydrolysis education still require enhancement, particularly in areas such as fluency, flexibility, originality, and elaboration. The implementation of a Problem-Based Learning (PBL) approach to create creative Instagram stories is anticipated to address these deficiencies. In a study focusing on salt hydrolysis content within chemistry education, three Science classes (XI Science 1, XI Science 2, and XI Science 3) were assessed, yielding average poster scores of 82.88, 81.80, and 88.28, respectively. These results indicate that while there is some proficiency in creative expression, there is still room for improvement in fostering students' overall creative skills (Suryaningsih et al., 2023). By integrating innovative learning methods like PBL, educators aim to enhance students' creative abilities and deepen their understanding of complex scientific concepts.

The implementation of the PjBL-STEM paradigm significantly aids students in developing their critical thinking skills while enhancing their understanding of the subject matter. These skills are vital in preparing children to confront and solve real-world problems they encounter in everyday life. Observational findings indicate that students' critical thinking abilities and self-efficacy in learning ecosystem content are positively impacted by the project-based learning model integrated with the STEM approach. This is supported by the acceptance of the first hypothesis (H_1) and the rejection of the null hypothesis (H_0). The data revealed an impressive increase in self-efficacy, reaching 93.78%, while the indicator reflecting the achievement of critical thinking skills demonstrated a percentage of 31% (Allanta & Puspita, 2021). These results highlight the effectiveness of the PjBL-STEM model in fostering essential skills that empower students to navigate complex challenges in their academic and personal lives.

The application of the *PINTAR* methodology in teaching social studies to fourth-grade students at Elementary School Beringin 2 effectively facilitated the development of critical thinking skills, demonstrating growth in each session. This indicates that almost every student met the criteria for high skill development and achieved the

established success indicators. Across each meeting, students' learning outcomes exhibited significant improvement, affirming that they had attained the set success metrics (Agusta, 2024). This trend underscores the efficacy of the *PINTAR* methodology in not only enhancing critical thinking but also in reinforcing overall academic achievement in the classroom.

The adoption of the PBL-STEAM approach holds significant promise for enhancing educational standards. However, the success of this methodology heavily relies on the quality of teachers involved. It is essential for educators to engage in continuous professional development that strengthens their pedagogical skills in designing and implementing project-based learning effectively. Aligned with Sustainable Development Goal (SDG 4), which emphasizes the need for universal access to high-quality and equitable lifelong learning, the PBL-STEAM model has the potential to transform the education landscape. With the right support and resources, this approach can foster an engaging and effective learning environment that prepares students for the challenges of the future.

CONCLUSION

Fundamental Finding: This research consistently demonstrates that integrating the Problem-Based Learning (PBL) model with the STEAM approach positively enhances students' critical thinking skills. The combination of PBL, which prompts students to actively seek solutions to real-world problems, and STEAM, which combines various disciplines, has proven effective. Students engaged in PBL-STEAM learning exhibited significant improvements in critical, analytical, and creative thinking skills, becoming more adept at analyzing information, evaluating arguments, and designing innovative solutions. **Implication:** This learning model promotes the development of essential 21st-century skills needed in the digital age, including collaboration, effective communication, and complex problem-solving. Students learn to work in teams, articulate ideas clearly, and tackle challenges systematically. By involving students in projects relevant to real life, PBL-STEAM enhances their motivation and makes learning more enjoyable. **Limitation:** This research is focused on critical thinking development through the PBL-STEAM model, which aligns well with the complex and dynamic demands of the future workforce. Nonetheless, there are still gaps in the current implementation of PBL-STEAM. Future research indicates that the PBL-STEAM model has the potential to enhance the quality of education and equip students to be productive and creative global citizens based on the reviewed findings. **Future Research:** Based on the research findings reviewed, it can be concluded that the PBL-STEAM model is a learning approach that can potentially improve the quality of education and prepare students to become productive and creative global citizens.

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