INSECTA Vol. 5 No. 1, 2024, pp. 71 - 86

Available online at
INSECTA
Integrative Science Education and Teaching Activity Journal
Journal homepage: https://jurnal.iainponorogo.ac.id/index.php/insecta

Article

Enhancing Academic Achievement through the Application of the 5E Learning Cycle Model

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Article Info
Article history:
Received: April 15, 2024
Accepted: May 9, 2024
Published: May 31, 2024

Keywords:
Learning Cycle 5E;
Learning Model;
Learning Outcomes

ABSTRACT
This study aims to evaluate the effectiveness of the 5E learning cycle model in improving student learning outcomes and their engagement in the learning process. The research adopts the Classroom Action Research method, conducted at SMA Muhammadiyah Ambon, with a sample from Class XI through random sampling. Data collection includes observation, tests, and documentation. Research instruments comprise observation sheets guiding the investigation, tests assessing students' mastery level, and documentation gathering relevant materials about the research context. Data analysis involves both qualitative and quantitative methods. Quantitative analysis processes numerical data, while qualitative analysis involves reduction, display, and verification. The research findings highlight the effectiveness of the 5E learning cycle model in enhancing student learning outcomes and engagement. Throughout the cycles, there is a noticeable increase in learning completeness based on cognitive assessments. There was a significant increase of 72.5% in Cycle I, and this trend further substantially increased in Cycle II by 85.0%. Performance assessments also reflected these positive trends, showing a 75.0% increase in the first Cycle and a significant 87.5% improvement in the second. This study, marked by its effectiveness, successfully concluded at the end of Cycle II. This success is evident in applying the learning model, the learning process involving teacher and student activities, and the overall improvement in student learning outcomes across cognitive components. The 5E learning cycle model holds significance in Education, emphasizing student-student-centred Learning. Therefore, it is recommended that the 5E learning cycle model be implemented sustainably in educational activities to create a dynamic learning environment and enhance overall learning outcomes.

INTRODUCTION

Staying relevant in the rapidly evolving global landscape requires a proactive approach to developing skills and competencies that align with the demands of the 21st century (Riti et al., 2021). The goal of Education should be to shape students' mindsets and prepare them to overcome future challenges. The upcoming generation will require innovative, lifelong Education and learning to address complex challenges with creativity and critical thinking

(Haryadi et al., 2017). The development of these abilities should encompass a comprehensive balance between knowledge, skills, attitudes, and values (Chalkiadaki, 2018; Schleicher, 2018; Wang et al., 2018). It is crucial to recognize that these abilities have quantitative and qualitative aspects (Falentina et al., 2021). The quantitative element deals with the quantity of knowledge and skills acquired, while the qualitative aspect pertains to the quality of these competencies. Critical factors in determining mastery of these abilities include teachers designing suitable strategies in the teaching and learning process. These strategies should encourage learners to be more active and engaged in educational activities (Hitipeuw & Rianghati, 2017). The role of educators is pivotal in fostering an environment that promotes not only the acquisition of knowledge but also the development of critical thinking, creativity, and other essential 21st-century skills. In essence, Education should be a dynamic process that goes beyond traditional methods and focuses on the holistic development of individuals. It should equip students with the tools they need to navigate a rapidly changing world, fostering a mindset that embraces lifelong Learning and adaptability.

Learning is a dynamic process through which knowledge is created by transforming experiences and combining them with existing knowledge (Hulaikah et al., 2020; Utamy & Rosdiana, 2023). Comprehensive learning implementation involves integrating various student abilities, including knowledge, skills, and comprehensive behaviours, to foster fair thinking and acting (Ang, 2018; Malik, 2018; Abaniel, 2021). Teachers are crucial in selecting an appropriate learning model when designing educational experiences (Yulaikah et al., 2022). Skilled educators need diverse abilities to effectively oversee the learning journey (Wakhidah & Anugra, 2023). A learning model serves as a framework that illustrates structured stages, grouping students' experiences in learning to achieve specific goals (Listyarini et al., 2018). An appropriate learning model is vital to creating an effective and engaging educational environment. Teachers should consider their students' diverse needs and learning styles, aligning the chosen model with the desired educational outcomes. Integrating various student abilities emphasizes the importance of a holistic approach to Education. It goes beyond the traditional focus on mere knowledge acquisition and includes the development of skills and behaviours that contribute to fair and critical thinking.

Accurately selecting a learning model holds significant implications for teachers in the teaching and learning process, especially in delivering materials that capture students' interest and enhance their understanding of the content, ultimately achieving more comprehensive objectives (Utami et al., 2022; Maghribi, 2023). Certainly, aligning the learning model with the material's specificity is crucial for effective Education. The choice of a learning model should complement the nature and goals of the educational content. (Shantia & Lufri, 2021). The selected learning model must be student-centred, with a primary focus on the needs and preferences of students. This student-centred approach is fundamental in creating interactive learning environments, particularly in scientific problem-solving investigations (Widyanto & Vienlentia, 2021). Interactive Learning engages students actively in the learning process, fostering a deeper understanding of the subject matter and promoting critical thinking skills.

The Learning Cycle, anchored in constructivism and Ausubel's meaningful learning theory, presents an influential instructional design paradigm (Lestari et al., 2018); at its core, this model unfolds through a series of activity stages, each playing a vital role in fostering the mastery of competencies crucial for students engaged in activity-oriented Learning (Nursafitri et al., 2021). The 5E Learning Cycle model, an exemplification of constructivism with its cyclic learning application, assigns the teacher a pivotal role in facilitating and overseeing the seamless progression of learning activities, meticulously navigating the planning and implementation stages (Yulianingtyas et al., 2017). The 5E learning cycle model encompasses a structured sequence of stages designed to guide the educational process effectively. These stages, namely the elicit, engagement, exploration, explanation, elaboration, and evaluation phases, provide a comprehensive framework for facilitating learning experiences. Starting with the elicitation phase, which involves extracting existing knowledge, the model then advances to the engagement phase. In this stage, the focus is on capturing students' interest and cultivating motivation. After the exploration phase, the focus shifts towards promoting active participation and hands-on activities, paving the way for the explanation phase, using formal concepts. Subsequently, the elaboration phase enables students to apply their understanding in more complex scenarios, while the final evaluation phase assesses their mastery of the material. This sequential structure ensures a systematic and engaging learning process, aligning with the principles of constructivism and Ausubel's meaningful learning theory within the educational landscape. (Marisna & Sigit, 2018)

The Learning Cycle model, as developed, consists of several key stages that are integral to the overall learning process:

1. Engagement: This initial stage prepares students for learning by exploring their initial understanding and knowledge. It involves forming groups to encourage collaborative work among students without direct teacher instruction. The goal is to create a conducive environment for learning, fostering curiosity and readiness among students.
2. Explanation: In this stage, the teacher plays a crucial role in motivating students to articulate their understanding of the material in their own words. The emphasis is on seeking clarification and providing answers to questions. Additionally, students can engage in discussions and explore ideas related to the material. This stage aims to deepen understanding and encourage active participation in the learning process.
3. Elaboration: The Elaboration stage focuses on guiding students to apply the learned material through practical activities, often in real-world or field settings. This hands-on approach facilitates problem-solving skills and a more profound understanding of the subject matter. It allows students to extend their knowledge and skills beyond the theoretical framework.
4. Evaluation: The final stage serves as a comprehensive evaluation of all preceding stages. It involves assessing the effectiveness of the learning cycle in terms of the instructional design and students' understanding. Evaluation activities may include assessments, reflections, and feedback, allowing for a thorough examination of the learning outcomes. This stage is critical for refining future implementations of the Learning Cycle model.

The Learning Cycle, rooted in constructivist studies inspired by Piaget, posits that knowledge is best acquired when students engage in reciprocal relationships with their environment (Cylindrica et al., 2021). This approach emphasizes acquiring knowledge and understanding science as a product, process, and tool, fostering a scientific attitude (Rahmawati et al., 2018). The learning cycle model in science education harmonizes with the scientific method, especially in scrutinizing the Earth's surface phenomena, highlighting the scientific principles intrinsic to the discipline. This approach nurtures students' inquiry skills and cultivates a deeper understanding of scientific concepts through hands-on exploration and experimentation (Lasaiba, 2023). In science, the subject of study encompasses formal and material dimensions. The formal aspect pertains to conceptual frameworks and theoretical perspectives concerning natural and social phenomena. Meanwhile, the material dimension encompasses Earth's geosphere, comprising the atmosphere, lithosphere, hydrosphere, pedosphere, biosphere, and anthroposphere. This comprehensive approach facilitates a holistic understanding of scientific principles and their real-world applications across various domains. (Making et al., 2023).

In science learning, the intended outcome is clear: students should engage in scientific research to acquire knowledge and foster a scientific attitude. However, a challenge arises as certain aspects of science education sometimes contradict its inherent nature and tend to lean towards a teacher-centred paradigm, as Adebayo (2021) noted. Traditional methods, such as lecture-based approaches teachers employ, often dominate science classrooms. While conveying information, these teacher-centred methods must be revised to encourage student creativity and exclusively address the cognitive domain, sidelining other crucial aspects of Learning. Consequently, this approach contributes to low student achievement in various school activities. Adebayo (2021) argues that the persistence of conventional lecture methods in science learning activities significantly hinders educational success, as corroborated by (Ahmed et al., 2021). The reluctance of teachers to adopt pedagogical approaches emphasizing student activities further compounds the issue (Cherono et al., 2021). The implications are profound, as this not only hampers the development of a scientific mindset but also limits students' engagement and success in their learning endeavours. Therefore, there is a pressing need to shift towards more student-centric and active learning methodologies in science education to better align with the intended goals of scientific exploration and holistic Learning.

This research holds significant relevance in modern Education, which is continuously evolving. By adopting the 5E learning cycle model, this study highlights the need for a holistic and student-centred approach to Learning. One of the unique aspects of this research is its emphasis on activity-oriented learning experiences aimed at stimulating student participation and enhancing their understanding of the learning process. The research problem in this study is the low level of student participation, which indicates barriers to creating an interactive learning environment and motivating students to engage in the learning process actively.

Furthermore, the lack of student involvement can hinder their understanding of the learning material and reduce the overall effectiveness of Learning. Another area for improvement is the mismatch between the learning model used and students' learning styles. The desired learning outcomes can result in suboptimal achievement of expected outcomes and pose challenges in creating an engaging and motivating learning environment for all students. The uniqueness of this research lies in its holistic approach to Learning, which considers not only cognitive aspects but also affective and psychomotor aspects of student learning. Thus, this research offers valuable contributions to enriching the understanding of the effectiveness of the 5E learning model in enhancing overall student learning outcomes and provides a more comprehensive view of the learning process as a whole.

METHODS

The research method used for this study is Classroom Action Research (CAR), following the model developed by Kemmis and Mc. According to Langitan et al. (2023), Taggart is a systematic and iterative process involving planning, acting, observing, and reflecting. This research aims to address identified issues within the classroom. The research begins with the planning phase, which involves conducting activities to address the specific problems. Planning is done comprehensively, covering the entire Cycle. The following implementation phase involves executing planned actions within the classroom setting. The observation phase consists of observing the effects of the implemented actions. Finally, the research enters the reflection stage, where findings from observations are analyzed to refine the overall plan and guide the implementation of actions in the next Cycle. This Classroom Action Research at SMA Muhammadiyah Ambon specifically targeted Grade XI students and the sample through random sampling. The research spanned approximately five months, from January to May 2022.

The data collection techniques in this research encompass both test and non-test methods. For non-test techniques, first, active observation is conducted by the researcher, where the researcher is directly involved in the teaching process. This observation focuses on student engagement and understanding concepts using an observation sheet validated by experts (expert judgment). The test technique involves learning outcome tests designed to gather data on the effectiveness of students' learning cycle models. These test instruments consist of questions developed to measure the student's abilities and understanding of the taught material.

Additionally, data is collected through documentation studies, including photographs depicting student activities during the learning process and other relevant documents. This documentation provides a concrete depiction of the implementation of the learning model and its contribution to student learning outcomes. With this comprehensive combination of data collection techniques, this research can provide an in-depth analysis of the effectiveness of the 5E learning cycle model in enhancing student learning outcomes and engagement.

The research procedure in this classroom action research is conducted through two cycles, each consisting of four main steps: planning, action, observation, and reflection. Before the planning stage, pre-research activities are carried out, including identifying and formulating problems. In the planning stage, actions to be implemented are designed, including developing a learning flow using the 5E learning cycle model. At this stage, lesson plans and learning media that align with the 5E learning cycle model are also prepared. The research instruments are also developed in advance to ensure their appropriateness and validity. The action stage is carried out in five steps according to the 5E learning cycle model: engagement, explanation, elaboration, and evaluation.

The observation phase is integral to classroom action research to monitor student engagement during action implementation. This process involves detailed observation of student activities and behaviours during classroom learning. Observations are conducted continuously throughout the learning process using pre-designed observation sheets. Additionally, the entire action process, including both intentional and unintentional effects of the actions, the conditions of the environment where the actions occur, and any challenges encountered, are systematically recorded in field notes designed to be flexible enough to encompass various situations that arise.

The final phase in each Cycle is reflection. Reflection aims to evaluate the shortcomings and strengths observed during the learning process, providing constructive feedback for improvement in the subsequent Cycle. This phase is crucial in classroom action research as it marks the end of one Cycle and is the foundation for planning the next. Thorough reflection will strengthen the planning and actions in the following Cycle. After completing Cycle I, the implementation of Cycle II will begin again with a planning phase that has been updated based on the reflections from Cycle I. The subsequent phases, namely action, observation, and reflection, will continue to be carried out considering the suggestions and feedback obtained from the previous Cycle's reflection, creating a continuous cycle of improvement aimed at enhancing the effectiveness of Learning.

The data analysis steps in this research encompass both qualitative and quantitative analysis. Quantitative analysis processes numerical data, enabling objective measurement and statistical assessment of the variables studied. For qualitative analysis, the Miles and Huberman model is employed with systematic stages:

1. Data Reduction: This stage involves selecting and simplifying data through summaries or brief descriptions. Data obtained from observations and documentation are classified and organized into more directed patterns, aligning with the research focus. This process helps separate relevant information from irrelevant, making it easier for the researcher to understand and analyze the data.
2. Data Display: Reduced data are presented simply through narrative descriptions, graphs, and tables. This presentation aims to facilitate data visualization visualization, allowing researchers to identify trends, patterns, and relationships between variables more clearly and systematically.
3. Conclusion Drawing/Verification: The final stage involves verifying and drawing conclusions from the presented data. Conclusions are expressed in concise, clear statements that encompass deep and broad meanings. These conclusions must be supported by sufficient data and critically analyzed to ensure the validity and reliability of the research findings.

With this comprehensive approach, data analysis in this research provides a clear picture of the results obtained and ensures that the conclusions are well-founded and scientific. This approach allows the researcher to combine the strengths of both quantitative and qualitative data, thereby offering more profound and more comprehensive insights into the phenomena studied.

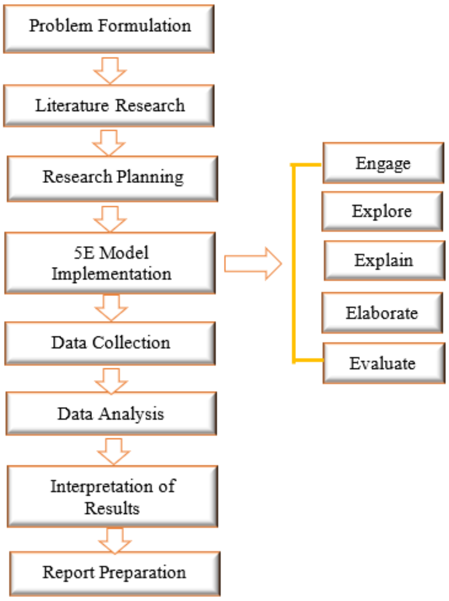

Figure 2. Research Flow Chart

The instruments used in this study must meet several essential criteria to ensure the reliability and validity of the collected data. Two primary requirements for the observation sheets and test instruments are validity and reliability. Instrument validity is obtained through pilot testing, involving empirical analysis of the learning outcome tests and the activity observation sheets. Based on the analysis results, the tests have a critical r value > 0.30, deemed valid. Additionally, the validity calculations for the observation sheets indicate that all items are valid, with a calculated r value > 0.30 (Sugiyono, 2007).

Subsequently, reliability analysis is conducted to ensure the consistency of the results provided by the instruments. The reliability analysis results indicate that the instruments used have an alpha value > 0.6, signifying that the instruments are reliable. Specifically, for the activity observation sheets, the obtained alpha value is 0.772, indicating a high level of reliability. By meeting these validity and reliability requirements, the research instruments can be used with confidence that they will provide accurate and consistent data. Validity ensures that the instruments measure what they are supposed to measure, while reliability guarantees that the measurement results are consistent and dependable. The combination of high validity and reliability in research instruments is crucial for obtaining reliable and credible research results, which will support the conclusions and recommendations from this study.

RESULTS AND DISCUSSION

Before delving into the cycle phases, a pre-cycle assessment incorporating observations and direct interviews with teachers to gain insights into students' learning activities. The pre-cycle findings revealed a concerning scenario where only 10 out of 40 students actively participated individually, and a mere 2 out of 8 groups demonstrated active engagement in Learning. Students lacked enthusiasm for learning at this stage, indicating a clear need for intervention and improvement. In response to the pre-cycle assessment, the Learning Cycle model was introduced Cycle I to foster active student engagement, encourage meaningful conversations, and provide opportunities for students to express their thoughts and questions.

The overarching goal was to address the low levels of participation observed in the pre-cycle phase. The results of the Classroom Action Research indicated a notable improvement in student enthusiasm, both in individual and group activities, during Cycle I compared to the pre-cycle phase. This positive change was attributed to implementing the Learning Cycle model effectively in guiding student activities.

Observations during Cycle I highlighted a significant increase in overall learning activities. This enhancement was especially conspicuous in executing the learning model, as previously overlooked activities such as explaining Earth-related material—began in every lesson. As a result, no essential elements or thorough reflections were present on each topic. Moving forward, the positive outcomes at Cycle I set the stage for continuous refinement and implementation of the Learning Cycle model. However, it is crucial to recognize that the model succeeded in enhancing participation and creating a more comprehensive and effective learning environment. The active engagement of students and the incorporation of previously missed activities showcased the Learning Cycle model's adaptability and impact in improving the learning experience's overall quality.

As the research progresses into subsequent cycles, the focus should remain on refining the Learning Cycle model based on ongoing observations, assessments, and feedback, ensuring a continuous cycle of improvement and meaningful engagement in the learning process. Recapitulation of student activities in Table 1.

Table 1. Summary of Student Involvement in Cycle 1

	N	Mean	Category
Engage	40	57.50	Sure
Explore	40	40.98	Not enough
Explain	40	69.82	Good
Extend	40	79.08	Good
Evaluate	40	46.05	Not enough
Average		58,57	Sure

Based on Table 1. During Cycle 1, alongside implementing the Learning Cycle model, observations were employed to evaluate student participation at each stage of the learning process. Table 1 presents the percentage of student involvement in each learning stage, while Figure 1 visually represents this data. The findings reveal that, on average, student participation across the five learning stages stood at 58.57 per cent, which is considered sufficient for each stage. However, this figure was at most 57,50%, indicating that student engagement in Cycle I could be considered relatively low.

Examining the number of students actively involved in the learning process further illuminates the dynamics of student engagement. For students to be engaged, they must actively participate in at least 57,50% of all learning phases. Active student participation is a crucial indicator of adequate learning quality, as it reflects the level of engagement and understanding they have towards the taught material (Lee & Yang, 2023). According to observational data, only 17 students participated in the learning process during Cycle I. This data points to a gap in achieving optimal engagement, emphasizing the need for further strategies and adjustments in subsequent cycles to enhance student involvement. Observational data can be a valuable tool for educators to identify areas where student engagement can be improved, enabling them to design more effective learning strategies (Downer et al., 2024).

While the initial implementation of the Learning Cycle model showed improvement in student activities compared to the pre-cycle phase, the observations during Cycle I underscore the importance of continually refining and adapting the model. The goal should be to raise student participation levels to achieve a more robust and interactive learning environment. The insights gained from this observational data serve as a valuable guide for educators to tailor their instructional methods and strategies, ensuring that subsequent cycles of the Learning

Cycle model lead to increased and sustained student engagement throughout all stages of the learning process; next, regarding the average values in Cycle 1, as seen in **Figure 3**.

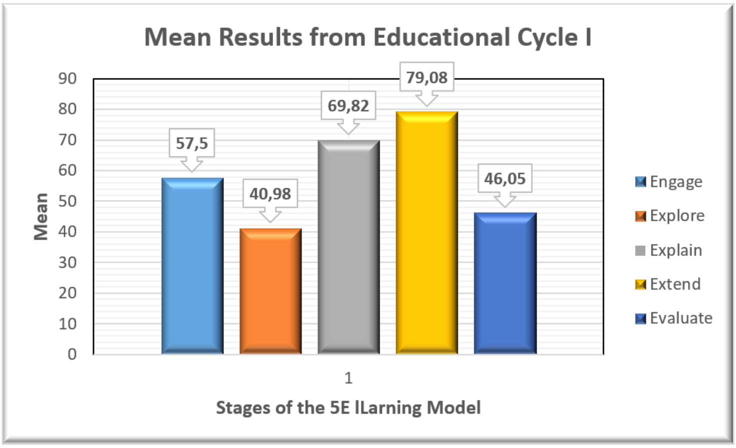

Figure 3. Mean Results from Educational Cycle I

Based on **Figure 3.** A concluding written test assesses students' learning outcomes in the initial Cycle. However, an experimental approach was employed to enhance the assessment process, encompassing observing students' performance in both affective and psychomotor domains. The findings from this multifaceted assessment were insightful and provided a more comprehensive understanding of the student's overall learning outcomes. An experimental approach in the evaluation process opens up opportunities to explore the affective and psychomotor dimensions of student learning, significantly enriching our understanding of overall learning outcomes (Enneking et al., 2019). This holistic evaluation involved cognitive abilities, as measured by the written test results, and delved into the affective aspects of Learning, such as attitudes, values, and emotions. Holistic evaluation encompassing various learning domains provides a deeper understanding of students' progress, enabling educators to design more effective interventions to support their development (Deng et al., 2024).

Additionally, the psychomotor component, focusing on physical and motor skills, was considered in the assessment process. By incorporating these diverse elements into the evaluation, educators gained a richer perspective on students' capabilities and growth. This iterative and comprehensive approach to assessment during Cycle I lays the foundation for a more nuanced and compelling learning evaluation system in subsequent cycles.

Table 2. Summary of Achievements in Student Learning during Cycle 1

Tes Kognitif		F	Per cent
Valid	Complete	29	72.5
	Not Complete	11	27.5
	Total	40	100.0
Performance Appraisal			
Valid	Complete	30	75.0
	Not Complete	10	25.0
	Total	40	100.0

Table 2 from Cycle I reveals that the learning model needs to be optimally implemented, pointing to suboptimal teacher and student participation. The data indicates that student involvement in critical stages such as engagement, extension, assessment, and evaluation needs to catch up to the 75% benchmark. The average activity level across these stages is 58.57%, with only 17 students actively participating. For a substantial improvement in the learning process, it is imperative that both the average student engagement and overall learning implementation reach and exceed the 57,50% threshold. Increasing active student participation is a crucial indicator of quality learning dynamics. This action demonstrates a commitment to creating a dynamic and engaging educational environment where the teaching and learning process becomes more effective. Through active participation, students become beneficiaries of the learning process and active agents in shaping their knowledge and understanding. It reflects a dedication to a student-centred approach to Learning, recognizing their central role in achieving learning objectives (Utami et al., 2022). Thus, a significant increase in active student participation provides an overview of learning success and illustrates a collective commitment to creating an inclusive, inspirational, and growth-oriented learning environment.

In Cycle I, despite 80.0% of students passing the cognitive test and 82.5% completing the performance evaluation, the study still needs to meet the success criterion of 85% for overall student success. This outcome implies that the learning model, learning process, and learning outcomes fell short of the research benchmark. The evaluation criteria suggest a need for corrective actions in the second Cycle to enhance the study's success; adjustments may include refining the learning model, addressing potential gaps in the learning process, and tailoring instructional strategies to better align with students' needs. This iterative approach allows continuous improvement, ensuring that subsequent cycles yield outcomes.

Cycle 2

In contrast to the initial Cycle, where the teacher's instructional activities showed limited improvement and the learning stages were not fully executed, Cycle II witnessed significant positive changes. The teacher demonstrated a more comprehensive implementation of the learning stages, showcasing a commitment to refining instructional practices. Notably, improvements were evident not only in the execution stage but also in the overall learning process. The detailed insights provided by Table 3 and Figure 4 visually represent the enhanced percentage of student engagement across each learning stage during Cycle II. These improvements reflect a responsive and adaptive approach, demonstrating the teacher's dedication to fostering a more effective and engaging learning environment for students in the second Cycle.

Table 3. Recapitulation of Student Activities in Cycle II

	N	Mean	Kategori
Engage	40	78.00	Very good
Explore	40	80.75	Very good
Explain	40	79.40	Very good
Extend	40	83.80	Very good
Evaluate	40	80.15	Very good
Rata-Rata		80.42	Very good
Valid (listwise)			

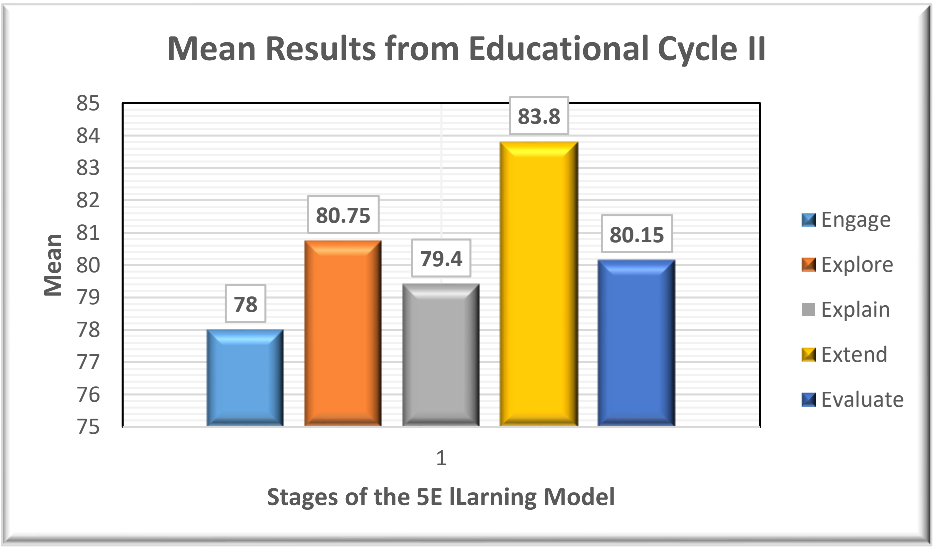

Figure 4. Mean Results from Educational Cycle II

Overall, student participation rates in Cycle II are significantly higher compared to Cycle I (Table 3 and Figure 4). Almost every student actively participates in each stage of Learning, as evidenced by a significant increase in the percentage of students involved in Cycle II compared to Cycle I, especially in the Explore, Extend, Engage, and Evaluate phases. All stages of learning in Cycles I and II have experienced improvement, with the Explore and Evaluate stages showing significant increases. The Extend stage has an average student activity of 83.80 per cent, while the Evaluate stage averages 80.15 per cent.

The learning process evaluation extends beyond mere averages, encompassing the intensity of student engagement at each stage and the overall participation rates. In Cycle II, 87.5 per cent of the total student body, 35 students, actively immersed themselves in the educational journey. This substantial involvement underscores the dynamism of the learning environment. The significant increase in student participation rates in the learning process is a positive indicator of the effectiveness of the applied teaching strategies, reflecting the success of efforts to create an inclusive and dynamic learning environment (Yulaikah et al., 2022). This research finding is consistent with Asmuni (2020), which indicates that implementing the 5E learning cycle model can enhance student learning activities. All indicators of student activity show an increase from Cycle I to Cycle II. When averaged for each Cycle, the average for Cycle I is 66% with a good criterion, while the average for Cycle II increases to 81% with an excellent criterion. To gain deeper insights into the student's progress, Table 4 meticulously delineates the outcomes of cognitive and performance assessments conducted during Cycle II. These assessments serve as vital indicators of the effectiveness of the teaching methodologies employed, shedding light on the student's comprehension and application of the acquired knowledge.

Table 4. Summary of Achievements in Student Learning during Cycle 1

Tes Kognitif		**F**	**Per cent**
Valid	Complete	34	85.0
	Not Complete	6	15.0
	Total	40	100.0
Performance Appraisal			
Valid	Complete	35	87.5
	Not Complete	5	12.5
	Total	40	100.0

Based on Table 4. The transition from Cycle I to Cycle II in this research marks a notable upswing in cognitive test scores and performance assessments, affirming the efficacy and success of the implemented learning model. The mental test results exhibit a commendable improvement, with a rise from 72.5% in Cycle I to an impressive 85.0% in Cycle II. Similarly, the performance assessments witnessed a substantial increase, climbing from a 75.0% achievement in Cycle I to an elevated 87.5% in Cycle II. This upward trajectory underscores the positive impact of the learning process, encompassing the collaborative efforts of teachers and students. The multifaceted evaluation, spanning cognitive, emotional, and psychomotor domains, further solidifies the research's effectiveness in nurturing comprehensive learning outcomes during Cycle II. The symbiotic interplay of the learning model and the dynamic engagement of teachers and students has contributed to the success of this educational endeavour.

Implementing the 5E learning cycle model has substantially enhanced learning outcomes and student engagement, with an impressive 75% improvement observed. This noteworthy progress suggests that when at least 75 per cent of students actively participate in the learning process, the utilization of the 5E learning cycle model contributes significantly to the success of the learning experience. The process and outcomes of Learning are crucial indicators of its quality. The significant positive impact of the 5E model on student activities and learning outcomes highlights its effectiveness in cultivating successful learning environments. When students actively engage in the learning process, they develop a deeper understanding and better retention of the material.

Additionally, active engagement promotes critical, creative, and collaborative skills essential for success in the modern era. By focusing on the stages of Engagement, Exploration, Explanation, Elaboration, and Evaluation, the 5E model helps students integrate new knowledge into their cognitive frameworks more comprehensively. Has the potential to create more independent, analytically-minded students who are prepared to tackle future challenges (Tegegne & Kelkay, 2023)

The essence of science studies lies in fostering practical learning experiences, emphasizing process skills, and cultivating scientific thinking patterns. Adopting the 5E learning cycle paradigm shifts the focus from direct teacher-led instruction to a facilitative role, as highlighted by (Partini et al., 2017). This approach aligns with the requirements of the KTSP and resonates with Piaget's constructivist perspective. As Piaget advocates, constructivist-based Learning emphasizes that students actively construct their understanding through meaningful learning activities. In the 5E learning cycle model context, active student participation at every stage is physically and psychologically crucial. This active engagement ensures that students are not passive recipients of information but are deeply involved in the learning process. Each phase—Engagement, Exploration, Explanation, Elaboration, and Evaluation—requires students to interact with the material and each other, promoting hands-on Learning and critical thinking. This interactive approach makes learning more relevant and meaningful, boosting motivation and interest. As students see the practical applications of their knowledge and receive continuous feedback, their learning outcomes improve, leading to a deeper understanding and better retention of concepts. (Sotáková & Ganajová, 2023)

Research conducted by Asmuni (2020) underscores the positive impact of the 5E learning cycle model on students' activity levels and mastery of concepts, which aligns with broader literature and indicates an enhancement in student learning processes and outcomes. Notably, Cylindrica et al. (2021) found that students taught with the Learning Cycle 5E model, supported by e-scaffolding, demonstrated a higher conceptual knowledge level than those. The learning cycle model, emphasizing interactive and participatory Learning, substantially enhances students' reasoning abilities. The collective evidence from various studies indicates that this model effectively increases students' active engagement and conceptual mastery in science education. More specifically, the Learning Cycle 5E model—which consists of the phases of Engagement, Exploration, Explanation, Elaboration, and Evaluation—facilitates the learning process in a deeper and more meaningful way. These phases help students not only understand new concepts but also apply them in different contexts, thereby strengthening their memory and critical thinking skills (Shahbazloo & Abdullah Mirzaie, 2023)

The research conducted by Lestari et al. (2018) underscores the positive impact of incorporating reflective self-assessment within the 5E Learning Cycle. Students exhibited improved representation skills, encompassing verbal, visual, and mathematical abilities. Similarly, Marisna and Sigit (2018) identified significant differences in cognitive learning outcomes between students exposed to the Learning Cycle 5E-Mind mapping and those using the conventional Learning Cycle 5E model. The former demonstrated superior cognitive learning outcomes, emphasizing the effectiveness of incorporating mind mapping into the 5E learning process, with scores of 81.13 compared to 75.16.

Research findings by Nursafitri et al. (2021) highlight variations in conceptual understanding among students exposed to the 5E learning cycle model through analogies, the conventional 5E learning cycle, and conventional teaching methods. Notably, the analogously higher average conceptual understanding scores in the 5E learning cycle class underscore the model's efficacy in enhancing conceptual comprehension. Rahmawati et al. (2018) contribute to the body of evidence by demonstrating significant differences in process skills between students taught using the 5E Learning Cycle and those taught using conventional methods, emphasizing the unique contributions of the 5E learning cycle paradigm to developing crucial process skills.

Harefa (2020) adds another layer to the discussion by asserting that the learning cycle concept places students at the core of the learning process. This approach encourages students to take responsibility for their Education, fostering independence and purposeful Learning. The idea aligns with the perspective that students benefit more from actively seeking knowledge than passively receiving teacher information (Annisa, 2022). This shift towards a more interactive learning environment, as advocated by Bruner (1966 and Harefa, 2020), is posited as essential for successfully addressing educational challenges. In summary, the diverse research findings emphasize the positive influence of the 5E learning cycle paradigm on various aspects of Learning, including representation skills, cognitive outcomes, conceptual understanding, and process skills. The overarching theme is that this instructional approach empowers students, fostering a more engaged and practical learning experience.

The learning cycle model unfolds through well-defined stages, commencing with the initial elicitation stage. During this phase, students are encouraged to delve deeper into phenomena, stimulating continued thought and introducing new concepts relevant to the topic under discussion. This initial stage sets the groundwork for active engagement, prompting students to formulate hypotheses based on their existing conceptual framework. Following the initial elicitation, the learning cycle progresses to the engagement stage, where students actively participate in designing experiments to test their hypotheses. This phase involves keen observation and hands-on experimentation, particularly in introducing novel concepts. The engage and explore stages work in tandem to foster a dynamic and immersive learning experience.

As the learning cycle progresses to the expansion phase, students enhance their comprehension by integrating new concepts into their cognitive frameworks. Academic achievements are acknowledged as students critically analyze, analyzing observations or experimental data, enriching their cognitive schema (Jian et al., 2023). The culmination of the learning cycle is the investigation stage, wherein students' scientific attitudes come to the forefront. Armed with a comprehensive understanding of the subject matter, students apply their scientific knowledge to investigate and interpret data related to the topics they have been studying. This stage represents a synthesis of the knowledge acquired throughout the learning cycle, emphasizing the application of scientific principles and critical thinking. Essentially, the learning cycle model guides students through a holistic learning experience, encouraging exploration, experimentation, and thoughtful analysis. The stages unfold sequentially, fostering the development of scientific attitudes and the practical application of acquired knowledge.

CONCLUSION

The 5E learning cycle model has proven effective in improving student learning outcomes and fostering active engagement in the learning process. Through the implementation of the Classroom Action Research method, improvements, particularly in cognitive assessment, were observed from one Cycle to the next. These findings prove that a holistic and student-centred approach to teaching can enhance students' understanding and promote active involvement in teaching-learning. Underscores the importance of adopting teaching strategies responsive to individual student needs to achieve optimal and sustainable learning outcomes.

ACKNOWLEDGMENT

The authors thank the Faculty of Teacher Training and Education, Pattimura University, for their financial support in this research endeavour. This support has facilitated the smooth and successful progress of our research. We hope that the findings of this study contribute to a

deeper understanding of the implementation of the 5E learning cycle model, which can be considered a progressive step in enhancing the effectiveness of Education. Recommendations for sustaining the implementation of the 5E learning cycle model aim to create a dynamic and effective learning environment, thereby positively impacting overall student learning outcomes. Therefore, student-centred learning approaches should be continued into everyday teaching practices that can foster a stimulating and dynamic learning environment, enabling students to reach their maximum learning potential. Consequently, educators can be effective learning facilitators, strengthening students' skills and knowledge in engaging and meaningful ways.

REFERENCES

Abaniel, A. (2018). Enhanced conceptual understanding, 21st-century skills and learning attitudes through an open-inquiry learning model in Physics. *International Journal of Higher Education Management (IJHEM)*,*5*(1), 30–43. https://d1wqtxts1xzle7.cloudfront.net/68453464

Adebayo, O. I. (2021). *Examining The Relative Effectiveness of The Culturo-Techno-Contextual Approach (Ctca) In Improving Secondary School Students 'achievement In Classical Genetics* [Department of Science and Technology Education, Faculty of Education, lagos]. https://www.researchgate.net/profile/Adekunle-Oladejo/publication/360068735

Ahmed, M. A., Shittu, F. A., Yahaya, L., & Dada, A. O. (2021). Effects of concept-mapping instructional strategy on senior school student achievement in biology, Lagos state, Nigeria. *MOJES: Malaysian Online Journal of Educational Sciences*, *9*(1), 14–23. http://ojie.um.edu.my/index.php/MOJES/article/view/28216

Ang, M. (2018). Character and service dimensions of global competencies for 21st-century Learning: cross-sectional perspectives. *International Journal of Higher Education Management*, *5*(1). https://d1wqtxts1xzle7.cloudfront.net/68453464

Annisa, D. (2022). Pengaruh Model Pembelajaran Learning Cycle terhadap Kemampuan Representasi Matematis. *Journal on Education*, *4*(3), 960–967. https://doi.org/https://doi.org/10.31004/joe.v4i3.491

Asmuni, A. (2020). Penerapan Model Pembelajaran Learning Cycle 5e untuk Meningkatkan Aktivitas dan Penguasaan Konsep Siswa Pada Mata Pelajaran PAI dan Budi Pekerti di SMA Negeri 1 Selong. *Jurnal Paedagogy*, *7*(3), 175. https://doi.org/10.33394/jp.v7i3.2743

Bruner, J. S. (1966). *Toward a theory of instruction* (Vol. 59). Harvard University Press. https://books.google.co.id/books?hl=id&lr=&id=F_d96D9FmbUC&o

Chalkiadaki, A. (2018). A systematic literature review of 21st century skills and competencies in primary Education. *International Journal of Instruction*, *11*(3), 1–16. https://eric.ed.gov/?id=EJ1183407

Cherono, J., Samikwo, D., & Kabesa, S. (2021). *Effect of 7E learning cycle model on students' academic achievement in biology in secondary schools in Chesumei sub-county, Kenya*. https://doi.org/https://doi.org/10.21831/jpe.v4i2.9488

Cylindrica, V. B., Dasna, I. W., & Sumari, S. (2021). Pengaruh Model Pembelajaran Learning Cycle 5E berbantuan E-scaffolding pada Materi Laju Reaksi terhadap Pemahaman Konsep Siswa dengan Motivasi Berprestasi Berbeda. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *6*(7), 1115. https://doi.org/10.17977/jptpp.v6i7.14934

Deng, Z., Dong, B., Guo, X., & Zhang, J. (2024). Impact of Indoor Air Quality and Multi-domain Factors on Human Productivity and Physiological Responses: A Comprehensive Review. *Indoor Air*, *2024*, 5584960. https://doi.org/10.1155/2024/5584960

Downer, J. T., Doyle, N. B., Pianta, R. C., Burchinal, M., Field, S., Hamre, B. K., LoCasale-Crouch, J., Howes, C., LaParo, K., & Scott-Little, C. (2024). Coaching and Coursework Focused on Teacher-Child Interactions During Language/Literacy Instruction: Effects on Teacher Outcomes and Children's Classroom Engagement. *Early Education and Development*, *12*(2), 1–31. https://doi.org/10.1080/10409289.2024.2303604

Enneking, K. M., Breitenstein, G. R., Coleman, A. F., Reeves, J. H., Wang, Y., & Grove, N. P. (2019). The Evaluation of a Hybrid, General Chemistry Laboratory Curriculum: Impact on Students' Cognitive, Affective, and Psychomotor Learning. *Journal of Chemical Education*, *96*(6), 1058–1067. https://doi.org/10.1021/acs.jchemed.8b00637

Harefa, D. (2020). Peningkatan Prestasi Belajar IPA Siswa Pada Model Pembelajaran Learning Cycle Dengan Materi Energi dan Perubahannya. *Trapsila: Jurnal Pendidikan Dasar*, *2*(01), 25. https://doi.org/10.30742/tpd.v2i01.882

Haryadi, S., Djatmika, E. T., & Setyosari, P. (2017). Suplemen Buku Ajar Tematik Materi Energi Alternatif & Sumber Daya Alam Berbasis. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *Volume: 2*, 1330–1337. https://doi.org/http://dx.doi.org/10.17977/jptpp.v2i10.10067

Hitipeuw, I., & Rianghati, L. (2017). The influence of video based on experiential Learning on the Socio-Emotion of Children in Kindergarten. *International Journal of Multidisciplinary Thought*, *06*(01), 2156–6992. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2976015

Hulaikah, M., Degeng, I. N. S., Sulton, & Murwani, F. D. (2020). The effect of experiential learning and adversity quotient on problem-solving ability. *International Journal of Instruction*, *13*(1), 869–884. https://doi.org/10.29333/iji.2020.13156a

Jian, M., Jin, D., & Wu, X. (2023). Research hotspots and trends in developing international learning cycle models: A bibliometric analysis based on CiteSpace Bibliometric analysis based on CiteSpace. *Heliyon*, *9*(11), e22076. https://doi.org/10.1016/j.heliyon.2023.e22076

Langitan, L. V., Putri, N. L., & Suwaryaningrat, N. D. E. (2023). Meningkatkan Kemampuan Mengenal Lambang Bilangan 1-10 Melalui Lembar Kerja Peserta Didik Pada Anak Usia 5-6 Tahun Di TK Frater Don Bosco Tomohon. *Jurnal Ilmiah Wahana Pendidikan*, *9*(9), 761–768. https://doi.org/https://doi.org/10.5281/zenodo.8118584

Lasaiba, M. A. (2023). Sistem informasi geografi dan penginderaan jauh dalam pemetaan zona longsor lahan di kawasan terbangun. *STRING (Satuan Tulisan Riset Dan Inovasi Teknologi)*, *7*(3), 344–358. https://doi.org/http://dx.doi.org/10.30998/string.v7i3.16161

Lee, W. W. S., & Yang, M. (2023). Effective collaborative Learning from Chinese students' perspective: a qualitative study in a teacher-training course. *Teaching in Higher Education*, *28*(2), 221–237. https://doi.org/10.1080/13562517.2020.1790517

Lestari, I. D., Yuliati, L., & Suwono, H. (2018). Kemampuan Representasi Siswa SMP dalam The 5E Learning Cycle dengan Reflective Self Assessment pada Materi Kalor. *Jurnal Pendidikan Teori Penelitian Dan Pengembangan*, 165–173. https://doi.org/http://dx.doi.org/10.17977/jptpp.v3i2.10492

Listyarini, D. W., As'ari, A. R., & Furaidah. (2018). Pengaruh Model Teams Games Tournament Berbantuan Permainan Halma terhadap Minat dan Hasil Belajar pada Materi Bunyi Siswa Kelas IV Sekolah Dasar. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *3*(5), 538–543. https://doi.org/http://dx.doi.org/10.17977/jptpp.v3i5.10930

Lorsbach, T. C., & Reimer, J. F. (2008). Context processing and cognitive control in children and young adults. *The Journal of Genetic Psychology*, *169*(1), 34–50. https://www.tandfonline.com/doi/abs/10.3200/GNTP.169.1.34-50

Maghribi, A. N. (2023). Integrative Science Education and Teaching Activity Journal The Influence of the British Style Debate Learning Model Based on Logical Inference in Enhancing Students ' Scientific Thinking Abilities. *INSECTA*, *4*(2), 160–169. https://doi.org/https://doi.org/10.21154/insecta.v4i2.7465

Making, J. K., Lasaiba, M. A., & Lalihun, I. (2023). *Geospasial daerah rawan longsor lahan dalam pengembangan model pendidikan kebencanaan di wilayah kota ambon* (Issue January). https://www.researchgate.net/publication/367326553

Malik, R. S. (2018). Educational challenges in the 21st century and sustainable development. *Journal of Sustainable Development Education and Research*, *2*(1), 9–20. https://doi.org/https://doi.org/10.17509/jsder.v2i1.12266

Marisna, R., & Sigit, D. (2018). Perbedaan Hasil Belajar Kognitif Antara Siswa yang Dibelajarkan dengan Model Pembelajaran Learning Cycle 5e dan Learning Cycle 5e-Mind Mapping pada Materi …. *Jurnal Pendidikan: Teori, Penelitian, Dan …*, *3*(7), 891–897. https://doi.org/http://dx.doi.org/10.17977/jptpp.v3i7.11332

Nursafitri, M., Santoso, A., & Sumari, S. (2021). Pengaruh Model Pembelajaran Learning Cycle 5E dengan Analogi terhadap Pemahaman Konsep Siswa pada Materi Laju Reaksi. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *6*(7), 1076. https://doi.org/10.17977/jptpp.v6i7.14928

Partini, Budijanto, & Bachri, S. (2017). Penerapan Model Pembelajaran Learning Cycle Untuk Meningkatkan Kemampuan Penalaran Siswa. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *2*(3), 268–272. https://doi.org/http://dx.doi.org/10.17977/jp.v2i2.8541

Rahmawati, Handayanto, S. K., & Dasna, I. W. (2018). Pengaruh Learning Cycle 5E Terhadap Keterampilan Proses Sains Peserta Didik Kelas VIII. *Jurnal Pendidikan : Teori, Penelitian, Dan Pengembangan*, *3*(3), 286–290. https://doi.org/http://dx.doi.org/10.17977/jptpp.v3i3.10624

Riti, Y. U. R., Degeng, I. N. S., & Sulton, S. (2021). Pengembangan Model Pembelajaran Berbasis Proyek dengan Menerapkan Metode Design Thinking untuk Meningkatkan Keterampilan Berpikir Kritis Siswa Dalam Mata Pelajaran Kimia. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *6*(10), 1581. https://doi.org/10.17977/jptpp.v6i10.15056

Schleicher, A. (2018). Educating learners for their future, not our past. *ECNU Review of Education*, *1*(1), 58–75. https://doi.org/https://doi.org/10.30926/ecnuroe20180101

Shahbazloo, F., & Abdullah Mirzaie, R. (2023). Investigating the effect of 5E-based STEM education in solar energy context on creativity and academic achievement of female junior high school students. *Thinking Skills and Creativity*, *49*, 101336. https://doi.org/https://doi.org/10.1016/j.tsc.2023.101336

Shantia, E., & Lufri, L. (2021). The Influence of Contextual Teaching and Learning (CTL) Learning Model on 21st Century Skills of Students in Class X Biology Learning. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *6*(11), 1792. https://doi.org/10.17977/jptpp.v6i11.15147

Sotáková, I., & Ganajová, M. (2023). The effect of the 5E instructional model on students' cognitive processes and attitudes towards chemistry as a subject. *Eurasia Journal of Mathematics, Science and Technology Education*, *19*(9). https://doi.org/10.29333/EJMSTE/13469

Tegegne, T. A., & Kelkay, A. D. (2023). Comparative study of using 5E learning cycle and the traditional teaching method in chemistry to improve student understanding of water concept: The case of primary school. *Cogent Education*, *10*(1), 2199634. https://doi.org/10.1080/2331186X.2023.2199634

Utami, P. Q., Sumari, S., & Dasna, I. W. (2022). Penerapan Model Pembelajaran Argument Driven Inquiry terhadap Kemampuan Argumentasi Ilmiah. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *7*(4), 122. https://doi.org/10.17977/jptpp.v7i4.15217

Utamy, V. G., & Rosdiana, L. (2023). Integrative Science Education and Teaching Activity Journal Analysis of Students ' Misconception Profile on Human Respiratory System Material using Four-Tier Diagnostic Test. *INSECTA*, *4*(2), 124–137. https://doi.org/https://doi.org/10.21154/insecta.v4i2.6929

Wakhidah, N., & Anugra, N. (2023). Integrative Science Education and Teaching Activity Journal Perceptions of Prospective Teachers on Basic Competencies in Science at Madrasah Ibtidaiyah. *INSECTA*, *4*(2), 110–123. https://doi.org/https://doi.org/10.21154/insecta.v4i2.6093

Wang, Y., Lavonen, J., & Tirri, K. (2018). Aims to learn 21st-century competencies in national primary science curricula in China and Finland. *Eurasia Journal of Mathematics Science and Technology Education*. https://doi.org/https://doi.org/10.29333/ejmste/86363

Widyanto, I. P., & Vienlentia, R. (2021). Peningkatan Kemampuan Berpikir Kritis dan Hasil Belajar Peserta Didik Melalui Model Pembelajaran Discovery Learning. *Jurnal Didaktika Pendidikan Dasar*, *5*(3), 637–656. https://doi.org/10.26811/didaktika.v5i3.201

Yulaikah, I., Rahayu, S., & Parlan, P. (2022). Efektivitas Pembelajaran STEM dengan Model PjBL Terhadap Kreativitas dan Pemahaman Konsep IPA Siswa Sekolah Dasar. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *7*(6), 223. https://doi.org/10.17977/jptpp.v7i6.15275

Yulianingtyas, E., Budiasih, E., & Marfuah, S. (2017). Pengaruh Penggunaan Jurnal Belajar Dalam Model Pembelajaran Learning Cycle 6E Terhadap Kesadaran Metakognitif Siswa Sman 8 Malang Pada Materi Redoks. *Teori, Penelitian, Dan Pengembangan*, *2*(5), 724–730. https://doi.org/http://dx.doi.org/10.17977/jptpp.v2i5.9203