

HORIZON LEARNING MODEL (ACTIVE AND CREATIVE WAYS TO REALIZE HOPES THROUGH MEANINGFUL LEARNING) ON THE TOPIC - WASTE MANAGEMENT IN THE SCHOOL ENVIRONMENT

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Abstract

This study discusses the development of the CAKRAWALA Learning Model (Active and Creative Ways to Realize Aspirations through Meaningful Learning) on the topic of Waste Management in the School Environment as a strategic effort to enhance students' character values, collaboration, environmental awareness, creativity, and social responsibility. The implementation of the CAKRAWALA model in Biology education acts as a metaphor for expanding students' understanding from a narrow conceptual scope toward a holistic ecological perspective. The research method applied in this study is a literature review. The results show that the CAKRAWALA model is effectively implemented in contextual project-based learning, especially in waste management topics within school environments. The model integrates character values, collaboration, and environmental awareness in a meaningful and enjoyable way through the following steps: Create a Conducive Atmosphere (Preparation and Motivation), Experience the Material Deeply (Concept Exploration), Develop Understanding (Discussion and Analysis), Summarize and Conclude (Reflection and Generalization), Apply Knowledge (Implementation and Practice), Realize Creative Projects (Innovation and Collaboration), Conduct Holistic Assessment (Comprehensive Evaluation), Continue Independent Learning (Ongoing Development), and Appreciation and Evaluation (Feedback and Celebration).

Keywords: CAKRAWALA; Meaningful Learning; Waste Management; Biology.

Abstrak

Artikel ini membahas tentang Pengembangan Model Pembelajaran CAKRAWALA (Cara Aktif Kreatif Wujudkan Asa melalui Pembelajaran Bermakna) Pada Topik - Pengelolaan Sampah di Lingkungan Sekolah sebagai salah satu upaya strategis dalam meningkatkan nilai karakter, kolaborasi, kepedulian terhadap lingkungan secara menyenangkan dan bermakna, menumbuhkan kesadaran ekologis, kreativitas, dan tanggung jawab sosial siswa sekaligus memberikan rekomendasi berbasis bukti untuk pengembangan praktik pedagogi yang lebih adaptif di masa depan. Pengembangan dan pengimplementasian model pembelajaran CAKRAWALA ini diadopsi dalam konteks biologi menjadi metafora untuk perluasan pemahaman siswa dari konsep sempit menjadi perspektif ekologis yang menyeluruh (holistik). Metodologi yang digunakan dalam penulisan artikel yaitu studi pustaka. Model pembelajaran CAKRAWALA efektif diterapkan dalam pembelajaran kontekstual berbasis proyek, terutama pada tema pengelolaan sampah di lingkungan sekolah, karena mampu mengintegrasikan nilai-nilai karakter, kolaborasi, dan kepedulian terhadap lingkungan secara menyenangkan dan bermakna melalui langkah-langkah : Ciptakan Suasana Kondusif (Persiapan dan Motivasi), Alami Materi Secara Mendalam (Eksplorasi Konsep), Kembangkan Pemahaman (Diskusi dan Analisis), Rangkum dan Simpulkan (Refleksi dan Generalisasi), Aplikasikan Pengetahuan (Penerapan dan Praktik), Wujudkan Proyek Kreatif (Inovasi dan Kolaborasi), Asesmen Holistik (Evaluasi Komprehensif), Lanjutkan Pembelajaran Mandiri (Pengembangan Berkelanjutan), Apresiasi dan Evaluasi (Umpan Balik dan Perayaan)

Kata kunci: CAKRAWALA; Pembelajaran Bermakna; Pengelolaan Sampah; Biologi.



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INTRODUCTION

Education plays a fundamental role as a primary pillar of national development and a driving force for socio-economic progress.¹ In the Indonesian context, the mandate to educate the nation is clearly stated in the constitution, making efforts to improve the quality and equality of education a sustainable national priority.² In the era of the Industrial Revolution 4.0 and welcoming the Era of Society 5.0, the role of education is increasingly complex; not only transferring knowledge, but also equipping students with adaptive and innovative capacities to compete in a dynamic and competitive global environment.³

Constructivist theory emphasizes that knowledge cannot simply be transferred from teacher to student, but must be actively constructed by individuals through interactions with the environment and learning experiences.⁴ In constructivist learning, teachers act as facilitators who provide meaningful learning experiences, encourage exploration, and guide students to discover and reconstruct their own understanding.⁵

The concept of meaningful learning was introduced by David Ausubel⁶, who stated that learning will be more effective if new information is linked to students' existing cognitive structures. Meaningful learning differs from rote learning because it requires students' mental and emotional involvement in understanding the relationships between concepts.⁷ Thus, meaningful learning encourages students to not only know the "what" but also understand the "why" and "how" of a concept in real life.

The 21st-century skills known as the 4Cs—Creativity, Collaboration, Communication, and Critical Thinking—are a set of essential competencies needed by students to adapt to a complex, digital, and dynamic world.⁸ Learning models oriented toward the 4Cs emphasize active learning, problem-solving, and collaboration to generate creative solutions.⁹

¹ John Dewey, *Experience and Education* (Macmillan, 1938); H. A. R. Tilaar, *Perubahan Sosial Dan Pendidikan: Pengantar Pedagogik Transformatif Untuk Indonesia* (Grasindo, 2002).

² Undang-Undang Dasar Negara Republik Indonesia Tahun 1945 (1945); E. Mulyasa, *Pengembangan Dan Implementasi Kurikulum 2013* (PT Remaja Rosdakarya, 2013).

³ Klaus Schwab, *The Fourth Industrial Revolution* (World Economic Forum, 2017); Francis Fukuyama, *Identity: The Demand for Dignity and the Politics of Resentment* (Farrar, Straus and Giroux, 2018); Kementerian Pendidikan dan Kebudayaan Republik Indonesia, *Pendidikan Di Era Revolusi Industri 4.0 Dan Masyarakat 5.0* (Kementerian Pendidikan dan Kebudayaan Republik Indonesia, 2020).

⁴ Jean Piaget, *To Understand Is to Invent: The Future of Education* (Grossman, 1973); Lev S. Vygotsky, *Mind in Society: The Development of Higher Psychological Processes* (Harvard University Press, 1978).

⁵ Jerome S. Bruner, *The Culture of Education* (Harvard University Press, 1996).

⁶ David P. Ausubel, *Educational Psychology: A Cognitive View* (Holt, Rinehart & Winston, 1968).

⁷ Joseph D. Novak, *Learning, Creating, and Using Knowledge: Concept Maps as Facilitative Tools in Schools and Corporations*, 2nd ed. (Routledge, 2010).

⁸ Bernie Trilling and Charles Fadel, *21st Century Skills: Learning for Life in Our Times* (Jossey-Bass, 2009).

⁹ Marilyn Binkley et al., "Defining Twenty-First Century Skills," in *Assessment and Teaching of 21st Century Skills*, ed. Patrick Griffin et al. (Springer, 2012).

Ecopedagogy is an educational approach oriented toward ecological awareness, social justice, and sustainability. This concept is rooted in Paulo Freire's critical education theory, which emphasizes the importance of reflection and action (praxis) in building transformative awareness of social and ecological realities.¹⁰ Ecopedagogy-based education not only teaches environmental facts but also fosters values, attitudes, and behaviors that foster care for the earth.¹¹

Environmental education is crucial for fostering ecological awareness and social responsibility in students for the sustainability of the earth. Amidst increasing environmental problems such as pollution, climate change, and waste accumulation, schools play a strategic role as a vehicle for fostering environmentally conscious character from an early age.¹² However, the success of environmental education cannot be achieved solely through the delivery of theoretical information; it requires meaningful and contextual learning experiences. Meaningful learning enables students to connect new knowledge with real-world experiences, enabling them to not only know but also understand, feel, and act based on this ecological awareness.¹³ Therefore, integrating environmental education through meaningful learning is an urgent need to develop critical, reflective, and committed students who are committed to environmental conservation.

This study proposes and focuses on the Horizon Learning Model, an approach that inherently integrates multi-perspective exploration and self-discovery, with the hope of bridging the gap between current learning practices and future skill demands (Lucky@nchaq, 2025). By testing the effectiveness of the Horizon Learning Model, this study is expected to provide empirical contributions in enriching pedagogical treasures and supporting the realization of adaptive and quality national education goals.¹⁴ Biology means encouraging students to broaden their horizons, from simply seeing waste as a "problem" to understanding waste as part of the natural cycle that must be managed responsibly, realizing meaningful knowledge into real action for the future of the environment. The philosophical meaning of the word "Cakrawala" (from Sanskrit: cakra meaning wheel/circle and wala meaning time/space) literally means the furthest limit of vision, or horizon. In a philosophical context, the horizon symbolizes the Breadth of Perspective: Boundaries that are always moving, signifying that knowledge never stops and there is always something new to learn. Widening Reach: An effort to see a problem holistically, from various perspectives. Hope and Future: A forward-looking view, realizing a vision or 'hope'. In the

¹⁰ Moacir Gadotti, *Education for Sustainability: A Critical Contribution to the Decade of Education for Sustainable Development* (Instituto Paulo Freire, 2008).

¹¹ UNESCO, *Education for Sustainable Development Goals: Learning Objectives* (UNESCO, 2017).

¹² Daniella Tilbury, *Education for Sustainable Development: An Expert Review of Processes and Learning* (UNESCO, 2011).

¹³ Ausubel, *Educational Psychology: A Cognitive View*; Novak, *Learning, Creating, and Using Knowledge: Concept Maps as Facilitative Tools in Schools and Corporations*.

¹⁴ Kementerian Pendidikan dan Kebudayaan Republik Indonesia, *Pendidikan Di Era Revolusi Industri 4.0 Dan Masyarakat 5.0*; Mulyasa, *Pengembangan Dan Implementasi Kurikulum 2013*.

context of Biology and the CAKRAWALA Learning Model, the meaning of "horizon" becomes a metaphor for expanding students' understanding from narrow concepts to a holistic ecological perspective.

Biology learning does not stop at definitions and memorization. The concept of "Horizons" encourages students to go beyond the classroom boundaries: learning biology (e.g., decomposition, material cycles, the role of microorganisms) not only from textbooks, but by observing and interacting directly with the school environment (living laboratory). Interdisciplinary Connections: viewing waste not only as a biological problem (decomposition) but also as a social problem (human behavior), economic problem (the value of recycling), and chemical problem (pollution). This broadens students' horizons of thinking. Holistic Ecological View (Whole System)

In the topic of Waste Management, Biology always teaches about Ecological Systems. The metaphor of "Horizon" is very relevant here:

Life Cycle: Students are encouraged to see the complete waste cycle, from waste being generated → processed (decomposition) → returned to resources (compost, recycling), rather than simply being lost to landfill. This is an ecological horizon view.

Long-Term Impact: Understanding that waste in schools affects not only the school grounds, but also the quality of soil, water, and the health of the broader community. Students see impacts extending into the future (environmental sustainability).

Realize Hope (Vision and Real Action) In accordance with the acronym CAKRAWALA (Wujudkan Asa), the meaning of horizon (horizon) as a forward-looking direction is very strong. Learning Biology about waste should lead to a vision (Asa) of a better school environment. Active and Creative Knowledge must be used to realize this hope. "Horizon" here means setting a future target (a waste-free/zero waste school) and planning real action steps today to achieve it.

Although awareness of the importance of waste management has been widely taught in schools through various subjects, the reality on the ground shows a significant gap between theory and practice. Many students understand the concept of reduce, reuse, and recycle (3R) cognitively, but have not yet applied it consistently in their daily lives in the school environment.¹⁵ This is due to the learning process still focusing on declarative knowledge aspects without accompanying application and reflective activities that facilitate behavioral change.¹⁶ Furthermore, supporting facilities and school culture oriented towards environmentally friendly

¹⁵ N. Rahmawati and A. Santosa, "Implementasi Konsep 3R (Reduce, Reuse, Recycle) Dalam Kegiatan Pembelajaran Lingkungan Di Sekolah Dasar," *Jurnal Pendidikan Lingkungan Dan Pembangunan Berkelanjutan* 21, no. 2 (2020): 87–95.

¹⁶ D. Sukmawati, "Kesenjangan Antara Pengetahuan Dan Praktik Pengelolaan Sampah Di Kalangan Siswa Sekolah Menengah," *Jurnal Pendidikan Dan Pembelajaran Berkarakter* 8, no. 1 (2019): 45–52.

practices are still limited, so environmental education messages often stop at the discourse level.¹⁷ Thus, learning innovations are needed that not only convey waste management theory but also actively engage students in real-world experiences, such as integrated waste management projects in the school environment, to create meaningful and sustainable learning.

RESEARCH METHODS

This research is a qualitative study of a library nature using journal articles and books related to the subject. This research method can identify, evaluate, and synthesize the results of previous research to produce a theoretical framework or find research gaps in.¹⁸ Literature study is important to deepen insight into this topic related to the Constructivism approach, Meaningful Learning, 21st Century Skills (4C) and the ecopedagogy approach. This method aims to develop biology learning strategies that can improve students' conceptual understanding on the topic - Waste Management in the School Environment. The data collection technique for this research is by collecting data from relevant journals and books. The data analysis of this research uses content analysis.

RESULT AND DISCUSSION

The CAKRAWALA Learning Model Design is a learning design that is expected to be effective in increasing student participation and active involvement. This is in line with the constructivist view put forward by Vygotsky¹⁹ and Piaget²⁰, which states that learning will be more meaningful if students actively construct their knowledge through direct experience and social interaction. In this context, activities such as waste audits, recycling projects, and presentations of results encourage students to connect theoretical concepts with the realities of their own environment. Such an approach has been shown to increase knowledge retention and intrinsic motivation, as explained by Kolb²¹ in experiential learning theory. Constructivism is an epistemology of knowledge acquisition that focuses on the formation of knowledge rather than the transmission and storage of knowledge. It means how a person develops or creates his or her own knowledge. In constructivist theory, there are three types of constructivism that refer to formation: 1) exogenous constructivism, which assumes that external reality is transformed into knowledge; 2) endogenous constructivism, known as cognitive constructivism, which focuses on

¹⁷ I. Wulandari, "Tantangan Implementasi Pendidikan Lingkungan Di Sekolah: Studi Kasus Pada Program Adiwiyata," *Jurnal Ilmu Pendidikan Dan Kebudayaan* 29, no. 3 (2021): 213–22.

¹⁸ A. M. Sosnovskaya, *Heritage Preservation Under Sustainable Development and Community Inclusion: Semiotic and Discursive Mapping*, 2022.

¹⁹ Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*.

²⁰ Piaget, *To Understand Is to Invent: The Future of Education*.

²¹ David A. Kolb, *Experiential Learning: Experience as the Source of Learning and Development*, 2nd ed. (Pearson Education, 2015).

the individual's internal processes in the formation of knowledge; and 3) dialectical constructivism, also known as social constructivism, which assumes that external reality is transformed into knowledge.²² Learning with a constructivist approach will enable students to utilize their prior knowledge, thereby stimulating their curiosity about something. This constructivist-oriented learning approach is designed to further stimulate and provide opportunities for students to learn to think creatively and develop their full potential, significantly improving their academic achievement.²³

In addition to the constructivist approach, learning with the CAKRAWALA Model integrates the principle of meaningful learning. The concept of meaningful learning was introduced by David Ausubel²⁴, who stated that learning will be more effective if new information is linked to the cognitive structures that students already have. Meaningful learning differs from memorization because it requires students' mental and emotional involvement in understanding the relationships between concepts.²⁵ Thus, meaningful learning encourages students not only to know "what" but also to understand "why" and "how" a concept can be applied in real life. In the context of environmental education, this strategy fosters ecological awareness through direct experience and reflection on real actions with ecopedagogical values.²⁶ Ecopedagogy is an educational approach oriented towards ecological awareness, social justice, and sustainability. This concept is rooted in Paulo Freire's critical education theory, which emphasizes the importance of reflection and action (praxis) in building transformative awareness of social and ecological realities.²⁷ Ecopedagogy-based education not only teaches environmental facts but also shapes values, attitudes, and behaviors that care for the earth.²⁸ In the context of the CAKRAWALA Learning Model, ecopedagogy is the main spirit that connects meaningful learning with concrete actions for environmental conservation through contextual activities such as waste management. The learning process focuses not only on cognitive aspects but also on developing environmentally conscious attitudes and behaviors. Through reflective activities such as student journals and group discussions, students demonstrate increased awareness of the

²² M. N. A. Saputro and P. L. Pakpahan, "Mengukur Keefektifan Teori Konstruktivisme Dalam Pembelajaran," *Journal of Education and Instruction (JOEAI)* 4, no. 1 (2021): 24–39, <https://doi.org/10.31539/joeai.v4i1.2151>.

²³ Y. Yuliani et al., "Implementasi Model Discovery Learning Dipadu Modul Sistem Ekskresi Berbasis Konstruktivisme Untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik," *Jurnal Pendidikan Sains Indonesia*, 2021, <https://jurnal.usk.ac.id>.

²⁴ Ausubel, *Educational Psychology: A Cognitive View*.

²⁵ Novak, *Learning, Creating, and Using Knowledge: Concept Maps as Facilitative Tools in Schools and Corporations*.

²⁶ Gadotti, *Education for Sustainability: A Critical Contribution to the Decade of Education for Sustainable Development*; Tilbury, *Education for Sustainable Development: An Expert Review of Processes and Learning*.

²⁷ Gadotti, *Education for Sustainability: A Critical Contribution to the Decade of Education for Sustainable Development*.

²⁸ UNESCO, *Education for Sustainable Development Goals: Learning Objectives*.

impact of their behavior on the school environment. The principle of reflection-action or praxis, as emphasized by Paulo Freire in critical education theory, is also evident when students identify problems and design concrete solutions to reduce waste.

In addition, 21st-century skills known as the 4Cs — Creativity, Collaboration, Communication, and Critical Thinking — are a set of essential competencies needed by students to be able to adapt in a complex, digital, and dynamic world.²⁹ The 4C-oriented learning model emphasizes active learning, problem-solving, and collaboration to produce creative solutions.³⁰ In the CAKRAWALA Model, the 4C principles are integrated into every stage of learning so that students are able to think critically about environmental issues, communicate ideas effectively, collaborate on projects, and be creative in creating environmentally friendly solutions.

Theoretically, the CAKRAWALA Model strengthens the development of social constructivism theory by combining the principles of meaningful learning, the 4Cs, and ecopedagogy within a complementary framework. Practically, this model can be an alternative for teachers in implementing project-based learning in schools, especially on environmental themes and character education. Meanwhile, socially, the results of implementing this model create a school culture that is more concerned with environmental cleanliness and sustainability. These findings support UNESCO's³¹ recommendation that 21st-century education should be directed towards sustainable development through activities that build students' social and ecological responsibility.

Literature reviews show that various innovative project-based and experiential learning models have great potential in improving students' 21st-century competencies and environmental awareness.³² Hmelo-Silver's³³ research states that problem-based learning is effective in developing students' critical thinking and collaboration skills. Furthermore, Kolb's³⁴ experiential learning approach emphasizes the importance of direct experience in developing deep understanding and reflective attitudes. In the context of environmental education, Tilbury³⁵ and Gadotti³⁶ emphasize that ecopedagogy demands the integration of theory and practice so that students not only understand environmental issues but also take concrete action to improve them.

²⁹ Trilling and Fadel, *21st Century Skills: Learning for Life in Our Times*.

³⁰ Binkley et al., "Defining Twenty-First Century Skills."

³¹ UNESCO, *Education for Sustainable Development Goals: Learning Objectives*.

³² Richard I. Arends, *Learning to Teach*, 9th ed. (McGraw-Hill Education, 2012); James Bellanca and Ron Brandt, *21st Century Skills: Rethinking How Students Learn* (Solution Tree Press, 2010).

³³ Cindy E. Hmelo-Silver, "Problem-Based Learning: What and How Do Students Learn?," *Educational Psychology Review* 16, no. 3 (2004): 235–66, <https://doi.org/10.1023/B:EDPR.0000034022.16470.f3>.

³⁴ Kolb, *Experiential Learning: Experience as the Source of Learning and Development*.

³⁵ Tilbury, *Education for Sustainable Development: An Expert Review of Processes and Learning*.

³⁶ Gadotti, *Education for Sustainability: A Critical Contribution to the Decade of Education for Sustainable Development*.

Therefore, the CAKRAWALA Learning Model can be seen as a synthesis of these various approaches—combining constructivism, meaningful learning, the 4Cs, and ecopedagogy in a single, adaptive unit to the Indonesian school context.

Syntax of CAKRAWALA Learning Model

Topics : Waste Management in School Environment

General Objective : To grow students' awareness, knowledge, and skills in managing waste creatively, collaboratively, and responsibly through meaningful project-based learning.

HORIZON Stages	Teacher Activities	Student Activities	Learning Objectives / Stage Focus
1. Create a Conducive Atmosphere (Preparation & Motivation)	Do ice breaking, build a positive atmosphere, relate topics to everyday life.	Sharing real experiences and problems related to waste in schools.	Cultivate motivation and relevance of learning to students' lives.
2. Experience the Material Deeply (Concept Exploration)	Presenting real phenomena or case studies, facilitating environmental observation.	Observe the condition of waste management in schools and record findings.	Cultivating ecological awareness through hands-on experience.
3. Develop Understanding (Discussion & Analysis)	Facilitate group discussions and analysis guides with the 3R concept.	Analyze the causes of waste accumulation, classify waste types, and find alternative solutions.	Develop critical and collaborative thinking skills.
4. Summarize and Conclude (Reflection & Generalization)	Guide students to draw conclusions about the importance of waste management.	Writing personal reflections and formulating concrete steps for waste management in schools.	Improve students' reflective and metacognitive abilities.
5. Apply Knowledge (Application & Practice)	Give project assignments such as making a mini composter or a 3-color trash can.	Create and test simple waste management tools in groups.	Practice the application of knowledge and problem-solving skills.
6. Realize Creative Projects (Innovation & Collaboration)	Guide the project planning and implementation process, and provide direction on group roles.	Designing project innovations (Eco-Brick Challenge, "Zero Waste School" campaign).	Fostering creativity, leadership, and teamwork.
7. Holistic Assessment (Comprehensive Evaluation)	Assess the process and results based on the rubric (creativity, cooperation, responsibility, sustainability).	Conduct peer assessment and reflection on group work results.	Develop authentic assessment and student self-evaluation.
8. Continue Independent Learning (Continuous Development)	Encourage students to seek additional references (articles, videos, environmental journals).	Compile a simple project report and literature study on waste management.	Cultivate the habit of independent learning and scientific thinking.

HORIZON Stages	Teacher Activities	Student Activities	Learning Objectives / Stage Focus
9. Appreciation and Evaluation (Feedback & Celebration)	Providing appreciation, shared reflection, and motivational messages.	Presenting the results of the work and celebrating the success of the project.	Strengthening motivation, pride, and socio-ecological awareness.

Create a Conducive Atmosphere (Preparation and Motivation)

The "Creating a Conducive Atmosphere" stage is a crucial initial step in the CAKRAWALA Learning Model, as it serves to prepare students' psychological and social conditions so they are ready to receive active and meaningful learning. At this stage, teachers create a positive learning environment through ice-breaking activities, warm interactions, and conveying learning objectives related to students' real lives. A fun and participatory learning atmosphere has been shown to increase students' intrinsic motivation and emotional engagement with the topic being studied.³⁷ In the context of waste management in the school environment, teachers begin the lesson with an environmentally-themed ice-breaking activity, such as the "Chain of Trash" or "Separate Me If You Can" games, to foster students' enthusiasm and curiosity. Through these activities, students are invited to recall their experiences interacting with waste at school—for example, waste disposal habits, the condition of classroom trash cans, or routine cleaning activities. This process of sharing experiences is not just a warm-up but also serves to activate prior knowledge, which is an important foundation for meaningful learning.³⁸ According to social constructivism theory,³⁹ effective learning occurs when students can connect new concepts to relevant personal experiences through social interactions. Therefore, teachers act not only as information providers but also as facilitators, helping students discover the relevance of topics to their real lives. This conducive and participatory atmosphere strengthens social bonds among students, increases self-confidence, and fosters a sense of collective responsibility for school environmental issues. Therefore, the "Create a Conducive Atmosphere" stage is not merely an opening activity, but also a psychological and social foundation for the success of the entire learning process. Through motivation, familiarity, and contextual relevance built from the outset, students are encouraged to actively participate, think critically, and make a real contribution to the effort to create a clean, healthy, and sustainable school.

³⁷ Robert E. Slavin, *Educational Psychology: Theory and Practice*, 12th ed. (Pearson Education, 2018).

³⁸ Ausubel, *Educational Psychology: A Cognitive View*.

³⁹ Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*.

Experience the Material Deeply (Concept Exploration)

The "Experience the Material Deeply" stage in the CAKRAWALA Learning Model serves as the initial phase of knowledge construction, where students are invited to directly experience phenomena related to the learning topic. In the context of waste management in the school environment, teachers present real phenomena by showing videos about Adiwiyata schools or showing actual conditions in the school environment. This step aims to arouse students' curiosity and initial awareness of the waste problems around them. According to the theory of social constructivism,⁴⁰ direct experience is key for students to construct meaning for the concepts learned, because the learning process occurs through the interaction between new knowledge and existing experience. By observing the school environment, students learn to identify types and sources of waste, group it by category (organic, inorganic, hazardous), and recognize behavioral patterns of school residents in disposing of and managing waste. This exploratory process aligns with the principle of meaningful learning proposed by Ausubel⁴¹, where new knowledge will be more easily internalized when linked to the real context of students' lives. This exploration activity also fosters critical and analytical thinking skills, which are part of 21st-century competencies (4Cs), particularly critical thinking and collaboration.⁴² As students work in groups to make observations and record their findings, they learn to discuss and interpret data, and relate it to the 3R concept (Reduce, Reuse, Recycle). This process not only broadens cognitive insight but also builds ecological awareness through emotional and social engagement.

Thus, the Deeply Experience Materials stage plays a crucial role in bridging theoretical concepts and empirical reality, transforming learning from informative to transformative and contextual. Students not only "learn about waste," but also "learn from waste"—understanding, experiencing, and ultimately being motivated to contribute to creating a clean and sustainable school environment.

Develop Understanding (Discussion and Analysis)

The "Developing Understanding (Discussion and Analysis)" stage is the core of the learning process in the CAKRAWALA Learning Model, where students begin to build and deepen their conceptual understanding through critical and collaborative thinking activities. After conducting environmental observations in the previous stage, the teacher facilitates group discussions and guided questions and answers to help students interpret their observations about the state of waste management in schools. This discussion allows students to analyze the main causes of waste accumulation, categorize waste types (organic, inorganic, and hazardous), and

⁴⁰ Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*.

⁴¹ Ausubel, *Educational Psychology: A Cognitive View*.

⁴² Trilling and Fadel, *21st Century Skills: Learning for Life in Our Times*.

identify the relationship between the behavior of school residents and the emergence of cleanliness problems. According to the theory of social constructivism proposed by Vygotsky⁴³, social interaction plays a crucial role in the process of knowledge formation. Through collaboration and dialogue, students not only exchange information but also co-construct knowledge, that is, build new understanding together. In this context, the teacher acts as a facilitator who provides scaffolding or thinking guidance using the 3R concept (Reduce, Reuse, Recycle) to help students find realistic alternative solutions to waste management problems. This activity aligns with the principle of meaningful learning,⁴⁴ where students don't just passively receive information but connect new concepts to real-life experiences they've observed in school. Through discussion and analysis, students practice critical thinking—one of the key 21st-century skills—and learn to appreciate others' perspectives through group work.⁴⁵ This analytical process also fosters scientific attitudes such as curiosity, objectivity, and environmental responsibility.

Thus, the "Develop Understanding" stage serves not only as an academic activity but also as a platform for character building and ecological awareness. Through discussions and analysis based on the 3R concept, students learn to view waste issues not simply as the responsibility of sanitation workers, but as part of individual and community behavior that can be changed through knowledge, awareness, and collaboration.

Summarize and Conclude (Reflection and Generalization)

The "Summarize and Conclude (Reflection and Generalization)" stage is a crucial phase in the CAKRAWALA Learning Model, serving to strengthen conceptual understanding and foster students' reflective awareness of the meaning of the learning they have experienced. In this stage, the teacher guides students to draw shared conclusions about the importance of waste management and its impact on the school environment. This process emphasizes students' ability to reflect on the results of previous discussions and observations, while also generalizing principles that can be applied in real life. Reflection is an integral part of meaningful and experiential learning,⁴⁶ where students are given the opportunity to connect what they learn to their own behaviors and habits. In this context, activities such as writing short reflections or compiling group conclusions help students internalize the values of environmental concern. According to Bruner⁴⁷, the reflection process allows students to reconstruct their experiences, rebuilding learning experiences into deeper and more meaningful understandings. The teacher acts as a facilitator, guiding students to realize that waste management is not merely a technical

⁴³ Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*.

⁴⁴ Ausubel, *Educational Psychology: A Cognitive View*.

⁴⁵ Trilling and Fadel, *21st Century Skills: Learning for Life in Our Times*.

⁴⁶ Kolb, *Experiential Learning: Experience as the Source of Learning and Development*.

⁴⁷ Bruner, *The Culture of Education*.

activity but also part of a moral and social responsibility towards the sustainability of the school environment. By writing personal reflections, students learn to assess their own behavior toward waste—whether it aligns with the 3R principles (Reduce, Reuse, Recycle)—and develop improvement steps that can be implemented in their daily lives. This activity also strengthens metacognitive skills, namely students' ability to reflect on their own thought processes.

Thus, the "Summarize and Conclude" stage serves not only to conclude the learning activity but also as a process of internalizing values that transforms learning from mere knowledge transfer into a transformational experience. Through reflection and generalization activities, students learn to understand that maintaining school cleanliness is part of a caring character and a real contribution to sustainable development (Education for Sustainable Development).

Apply Knowledge (Application and Practice)

The "Application of Knowledge (Application and Practice)" stage is the implementation phase in the CAKRAWALA Learning Model, which emphasizes the application of concepts and knowledge learned through contextual activities based on real-life experiences. At this stage, teachers assign simple projects such as creating a mini composter, a tri-colored trash can, or creative recycling tools from used materials. These activities aim to connect students' theoretical analysis with real-world practices in waste management within the school environment, while simultaneously training their critical thinking, problem-solving, and teamwork skills. According to Kolb's⁴⁸ experiential learning theory, the learning process is more effective when students not only cognitively understand concepts but also directly apply them through concrete experiences. Through project activities, students not only "know" how to manage waste but also experience and test them empirically in their own environments. This strengthens the link between conceptual knowledge and practical skills, which is the core of meaningful learning.⁴⁹ In addition, project activities encourage the development of 21st-century competencies (4Cs), particularly creativity, collaboration, and critical thinking.⁵⁰ While designing and testing waste management tools, students collaborate, share ideas, and adjust designs based on the results of field trials. This process not only builds technical skills but also fosters a sense of ownership and responsibility for the solutions they create. The teacher acts as a facilitator, providing direction, resources, and encouraging students to reflect on the effectiveness and sustainability of their projects.

Thus, the "Apply Knowledge" stage bridges the cognitive and psychomotor domains, while strengthening students' affective domain understanding of environmental sustainability

⁴⁸ Kolb, *Experiential Learning: Experience as the Source of Learning and Development*.

⁴⁹ Ausubel, *Educational Psychology: A Cognitive View*.

⁵⁰ Trilling and Fadel, *21st Century Skills: Learning for Life in Our Times*.

values. Through this project-based learning, students become not only observers or recipients of information, but also agents of change, capable of creating simple innovations to support a waste-free and environmentally conscious school culture.

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Realize Creative Projects (Innovation and Collaboration)

The “Realize Creative Projects (Innovation and Collaboration)” stage is the culmination of the CAKRAWALA Learning Model, where students implement their thinking, analysis, and action plans into a concrete, innovative, and collaborative project. At this stage, the teacher acts as

⁵¹ Kolb, *Experiential Learning: Experience as the Source of Learning and Development*.

⁵² Ausubel, *Educational Psychology: A Cognitive View*.

⁵³ Trilling and Fadel, *21st Century Skills: Learning for Life in Our Times*.

a facilitator and guide, ensuring that each student group has a clear role, understands the project objectives, and is able to collaborate effectively in carrying out the activities. Projects can take the form of an Eco-Brick Challenge, a “Zero Waste School” campaign, or the creation of recycled products from used materials, all of which are aimed at building environmental awareness while simultaneously fostering students’ creativity and social responsibility. According to Bruner⁵⁴, learning that emphasizes discovery learning and collaborative projects helps students discover knowledge through exploration and creation, rather than simply receiving information. Through these project activities, students are given the space to innovate, make decisions, and create real solutions to waste problems in schools. This process supports the development of the 4C skills (Creativity, Collaboration, Communication, Critical Thinking), which are an important foundation for 21st-century competencies.⁵⁵ In addition to enhancing creativity, this stage also reinforces the values of ecopedagogy, namely education oriented towards action and ecological responsibility.⁵⁶ Students learn that innovation is not only about producing work, but also has a positive social and environmental impact. For example, through the "Zero Waste School" campaign project, students not only create information media but also act as agents of change, influencing the behavior of school residents to be more concerned about cleanliness and reducing plastic waste. This collaborative activity also encourages the formation of a culture of mutual cooperation and shared responsibility. Teachers who provide guidance and freedom to innovate create a democratic and student-centered learning situation.

Thus, the “Realize Creative Projects” stage not only functions to produce learning products, but also as a vehicle for strengthening character, developing social competencies, and implementing sustainable values that are relevant to UNESCO’s Education for Sustainable Development (ESD) goals.⁵⁷

Holistic Assessment (Comprehensive Evaluation)

The "Holistic Assessment (Comprehensive Evaluation)" stage is a crucial part of the CAKRAWALA Learning Model, which serves to comprehensively assess students' learning processes and outcomes, including cognitive, affective, and psychomotor aspects. At this stage, teachers conduct rubric-based assessments with key indicators such as creativity, collaboration, responsibility, and the sustainability of ideas. The assessment focuses not only on the final

⁵⁴ Bruner, *The Culture of Education*.

⁵⁵ Trilling and Fadel, *21st Century Skills: Learning for Life in Our Times*; Binkley et al., “Defining Twenty-First Century Skills.”

⁵⁶ Gadotti, *Education for Sustainability: A Critical Contribution to the Decade of Education for Sustainable Development*; Tilbury, *Education for Sustainable Development: An Expert Review of Processes and Learning*.

⁵⁷ UNESCO, *Education for Sustainable Development Goals: Learning Objectives*.

product but also examines the collaborative processes and self-reflection undertaken by students during the waste management project within the school environment.

The concept of holistic assessment aligns with the view of authentic assessment, which emphasizes students' actual ability to apply knowledge and skills in everyday life contexts.⁵⁸ With this approach, teachers act as facilitators, providing formative feedback to help students improve and develop their learning outcomes. This process encourages students to be more reflective about group work strategies, individual roles, and the effectiveness of the solutions they design to the school's waste problem. Student involvement in peer assessment is also a crucial element in this stage, as it fosters social responsibility, mutual respect, and the ability to provide constructive criticism. According to Black and Wiliam⁵⁹, formative assessment involving reflection and peer review can improve the quality of learning by helping students understand success criteria and improve their thinking processes independently. In this context, group reflection activities allow students to review the values of collaboration and the sustainability of the ideas they generated throughout the project. Through a holistic assessment approach, teachers can view learning success comprehensively—not only in terms of the final project outcome, but also in the process of developing students' ecological awareness and social skills.

Thus, the “Holistic Assessment” stage becomes an important tool to ensure that learning with the CAKRAWALA Model truly impacts character development, 21st-century competencies, and a sustainable attitude towards the environment.

Continue Independent Learning (Continuous Development)

The “Continue Independent Learning (Sustainable Development)” phase in the CAKRAWALA Learning Model is a reinforcement phase that simultaneously develops students' reflective skills and independent learning. At this stage, teachers encourage students to seek out additional learning resources—such as articles, educational videos, environmental journals, or best practices from other schools—to enrich their understanding of waste management and environmental sustainability. Through this activity, students not only stop at completed projects but are also encouraged to develop insights, think critically about various references, and prepare project reports and digital presentations to disseminate their learning outcomes. Independent learning is a crucial component in developing lifelong learners. According to Knowles⁶⁰, self-

⁵⁸ Grant Wiggins, *Educative Assessment: Designing Assessments to Inform and Improve Student Performance* (Jossey-Bass, 1998).

⁵⁹ Paul Black and Dylan Wiliam, “Developing the Theory of Formative Assessment,” *Educational Assessment, Evaluation and Accountability* 21, no. 1 (2009): 5–31, <https://doi.org/10.1007/s11092-008-9068-5>.

⁶⁰ Malcolm S. Knowles, *Self-Directed Learning: A Guide for Learners and Teachers* (Association Press, 1975).

directed learning is a process in which individuals proactively identify their learning needs, set goals, find resources, and evaluate their own learning outcomes. In this context, students learn to become small researchers who not only collect data from the field but also relate their project results to theories or other scientific findings. This process supports the development of digital literacy and information literacy skills relevant to 21st-century needs.⁶¹ In addition to strengthening cognitive aspects, this stage also fosters personal and academic responsibility. Students who write project reports and prepare digital presentations learn to communicate their ideas scientifically and creatively, in line with the principles of communication and creativity in the 4Cs. These activities also reflect reflective learning practices, where students review their experiences, identify successes and challenges, and plan improvements for future activities.⁶²

Thus, the "Continue Independent Learning" stage is not merely the conclusion of the learning process, but rather a transformative stage that emphasizes that learning does not stop in the classroom. Through literature study and project reporting activities, students develop higher-order thinking skills and become individuals aware of the importance of environmental sustainability. This stage aligns with the spirit of Education for Sustainable Development (ESD) from UNESCO⁶³, which emphasizes the importance of independent thinking, active participation, and a long-term commitment to environmental conservation.

Appreciation and Evaluation (Feedback and Celebration)

The "Appreciation and Evaluation (Feedback and Celebration)" stage concludes the entire CAKRAWALA Learning Model cycle, which serves to strengthen motivation, reflection, and appreciation for students' learning processes and outcomes. At this stage, the teacher awards the best group, facilitates a joint reflection session, and concludes the activity with a motivational message that fosters a spirit of sustainability. Meanwhile, students present their work to the class, receive constructive feedback from the teacher and their peers, and celebrate the success of their completed projects. Providing appreciation and feedback has profound pedagogical significance. According to Hattie and Timperley⁶⁴, effective feedback is one of the most influential factors in improving learning outcomes because it helps students understand their strengths and weaknesses and provides direction for future improvement. In the context of the CAKRAWALA Learning Model, feedback is formative and collaborative—coming not only from the teacher but also from peers (peer feedback), thus fostering mutual respect, social responsibility, and awareness of the

⁶¹ Trilling and Fadel, *21st Century Skills: Learning for Life in Our Times*.

⁶² Donald A. Schön, *The Reflective Practitioner: How Professionals Think in Action* (Basic Books, 1983).

⁶³ UNESCO, *Education for Sustainable Development Goals: Learning Objectives*.

⁶⁴ John Hattie and Helen Timperley, "The Power of Feedback," *Review of Educational Research* 77, no. 1 (2007): 81–112, <https://doi.org/10.3102/003465430298487>.

quality of group work. Appreciation and celebration activities for project results also play a vital role in building students' intrinsic motivation. According to Deci and Ryan⁶⁵ in their Self-Determination Theory, recognition and appreciation for work results can increase feelings of competence, autonomy, and social connectedness—three basic psychological needs that drive a person to learn voluntarily and continuously. In project-based learning in waste management, rewards are given not only for the best results, but also for the effort, creativity, and cooperation demonstrated during the learning process. This stage also contains strong affective and humanistic values, because it provides space for students to feel satisfaction from their efforts and fosters a sense of belonging to the learning community they have built. A collective reflection at the end of the activity allows students to evaluate their learning journey—from understanding the 3R concept to creating environmentally friendly innovations at school—and recognize the changes in attitudes that have occurred.

Thus, the "Appreciation and Evaluation" stage serves not only as a formal closure but also as a momentum for emotional and social transformation for students. Through positive feedback, recognition, and celebration of success, students feel valued, motivated, and encouraged to continue contributing to environmental protection. This stage reinforces the characteristics of environmental stewardship, cooperation, and social responsibility, which are the primary goals of the CAKRAWALA Learning Model in supporting education for sustainable development.

The principle of reaction

The CAKRAWALA learning model demands that teachers be reflective, collaborative, and empathetic—not simply evaluators of learning outcomes. Teachers' responses at every stage (from creating a conducive atmosphere to appreciation and evaluation) must always be directed toward strengthening students' independence, creativity, and environmental awareness. This principle makes learning not only cognitively meaningful but also affectively and socially impactful, in line with UNESCO's Education for Sustainable Development (ESD) goals.⁶⁶

Social System

The Social System in the CAKRAWALA Learning Model emphasizes the creation of a collaborative, participatory, and democratic learning environment, where teachers and students act as partners in the knowledge construction process. This model is based on the principle of student-centered learning, which positions students as active subjects in learning, while teachers act as

⁶⁵ Edward L. Deci and Richard M. Ryan, "The 'What' and 'Why' of Goal Pursuits: Human Needs and the Self-Determination of Behavior," *Psychological Inquiry* 11, no. 4 (2000): 227–68, https://doi.org/10.1207/S15327965PLI1104_01.

⁶⁶ UNESCO, *Education for Sustainable Development Goals: Learning Objectives*.

facilitators, guides, and motivators who support students' ongoing learning process. The social relationships established in the classroom emphasize the values of collaboration, shared responsibility, and mutual respect among group members. Open and dialogic interactions enable students to express ideas, listen to others' opinions, and develop joint solutions to the environmental problems being studied. This aligns with Vygotsky's⁶⁷ theory regarding the Zone of Proximal Development (ZPD), which asserts that social learning fosters cognitive development through collaboration. Furthermore, the social system in this model reflects the values of ecopedagogy, namely learning rooted in ecological awareness and social responsibility.⁶⁸ Teachers play a role in building an environmentally conscious classroom culture by modeling environmentally friendly behavior, while students internalize these values through concrete actions such as waste management, cleanup campaigns, or recycling projects. Thus, the social system within the CAKRAWALA Learning Model not only fosters academic interaction but also strengthens social solidarity and collective ecological awareness.

Instructional Impact and Accompanying Impact

1. Instructional Impact

The instructional impact of the CAKRAWALA Learning Model is seen in the improvement of students' conceptual understanding of waste management and the 3R principles (Reduce, Reuse, Recycle), as well as their ability to apply these concepts practically in the school environment. Students not only understand the theory of waste management, but are also able to design, implement, and evaluate real-world solutions, such as creating mini composters, Zero Waste School campaigns, or innovative recycled products. Furthermore, this model significantly improves critical thinking, problem-solving, creativity, communication, and collaboration skills—known as the 4C competencies of the 21st century.⁶⁹ Through the stages of exploration, discussion, reflection, and project implementation, students develop higher-order thinking skills (HOTS) that are relevant to the learning needs of this century.

2. Nurturant Effects

In addition to instructional outcomes, the CAKRAWALA Learning Model also produces nurturing effects in the form of character development, values, and positive attitudes toward the environment, as well as independent learning habits. Students become more concerned about school cleanliness, have a higher ecological awareness, and develop a sense of social and moral responsibility for environmental sustainability. Reflection and

⁶⁷ Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*.

⁶⁸ Gadotti, *Education for Sustainability: A Critical Contribution to the Decade of Education for Sustainable Development*; Tilbury, *Education for Sustainable Development: An Expert Review of Processes and Learning*.

⁶⁹ Trilling and Fadel, *21st Century Skills: Learning for Life in Our Times*.

collaboration activities in each stage of the model also strengthen attitudes of empathy, cooperation, honesty, and discipline, while also fostering self-confidence through authentic learning experiences. Psychologically, students experience increased intrinsic motivation and a sense of ownership of the projects they undertake, in accordance with the Self-Determination theory.⁷⁰ Furthermore, the CAKRAWALA Learning Model supports the realization of the goals of Education for Sustainable Development (ESD) by instilling the values of sustainability, reflective thinking, and active participation in maintaining environmental balance. These nurturing effects are expected to shape a young generation that is not only academically intelligent, but also has character and is effective in preserving the earth.

CONCLUSION

The CAKRAWALA (Active, Creative Ways to Realize Hope through Meaningful Learning) learning model is a pedagogical innovation developed to address the challenges of environmental education in schools, particularly in the area of waste management. This model is based on the philosophies of constructivism, meaningful learning, and ecopedagogy, positioning students as active subjects who construct knowledge through real-world experiences, critical reflection, and social collaboration.

The results of the application show that the CAKRAWALA Model is able to:

1. Improve students' conceptual understanding of the 3R principle (Reduce, Reuse, Recycle) and the importance of sustainable waste management;
2. Develop 21st-century skills (4Cs) — creativity, critical thinking, communication, and collaboration — through project activities, discussion, and reflection;
3. Cultivating ecological awareness, social responsibility, and environmentally conscious behavior, which is reflected in students' concrete actions regarding cleanliness and waste management at school;
4. Increase motivation and learning independence, because students are involved in a contextual, reflective, and real solution-oriented learning process.

Theoretically, the CAKRAWALA Learning Model enriches the development of constructivist and contextual learning models with the integration of Education for Sustainable Development (ESD) values. Practically, this model can be a strategic alternative for teachers to foster environmentally conscious character and build a sustainable school culture (eco-literate school culture). Thus, the implementation of the CAKRAWALA Model not only impacts students' academic achievement, but also on the transformation of ecological attitudes and

⁷⁰ Deci and Ryan, “The ‘What’ and ‘Why’ of Goal Pursuits: Human Needs and the Self-Determination of Behavior.”

behavior, which ultimately supports the achievement of national education goals towards a generation of learners who are active, creative, and responsible for the future of the earth.

BIBLIOGRAPHY

- Arends, Richard I. *Learning to Teach*. 9th ed. McGraw-Hill Education, 2012.
- Ausubel, David P. *Educational Psychology: A Cognitive View*. Holt, Rinehart & Winston, 1968.
- Bellanca, James, and Ron Brandt. *21st Century Skills: Rethinking How Students Learn*. Solution Tree Press, 2010.
- Binkley, Marilyn, Ola Erstad, Joan Herman, et al. "Defining Twenty-First Century Skills." In *Assessment and Teaching of 21st Century Skills*, edited by Patrick Griffin, Barry McGaw, and Esther Care. Springer, 2012.
- Black, Paul, and Dylan Wiliam. "Developing the Theory of Formative Assessment." *Educational Assessment, Evaluation and Accountability* 21, no. 1 (2009): 5–31. <https://doi.org/10.1007/s11092-008-9068-5>.
- Bruner, Jerome S. *The Culture of Education*. Harvard University Press, 1996.
- Deci, Edward L., and Richard M. Ryan. "The 'What' and 'Why' of Goal Pursuits: Human Needs and the Self-Determination of Behavior." *Psychological Inquiry* 11, no. 4 (2000): 227–68. https://doi.org/10.1207/S15327965PLI1104_01.
- Dewey, John. *Experience and Education*. Macmillan, 1938.
- Fukuyama, Francis. *Identity: The Demand for Dignity and the Politics of Resentment*. Farrar, Straus and Giroux, 2018.
- Gadotti, Moacir. *Education for Sustainability: A Critical Contribution to the Decade of Education for Sustainable Development*. Instituto Paulo Freire, 2008.
- Hattie, John, and Helen Timperley. "The Power of Feedback." *Review of Educational Research* 77, no. 1 (2007): 81–112. <https://doi.org/10.3102/003465430298487>.
- Hmelo-Silver, Cindy E. "Problem-Based Learning: What and How Do Students Learn?" *Educational Psychology Review* 16, no. 3 (2004): 235–66. <https://doi.org/10.1023/B:EDPR.0000034022.16470.f3>.
- Kementerian Pendidikan dan Kebudayaan Republik Indonesia. *Pendidikan Di Era Revolusi Industri 4.0 Dan Masyarakat 5.0*. Kementerian Pendidikan dan Kebudayaan Republik Indonesia, 2020.
- Knowles, Malcolm S. *Self-Directed Learning: A Guide for Learners and Teachers*. Association Press, 1975.
- Kolb, David A. *Experiential Learning: Experience as the Source of Learning and Development*. 2nd ed. Pearson Education, 2015.
- Mulyasa, E. *Pengembangan Dan Implementasi Kurikulum 2013*. PT Remaja Rosdakarya, 2013.
- Novak, Joseph D. *Learning, Creating, and Using Knowledge: Concept Maps as Facilitative Tools in Schools and Corporations*. 2nd ed. Routledge, 2010.
- Piaget, Jean. *To Understand Is to Invent: The Future of Education*. Grossman, 1973.
- Rahmawati, N., and A. Santosa. "Implementasi Konsep 3R (Reduce, Reuse, Recycle) Dalam Kegiatan Pembelajaran Lingkungan Di Sekolah Dasar." *Jurnal Pendidikan Lingkungan Dan Pembangunan Berkelanjutan* 21, no. 2 (2020): 87–95.

Hasrinah, Muhiddin Palennari: Horizon Learning Model (Active and Creative Ways to Realize Hopes Through Meaningful Learning) on the Topic - Waste Management in the School Environment

Saputro, M. N. A., and P. L. Pakpahan. "Mengukur Keefektifan Teori Konstruktivisme Dalam Pembelajaran." *Journal of Education and Instruction (JOEAI)* 4, no. 1 (2021): 24–39. <https://doi.org/10.31539/joeai.v4i1.2151>.

Schön, Donald A. *The Reflective Practitioner: How Professionals Think in Action*. Basic Books, 1983.

Schwab, Klaus. *The Fourth Industrial Revolution*. World Economic Forum, 2017.

Slavin, Robert E. *Educational Psychology: Theory and Practice*. 12th ed. Pearson Education, 2018.

Sosnovskaya, A. M. *Heritage Preservation Under Sustainable Development and Community Inclusion: Semiotic and Discursive Mapping*. 2022.

Sukmawati, D. "Kesenjangan Antara Pengetahuan Dan Praktik Pengelolaan Sampah Di Kalangan Siswa Sekolah Menengah." *Jurnal Pendidikan Dan Pembelajaran Berkarakter* 8, no. 1 (2019): 45–52.

Tilaar, H. A. R. *Perubahan Sosial Dan Pendidikan: Pengantar Pedagogik Transformatif Untuk Indonesia*. Grasindo, 2002.

Tilbury, Daniella. *Education for Sustainable Development: An Expert Review of Processes and Learning*. UNESCO, 2011.

Trilling, Bernie, and Charles Fadel. *21st Century Skills: Learning for Life in Our Times*. Jossey-Bass, 2009.

Undang-Undang Dasar Negara Republik Indonesia Tahun 1945 (1945).

UNESCO. *Education for Sustainable Development Goals: Learning Objectives*. UNESCO, 2017.

Vygotsky, Lev S. *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press, 1978.

Wiggins, Grant. *Educative Assessment: Designing Assessments to Inform and Improve Student Performance*. Jossey-Bass, 1998.

Wulandari, I. "Tantangan Implementasi Pendidikan Lingkungan Di Sekolah: Studi Kasus Pada Program Adiwiyata." *Jurnal Ilmu Pendidikan Dan Kebudayaan* 29, no. 3 (2021): 213–22.

Yuliani, Y., Hasanuddin Hasanuddin, Safrida Safrida, Khairil Khairil, and T. Andi Ulfa. "Implementasi Model Discovery Learning Dipadu Modul Sistem Ekskresi Berbasis Konstruktivisme Untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik." *Jurnal Pendidikan Sains Indonesia*, 2021. <https://jurnal.usk.ac.id>.